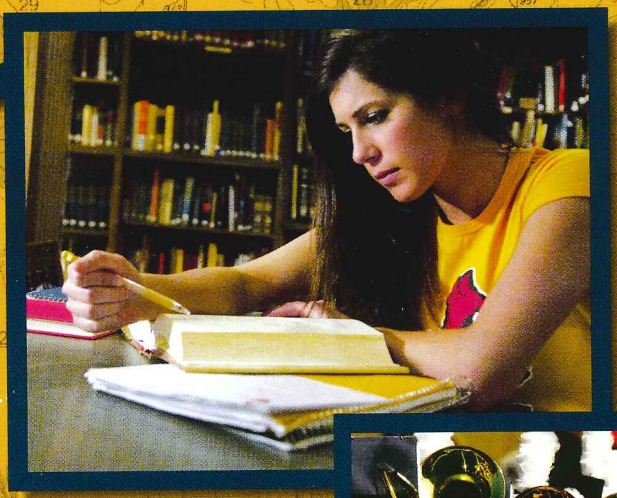
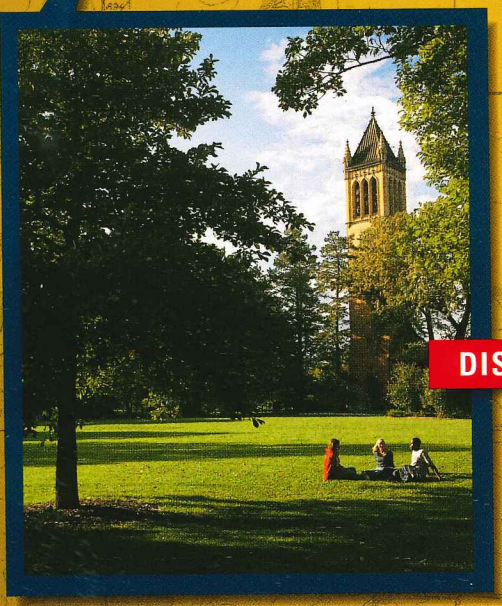
2009-2011

Iowa State University Catalog

UNDERGRADUATE AND GRADUATE COURSES AND PROGRAMS

EXPLORE





DISCOVER

INSPIRE

5,000 courses.

1,700 faculty.

100 majors.

One amazing adventure.

IOWA STATE UNIVERSITY

Iowa State University

Courses and Programs Catalog 2009 - 2011

The Iowa State University Catalog

The Iowa State University Catalog is a two-year publication which lists all academic policies, and procedures. In addition, it includes information for fees, curriculum requirements and first-year courses of study for over 100 undergraduate majors; course descriptions for nearly 5000 undergraduate and graduate courses; and a listing of faculty members at Iowa State University.

New courses developed and offered since catalog publication can be found on the Web at www.iastate.edu/~catalog/exp/.

Every effort has been made to make the catalog accurate as of the date of publication. However, all policies, procedures, fees, and charges are subject to change at any time by appropriate action of the faculty, the university administration, or the Board of Regents, State of Iowa.

Table of Contents

Academic Calendar 2009 - 2011

Fall Semester 2009

Classwork begins
Monday, August 24

University holiday, offices closed
Monday, September 7

Thanksgiving break, classes recessed,
Monday through Friday, November 23-27

University holidays, offices closed
Thursday and Friday, November 26-27

Classes resume
Monday, November 30

Commencement
Friday and Saturday, December 18-19

University holidays, offices closed
Thursday and Friday, December 24-25

Spring Semester 2010

University holiday, offices closed
Friday, January 1

Classwork begins
Monday, January 11

University holiday, offices closed
Monday, January 18

Spring break, classes recessed
Monday through Friday, March 15-19

Classes resume
Monday, March 22

Commencement
Friday and Saturday, May 7-8

Summer Session 2010

Classwork begins Session I
Monday, May 17

University holiday, offices closed
Monday, May 31

Classwork begins Session II
Monday, June 14

University holiday, offices closed
Monday, July 5

Commencement
Saturday, August 7

Fall Semester 2010

Classwork begins
Monday, August 23

University holiday, offices closed
Monday, September 6

Thanksgiving break, classes recessed
Monday through Friday, November 22-26

University holidays, offices closed
Thursday and Friday, November 25-26

Classes resume
Monday,November 29

Commencement
Friday and Saturday, December 17-18

University holidays, offices closed
Thursday and Friday, December 23-24

Spring Semester 2011

University holiday, offices closed
Friday, December 31

Classwork begins
Monday, January 10

University holiday, offices closed
Monday, January 17

Spring break, classes recessed
Monday through Friday, March 14-18

Classes resume
Monday, March 21

Commencement
Friday and Saturday, May 6-7

Summer Session 2011

Classwork begins Session I
Monday, May 16

University holiday, offices closed
Monday, May 30

Classwork begins Session II
Monday, June 13

University holiday, offices closed
Monday, July 4

Commencement
Saturday, August 6

Approved by the Board of Regents,
State of Iowa

The University

Iowa State University is one of the most respected land-grant universities in the nation. Established by the Iowa General Assembly in 1858, the Iowa Agricultural College and Model Farm was designated the first land-grant college when Iowa became the first state to accept the terms of the federal Morrill Act in 1864.

The act allowed Iowa to sell federal land to finance a new college open to all, regardless of wealth, race or gender; offering a practical education in engineering, agriculture and military science as well as classical studies; and sharing research knowledge with all Iowans. Iowa State University officially opened in 1869 and was the first coeducational land-grant school.

In 1903, the nation's first cooperative agricultural extension program was launched when Iowa State professors worked with farmers and county governments to establish demonstration farms and institutes.

It is our institutional commitment to the founding land-grant principles that has produced alumni who are leaders in their professions, research that has forever changed our society and knowledge-based information that has assisted the citizens of our state, nation and world community.

Iowa State's Points of Pride

*The world's first electronic digital computer was developed at Iowa State by math and physics professor John V. Atanasoff and graduate student Clifford Berry, in the late 1930s. Their invention, the ABC computer, has been called the most important technological innovation of the 20th century.

*The university is a leader in virtual reality research and its most advanced virtual reality theater, the C6, is the nation's first six-sided theater that totally immerses the user in images and sound.

*Iowa State's faculty members are recognized for their scholarly efforts. They serve as editors and on editorial and advisory boards of national and international academic professional journals.

*Iowa State is one of the top three U.S. universities in the development of patentable biotechnology.

*Iowa State's faculty includes two professors who have been recognized among the top 100 young technology innovators in the world.

*Iowa State's faculty includes members of the National Academy of Engineering and the National Academy of Sciences.

*Iowa State is a member of the prestigious Association of American Universities that has a membership of only 62 major research universities in the United States and Canada.

*Iowa State's learning communities program for undergraduate students is rated among the nation's best.

*Every state and more than 100 countries are represented in Iowa State's student body.

*Iowa State students have a reputation for winning national and international awards. They win contests for apparel design, NASA food technology, news writing for print and broadcast, computer software, vocal music, and music composition.

*Iowa State is nationally ranked for its beautiful campus and its central campus has been honored by the Association of Landscape Architects as one of only three university Centennial Medallion sites in the nation.

*Iowa State's 600 works of art on campus make its public art collection the largest of any university in the nation.

*Iowa State's Reiman Gardens has been recognized for having the nation's most outstanding public rose garden.

*Iowa State holds two world records certified by the Guinness Book of World Records: one for making the world's largest Rice Krispies Treat to celebrate that Mildred Day, an Iowa State alumnus, helped create the recipe for the popular snack food; and one for growing the tallest amaranth plant in the world.

*Iowa State's wrestling program boasts 5 Olympic gold medalists – the latest being graduate Cael Sanderson at the 2004 Olympic Games in Athens, Greece. Sanderson's perfect collegiate wrestling record of 159 wins has been recognized by *Sports Illustrated* as the second most impressive feat in college sports history.

**Washington Monthly* magazine ranks Iowa State among the top 20 public universities that do the best at serving the United States through educating economically challenged students, undertaking vital research that drives the U.S. economy and promoting the ethic of service to country.

*Iowa State's undergraduate programs for future entrepreneurs are ranked among the top 25 in the country.

*Iowa State's interior design, architecture and landscape architecture programs are ranked among the best in the nation.

*With more than 100 majors, 1700 faculty and 600 clubs and organizations, Iowa State has built a reputation for almost unlimited academic and social opportunities in a personal and welcoming environment.

2005-2010 Strategic Plan

Mission

Create, share, and apply knowledge to make Iowa and the world a better place.

• Create knowledge through world-class scholarship in teaching, research, and creative endeavors.

• Share knowledge through outstanding undergraduate, graduate, professional, and outreach programs.

• Apply knowledge to improve the quality of life for current and future generations.

In carrying out its mission, Iowa State will increase and support diversity in the university community. Diversity enlivens the exchange of ideas, broadens scholarship, and prepares students for lifelong, productive participation in society. See *Nondiscrimination and Affirmative Action Policy* in this section.

Culture

We accomplish our mission:

• through innovation, collaboration, and continuous improvement,
• with honesty, integrity, and professional ethics, and
• with sensitivity and responsiveness to the needs of our state, nation, and the world.

Core Values

We value:

• land-grant ideals,
• a diversity of ideas, peoples, and cultures,
• intellectual freedom,
• leadership, and
• excellence in all we do.

Vision

Iowa State University will be the best at advancing the land-grant ideals and putting science and technology to work.

Students will become broadly educated, global citizens who are culturally informed, technologically adept, and ready to lead. Faculty and staff will share a passion for creating, sharing, and applying knowledge to improve lives worldwide. Collaborations among partners both inside and outside the university community will flourish. The spirit of Iowa State University will be evident in the integration of the sciences and humanities and in the energy and creativity of its people.

Priorities for 2005-2010

Iowa State is a leading international, comprehensive university with a wide range of dynamic and diverse programs and initiatives. The university commits to continuously evaluating, improving, and evolving these programs as well as exploring and innovating new areas of inquiry and application.

Five priority areas and accompanying goals for 2005-2010 have been identified to reinforce existing strengths and pursue our vision.

Priority: Education

Strengthen undergraduate, graduate, and professional education to enhance student success at Iowa State University and beyond.

Goals

• Improve the rigor, challenge, and international reputation of academic programs.

• Strengthen students' critical thinking, creative abilities, and communication skills.

Enhance students' understanding of global, cultural, ethical, and diversity issues.

• Create an environment that welcomes students to explore a variety of disciplines and career paths.

• Increase interdisciplinary and experiential learning opportunities, such as learning communities, service learning, internships, research experiences, and international exchanges.

• Enhance programs for high-ability students.

• Partner with K-12 schools and community colleges to facilitate transfer to and student success at Iowa State University.

• Enhance services to enable students to find rewarding careers.

• Develop, recognize, and reward excellent teaching.

Priority: Programs

Increase the number of graduate, professional, and research programs that are among the very best -- especially in areas that build on university strengths and address local and global critical needs.

Goals

•Recruit and retain outstanding faculty who are or will be leaders in their fields.

• Increase the number and elevate the overall quality of graduate and professional students.

• Leverage strengths in science and technology to enhance research and scholarly excellence with emphasis on interdisciplinary initiatives involving biological, materials, and information sciences.

• Enhance areas of excellence in the arts, humanities, and social sciences that build on and complement the university's unique strengths.

• Improve facilities and support services for research.

• Enhance the visibility of outstanding faculty members and staff, research accomplishments, and graduate and research programs.

Priority: Economic Impact

Translate discoveries into viable technologies, products, and services to strengthen the economies of Iowa and the world.

Goals

• Expand the use of intellectual property developed at Iowa State University.

• Strengthen educational and outreach programs aimed at Iowa's economic, workforce, and technology development.

Foster an environment that encourages faculty, staff, and students to engage in transfer of technology and entrepreneurial activities.

Priority: Iowa Life

Elevate the state's appeal as a place to live, learn, work, and play.

Goals

• Strengthen our partnerships and communications with Iowans to better identify, address, and solve problems.

• Enhance the vitality of Iowa's communities and well-being of its people.

• Promote the wise use of Iowa's resources and build a sustainable future.

• Expand learning opportunities for Iowans of all ages.

• Partner with Iowans to strengthen their communities' economies and entrepreneurial capacities.

Priority: University Life

Ensure that the university is a great place to learn and work.

Goals

• Recruit and retain faculty, staff, and students who are dedicated to individual and organizational excellence and achievement.

• Expand the diversity of people, ideas, and cultures, and nurture an environment in which diversity can thrive.

• Achieve a sustainable balance between responsibilities and resources that will allow the university to efficiently and effectively realize its vision.

• Foster an environment in which all members of the university community can contribute their fullest while pursuing satisfying personal lives.

• Provide a rich array of extracurricular opportunities to learn, lead, and enjoy life.

• Promote a university that conserves resources and enhances environmental quality.

• Maintain the attractiveness of campus and improve the quality of its facilities.

• Advance the excellence of the university through enhanced connections between ISU and its family of alumni and friends.

• Ensure that intercollegiate athletics programs are models of academic success, integrity, and competitiveness.

Nondiscrimination and Affirmative Action Statement

(July 28, 2008 Reaffirmation)

Iowa State University is committed to developing and implementing a program of nondiscrimination and affirmative action, a responsibility the university accepts willingly because it is the right and just thing to do. Because an educational institution exposes the youth of Iowa and of the nation to a multitude of ideas that strongly influence their future development, it is an area of our society where removing barriers is critical. We insist on promoting the concept of inclusion and participation.

This commitment is part of a larger commitment to developing a safe and supportive climate for all members of the ISU community in classrooms and laboratories, in offices, in the residence hall system, and throughout the campus. Iowa State University recognizes that a non-discriminatory environment complements a commitment to academic inquiry and intellectual and personal growth.

The goal is to provide a non-discriminatory work environment, a non-discriminatory living and learning environment and a non-discriminatory environment for visitors to the campus. Iowa State University herein recommits itself to comply with all federal and state laws, regulations, and orders, including the policies of the Iowa Board of Regents, which pertain to nondiscrimination and affirmative action.

All administrators and personnel providing input into administrative decisions are directed to ensure that all decisions relative to employment, conditions of employment and access to programs and services will be made without regard to race, color, age, religion, national origin, sexual orientation, gender identity, sex, marital status, disability, or status as a U.S. veteran. Exceptions to this directive may be made in matters involving bona fide occupational qualifications, business necessity, actions designed to eliminate workforce underutilization, and/or where this policy conflicts with federal and state laws, rules, regulations, or orders.

Iowa State does not discriminate on the basis of race, color, age, ethnicity, religion, national origin, pregnancy, sexual orientation, gender identity, sex, marital status, disability, or status as a U.S. veteran. Inquiries can be directed to the Director of Equal Opportunity and Diversity, 3210 Beardshear Hall, (515) 294-7612. Iowa State University will base employment decisions so as to further the principle of equal employment opportunity and diversity.

No otherwise qualified person will be denied access to, or participation in, any program, activity, service, or the use of facilities on the basis of factors previously enumerated. Reasonable accommodation will be made to facilitate the participation of persons with disabilities in all such activities consistent with applicable federal and state laws, orders and policies.

Further, all supervisory personnel will be responsible for maintaining an environment that is free of discrimination and harassment. Acts by anyone that adversely affect another person's employment, conditions of employment, academic standing, receipt of services, and/or participation in, or enjoyment of, any other activity, will be regarded as a violation of university policy and thereby subject to appropriate disciplinary action. Retaliation against persons filing complaints, for bringing the violation of this policy forward for review, or for assisting in a review, pursuant to a filed complaint or grievance, is prohibited.

Iowa State University's commitment to nondiscrimination and affirmative action is of the highest priority and is to be adhered to as such. It applies to all university-sponsored programs and activities as well as those that are conducted in cooperation with the university.

Iowa State University has designated Carla R. Espinoza as the affirmative action officer and assigns overall program responsibility to her as the Director of Equal Opportunity and Diversity. Questions regarding complaints and/or compliance with affirmative action or equal opportunity should be directed to her at 3210 Beardshear Hall, Iowa State University, Ames, IA 50011-2024, (515) 294-7612

Iowa State University Accreditation and Administration

Accreditation

Iowa State University is accredited by the Higher Learning Commission of the North Central Association of Colleges and Schools.

Higher Learning Commission of the North Central Association of Colleges and Schools

30 N. LaSalle Street, Suite 2400

Chicago, IL 60602-2504

(800) 621-7440; (312) 263-0456;

Fax: (312) 263-7462

www.ncahigherlearningcommission.org

Board of Regents, State of Iowa

http://www2.state.ia.us/regents/

The laws of the United States and of the State of Iowa provide for resident academic instruction, research, and extension education, and for the management of Iowa State University of Science and Technology. The university and two other state educational institutions of higher learning are governed by the Board of Regents, State of Iowa, which is composed of nine members nominated by the Governor of Iowa and confirmed by the Senate of Iowa. The immediate regulation and direction of the academic, research, and extension activities of the university are delegated by the Board of Regents, State of Iowa, to the president and faculty of the university. The board appoints an executive director with overall responsibility for the administration of the central office of the board located in Urbandale.

Officers of Administration

Gregory L. Geoffroy, Ph.D.
President of the University

Elizabeth Hoffman, Ph.D.
Executive Vice President and Provost

Warren R. Madden, M.B.A.
Vice President for Business and Finance

Thomas L. Hill, Ph.D.
Vice President for Student Affairs

Wendy K. Wintersteen, Ph.D.
Dean of the College of Agriculture and Life Sciences

Labh Hira, Ph. D.
Dean of the College of Business

Mark C. Engelbrecht, M. Arch.
Dean of the College of Design

James E. Bernard, Ph.D.
Interim Dean of the College of Engineering

Pamela J. White, Ph.D.
Interim Dean of the College of Human Sciences

Michael B. Whiteford, Ph.D.
Dean of the College of Liberal Arts and Sciences

John U. Thomson, DVM
Dean of the College of Veterinary Medicine

Jack M. Payne, Ph.D.
Vice President for Extension and Outreach

Sharon Quisenberry, Ph.D.
Vice President for Research and Economic Development

David K. Holger, Ph.D.
Dean of the Graduate College

Olivia M. Madison, M.A.,
Dean of the Library

Dione D. Somerville, Ed.D.
Dean of Students

Admissions and Registrar

Office of Admissions

Director: Marc Harding, M.Ed.
Senior Associate Directors: Phil Caffrey, M.S.; Stephanie Salasek, M.S.

Office of the Registrar

Assistant Vice President for Enrollment and Registrar: Kathleen M. Jones, M.S.
Senior Associate Registrar and Director for Transfer Relations: Laura Doering, M.S.
Associate Registrar: Larry Dau, B.S.

Admission

When to Apply

Applicants for the fall semester are encouraged to apply during the fall of the year preceding their entry to Iowa State University. Applications for other terms should be submitted well in advance of the desired entry date.

Application deadlines are available at www.admissions.iastate.edu.

Completed applications for admission to the professional curriculum in the College of Veterinary Medicine, together with the required supporting transcripts, must be received by an established deadline. See Index, *College of Veterinary Medicine, Application and Admission.*

How to Apply

Applications for admission are available on the Web at www.admissions.iastate.edu.

Iowa State University operates on a rolling admissions basis. Admission of applicants for fall semester begins in July of the preceding year. Admission for other terms begins approximately 12 months prior to the beginning of the term. Admission offers are issued for a specific term and are valid only for the term specified.

Visits to the Campus

Visitors to Iowa State University are always welcome!

The Soults Family Visitor Center, located in the Memorial Union, is open Monday through Friday from 8 a.m. until 5 p.m., and most Saturday mornings from 9 a.m. until 1 p.m. when classes are in session. Counselors are available to speak with prospective students and their families about admission, financial aid, housing, student life, academic programs and other opportunities. Visitors are offered student-guided walking tours of campus and the residence halls along with an enrollment presentation and an academic information session.

Prospective students and parents are encouraged to visit the campus and the Soults Family Visitor Center. Arrangements for a campus visit or registration for "Experience Iowa State" or "Transfer Visit Days" open house programs can be made at www.admissions.iastate.edu or by contacting the Soults Family Visitor Center at 800-262-3810 or locally at 515-294-5836.

Admission requirements are stated in the Iowa Administrative Code. Admission policies are established by the Faculty Senate. Any Admission decisions are made by the admissions officers in accordance with the entrance requirements as set forth in the Iowa Administrative Code as well as the admission policies established by the Faculty Senate.

Undergraduate Admission into Degree Programs Directly from High School

Students who seek admission must meet the following requirements and also any special requirements for the college or curriculum of their choice.

Applicants must submit an application for admission and the appropriate application fee (see www.admissions.iastate.edu for current application fee information). In addition applicants must have their secondary school provide an official transcript of their academic record, including cumulative grade point average, rank in class, and certification of graduation.

Applicants must also arrange to have their ACT or SAT scores reported to Iowa State directly from the testing agency. U.S. citizen and immigrant applicants who will not graduate from an approved Iowa high school and whose primary language is not English must meet university communication proficiency requirements. This can be accomplished by achieving satisfactory scores on the Test of English as a Foreign Language (TOEFL), the International English Language Testing System (IELTS), the ACT or SAT. Contact the Office of Admissions for minimum score requirements for each examination.

Applicants may be required to submit additional information or data to support their applications.

A. Graduates of approved Iowa high schools who have the subject-matter background required by Iowa State University and who achieve a Regent Admission Index (RAI) score of at least 245 will be offered admission. Graduates of approved Iowa high schools who have the subject-matter background required by Iowa State University and who achieve less than a 245 RAI score will be considered for admission on an individual basis.

The RAI score will be calculated for each applicant based on the following equation:

(2 x ACT composite score)

+ (1 x percentile class rank)

+ (20 x high school GPA)

+ (5 x number of years of high school core courses completed)

RAI Score

Note: For purposes of calculating the RAI, SAT scores will be converted to ACT composite equivalents; high school rank is expressed as a percentile with 99% as the top value; high school GPA is expressed on a 4-point scale; and number of high school courses completed in the core subject areas is expressed in terms of years or fractions of years of study.

Applicants from high schools that do not present all four of the factors required for calculation of the RAI score will be considered for admission on an individual basis.

Those applicants who are not offered unconditional admission will either be given the opportunity to enroll for a trial period during the preceding summer session or be denied admission.

B. Nonresidents of Iowa, including international students, may be held to higher academic standards, but must meet at least the same requirements as resident applicants.

C. Applicants who are graduates of nonapproved high schools will be considered for admission in a manner similar to applicants from approved high schools, but additional emphasis will be given to scores earned on standardized examinations.

D. Applications may be considered from students who did not graduate with their high school classes. They will be required to submit all academic data to the extent that it exists and achieve scores on standardized examinations which will demonstrate that they are adequately prepared for academic study.

E. Students with satisfactory academic records may be admitted, on an individual basis, for part-time university study while enrolled in high school or during the summers prior to high school graduation.

F. Exceptional students may be admitted as full-time students before completing high school. Early admission is provided to serve persons whose academic achievement and personal and intellectual maturity clearly suggest readiness for college-level study.

High School Preparation Required for Admission

Graduation from an approved high school shall ordinarily precede entrance into Iowa State University.

Students who wish to enter Iowa State University directly from high school (or transfer from another college or university with less than 24 semester hours of graded transferable college credit) must meet the level of academic performance described above and show evidence of the following high school preparation:

English/Language Arts
Four years, emphasizing writing, speaking, and reading, as well as an understanding and appreciation of literature

Mathematics
Three years, including one year each of algebra, geometry, and advanced algebra

Science
Three years, including one year each of courses from two of the following fields: biology, chemistry, and physics

Social Studies
Two years

Additional Entrance Requirements for the College of Liberal Arts and Sciences and the College of Engineering

In addition to the high school preparation requirements described above, students applying to the College of Liberal Arts and Sciences must have completed an additional year of social studies, for a total of three years, and two years of a single foreign language. Students applying to the College of Engineering must have completed two years of a single foreign language.

Students who do not meet the high school course preparation requirements listed here, but who are otherwise well qualified, may be admitted after individual review of their applications.

Undergraduate Admission into Degree Programs by Transfer from Other Educational Institutions

Students who seek admission must meet the following requirements and also any special requirements for the college and curriculum of their choice.

Applicants must submit an application for admission, and the appropriate application fee (see www.admissions.iastate.edu for current application fee information). Applicants must also request that each college they have attended send an official transcript of record to the Office of Admissions. Failure to provide transcripts from all colleges or universities attended may result in denial of the application or dismissal from the university. If less than 24 semester hours of graded transferable college credit is completed prior to entry at Iowa State University, applicants must also request that their official high school transcript and ACT or SAT scores be sent to the Office of Admissions. Other transfer applicants are encouraged to provide high school academic information. Students who do not do so may be asked to take course placement examinations during orientation.

U.S. citizen and immigrant applicants who have not graduated from an approved Iowa high school and whose primary language is not English must meet the university's English communication requirement. This can be accomplished by achieving satisfactory scores on the Test of English as a Foreign Language (TOEFL), the International English Language Testing System (IELTS), the ACT or SAT. Contact the Office of Admissions for minimum score requirements for each examination.

A. Transfer applicants with a minimum of 24 semester hours of graded transferable credit from regionally accredited colleges or universities, who have achieved for all college work previously attempted the grade point average required by Iowa State for specific programs, will be admitted. A 2.00 grade point average (on a 4.00 grading scale) is the minimum transfer grade point average requirement. Some programs may require a transfer grade point average higher than this minimum. Higher academic standards may be required of students who are not residents of Iowa, including international students.

   Applicants who have not maintained the grade point average required by Iowa State University for specific programs or who are under academic suspension from the last college attended generally will be denied admission.

B. In addition to meeting the minimum transfer grade point average requirement described above, applicants who have completed fewer than 24 semester hours of graded transferable college credit prior to their enrollment at Iowa State must also meet the admission requirements for students entering directly from high school.

C. Transfer applicants under disciplinary suspension will not be considered for admission until information concerning the reason for the suspension has been received from the college assigning the suspension. Applicants granted admission under these circumstances will be admitted on probation.

D. Transfer applicants from colleges and universities not regionally accredited will be considered for admission on an individual basis, taking into account all available academic information.

Transfer Credit Practices

Iowa State University endorses the Joint Statement on Transfer and Award of Academic Credit approved by the American Council on Education (ACE) and the American Association of Collegiate Registrars and Admissions Officers (AACRAO). The current issue of *Transfer Credit Practices of Designated Educational Institutions*, published by AACRAO is an example of a reference used in determining transfer credit.

The acceptance and use of transfer credit are subject to limitations in accordance with the educational policies of Iowa State University.

A. Students from regionally accredited colleges and universities.

   Credit earned at regionally accredited colleges and universities is acceptable for transfer, except for the following, which may not be accepted, or may be accepted to a limited extent:

   —credit in courses determined by Iowa State University to be of a developmental, vocational, or technical nature

   —credit in courses or programs in which the institution granting the credit is not directly involved.

   No more than 65 semester or 97 quarter credits earned at two-year colleges can be applied to a bachelor's degree from Iowa State University. While there is no limit to the number of credits that may be transferred from a four-year institution, the last 32 semester credits must be completed at Iowa State University.

B. Students from colleges and universities which have candidate status.

   Credit earned at colleges and universities which have become candidates for accreditation by a regional association is acceptable for transfer in a manner similar to that from regionally accredited colleges and universities if the credit is applicable to the bachelor's degree at Iowa State University.

   Credit earned at the junior and senior classification from an accredited two-year college which has received approval by a regional accrediting association for change to a four-year college may be accepted by Iowa State University.

C. Students from colleges and universities not regionally accredited.

   When students are admitted from colleges and universities not regionally accredited, they may validate portions or all of their transfer credit by satisfactory academic study at Iowa State, or by examination. The amount of transfer credit and the terms of the validation process will be specified at the time of admission.

   In determining the acceptability of transfer credit from private colleges in Iowa which do not have regional accreditation, the Regent Committee on Educational Relations, upon request from such institutions, evaluates the nature and standards of the academic program, faculty, student records, library, and laboratories.

   In determining the acceptability of transfer credit from colleges in states other than Iowa which are not regionally accredited, acceptance practices indicated in the current issue of *Transfer Credit Practices of Designated Educational Institutions* will be used as a guide. For institutions not listed in the publication, guidance is requested from the designated reporting institution of the appropriate state.

D. Students from foreign colleges and universities.

   Transfer credit from foreign educational institutions may be granted after a determination of the type of institution involved, its recognition by the educational authorities of the foreign country, and an evaluation of the content, level, and comparability of the study to courses and programs at Iowa State University. Credit may be granted in specific courses or assigned to general areas of study. Extensive use is made of professional journals and references which describe the educational systems and programs of individual countries.

Additional Transfer Credit Policies

A. Students with credit obtained during military service.

Credit will be awarded for successful completion of technical or specialized schools attended while on active duty with the armed forces to the extent that the material is applicable toward degree requirements at Iowa State University. Application for such credit is made at the Office of Admissions, which follows many of the recommendations in the American Council on Education (ACE) publication *A Guide to the Evaluation of Educational Experiences in the Armed Services*.

B. Students with credit obtained through non-college sponsored instruction.

Credit will be awarded for successful completion of learning acquired from participation in formal courses sponsored by associations, business, government, industry, and unions to the extent that the material is applicable toward degree requirements at Iowa State University. Application for such credit is made at the Office of Admissions, which follows many of the recommendations in the American Council on Education (ACE) publication *The National Guide to Educational Credit for Training Programs.*

C. Students with credit obtained through correspondence courses.

Although Iowa State does not offer correspondence courses, college level courses taken by correspondence from accredited colleges or universities are acceptable for transfer at the undergraduate level if the courses taken are those that do not require laboratory study.

D. College Level Examination Program (CLEP).

Iowa State University will award credit for each of the following 14 examinations: Financial Accounting, Principles of Accounting, American Government, Biology, Calculus, French Language, Humanities, Principles of Macroeconomics, Principles of Microeconomics, Natural Sciences, Introductory Psychology, Social Sciences and History, Introductory Sociology, Spanish Language.

Application of CLEP credit to a degree program varies with the department, so students should consult with their department before they register for CLEP examinations. Additional information is available at www.admissions.iastate.edu/cbe/cbe_clep.php.

E. Students with "test-out" credit.

Students who have earned credit at other colleges or universities through Advanced Placement (AP), College Level Examination Program (CLEP), or International Baccalaureate (IB) examinations may qualify for credit at Iowa State University. Scores from these examinations should be sent directly to the Office of Admissions; credit will be awarded provided the scores satisfy Iowa State's requirements.

Credit earned at another college through locally designed test-out examinations may transfer to Iowa State University if accompanied by at least 12 transferable semester credits earned through coursework taken at that institution.

Articulation/Transfer Agreements

A. Iowa Regent Universities General Education Articulation Agreement.

Iowa State University participates in an articulation agreement with the other two Iowa Regent universities concerning the acceptance of their general education programs into the Iowa State University College of Liberal Arts and Sciences. Under the terms of this agreement, students who have satisfied general education requirements at the University of Northern Iowa or in the College of Liberal Arts at the University of Iowa may transfer to Iowa State's College of Liberal Arts and Sciences with their general education requirements met (with the possible exception of the foreign language and library requirements).

B. Associate of Arts (A.A.) Articulation Agreement with Iowa public community colleges.

Students who plan to enter the College of Liberal Arts and Sciences or the College of Business at Iowa State University with an associate of arts degree from an Iowa public community college, and who have at least 60 prescribed semester (90 quarter) credits acceptable for transfer and at least a 2.00 cumulative grade point average, will be considered to have met the general education requirements of that college. College of Business students will still be required to take an ethics and a global course to satisfy general education requirements unless they are taken as part of the associate of arts degree.

C. Associate of Science (A.S.) Articulation Agreement with Iowa public community colleges.

Students who plan to enter the College of Liberal Arts and Sciences at Iowa State University with an associate of science degree from an Iowa public community college, and who have at least 60 prescribed semester credits acceptable for transfer and at least a 2.00 cumulative grade point average, will be enrolled at junior level status upon entry to Iowa State University, College of Liberal Arts and Sciences. Transfer students with AS degrees will have their transfer credits evaluated course-by-course to determine how the courses will be applied to their intended Iowa State major/degree program requirements.

D. Career-technical credit from Iowa public community colleges.

Iowa State University will accept up to 16 semester (24 quarter) credits earned in career-technical courses where the sending Iowa public community college will accept such courses toward its associate of arts or associate in science degree. Certain career-technical courses at Iowa community colleges may be articulated to Iowa State University as academic credit. The hours earned in these articulated courses would transfer in addition to the 16 semester hour career-technical maximum. Please refer to the course equivalency guides on the Web (www.admissions.iastate.edu/equiv) or contact the Office of Admissions for more information.

E. AP and CLEP credit from Iowa public colleges and universities.

Iowa State University has an agreement with the Iowa public colleges and universities which allows credit earned through AP and CLEP examinations to transfer directly to Iowa State University if accompanied by at least 12 transferable semester credits earned through coursework taken at the sending institution.

On-line Transfer Articulation System (TRANSIT)

TRANSIT is Iowa State's online system, which displays how credits from a community college or another university may transfer to a degree program at Iowa State. In TRANSIT, prospective or current students can generate a transfer credit evaluation showing how their courses and degrees from a community college or university transfer to Iowa State University. In addition, students can request an unofficial degree audit, which will display how their transfer courses are applied within a particular Iowa State major/degree program. TRANSIT is easy to use and can be accessed by going to http://transit.iastate.edu.

Nondegree Undergraduate

Students who wish to attend Iowa State University to take undergraduate courses but who do not plan to seek an undergraduate degree from Iowa State University should apply as nondegree undergraduate students. Credit taken under the nondegree undergraduate classification is applicable for undergraduate degree purposes for those who are later admitted as degree-seeking undergraduate students. Credit obtained under the nondegree undergraduate classification may not, however, be applied toward a graduate degree.

Students enrolled in the Intensive English and Orientation Program (IEOP) are classified as nondegree students in the College of Liberal Arts and Sciences, and usually are not permitted to enroll in academic courses until they have satisfied requirements for admission as degree-seeking students. Permission to enroll in one academic course in addition to full-time intensive English study may be granted under special circumstances.

Reentering Students

Reentering students are those who have previously attended Iowa State University and are returning after an absence of at least one full year. See Index, *Academic Renewal Policy*; and *Reentry.*

International students need to reapply after an absence of one full semester, exclusive of summer session. International reentries must also contact the International Students and Scholars office to request the necessary visa application forms.

Reentering graduate students do not need to

complete a reentry form but should notify their department and the Office of the Registrar of their intent to reenter Iowa State University. See *Index*, *Reentry* for more information.

Residency

Classification of Residents and Nonresidents for Admission and Tuition Purposes

These criteria are contained in the *Policy Manual, Board of Regents, State of Iowa and or the Iowa Administrative Code: Board of Regents, State of Iowa.*

Graduate Assistants

Students with graduate assistantships of 1/4-time or more are assessed Iowa resident tuition and fees. Nonresident students with graduate assistantships of 1/4-time or more retain their nonresidency classification, but are assessed resident tuition and fees as long as the graduate assistantship is continued.

The spouse of a 1/4-time or more graduate assistant who is a nonresident is eligible for resident tuition and fees during the period of the assistantship appointment. Iowa residency is not granted, but a waiver of nonresident tuition and fees is in effect. When the graduate assistantship ends, the tuition and fee waiver for the spouse is terminated. (Board of Regents, State of Iowa, Minutes March 15, 1995, p. 801).

The graduate student must request the resident tuition assessment by **midterm** of the term in question. The benefit will not be granted retroactively.

General

A. A person enrolling at one of the three state universities shall be classified as a resident or nonresident for admission, tuition, and fee purposes by the registrar or someone designated by the registrar. The decision shall be based upon information furnished by the student and other relevant information.

B. In determining resident or nonresident classification, the issue is essentially one of why the person is in the state of Iowa. If the person is in the state primarily for educational purposes, that person will be considered a nonresident. For example, it may be possible that an individual could qualify as a resident of Iowa for such purposes as voting, or holding an Iowa driver's license, and not meet the residency requirements as established by the Board of Regents, State of Iowa, for admission, tuition, and fee purposes.

C. The registrar, or designated person, is authorized to require written documents, affidavits, verifications, or other evidence deemed necessary to determine why a student is in Iowa. The burden of establishing that a student is in Iowa for other than educational purposes is upon the student. A student may be required to file any or all of the following:

1. A statement from the student describing employment and expected source of support
2. A statement from the student's employer
3. A statement from the student's parents verifying nonsupport and the fact that the student was not listed as a dependent on tax returns for the past year and will not be so listed in future years
4. Supporting statements from persons who might be familiar with the family situation
5. Iowa state income tax return.

D. Change of classification from nonresident to resident will not be made retroactive beyond the term in which application for resident classification is made.

E. A student who gives incorrect or misleading information to evade payment of nonresident fees shall be subject to serious disciplinary action and must also pay the nonresident fees for each term previously attended.

F. Review committee. These regulations shall be administered by the registrar or someone designated by the registrar. The decision of the registrar or designated person may be appealed to a university review committee. The finding of the review committee may be appealed to the Board of Regents, State of Iowa.

Guidelines

The following guidelines are used in determining the resident classification of a student for admission, tuition, and fee purposes:

A. A financially dependent student whose parents move from Iowa after the student is enrolled remains a resident provided the student maintains continuous enrollment. A financially dependent student whose parents move from Iowa during the senior year of high school will be considered a resident provided the student has not established domicile in another state.

B. In deciding why a person is in the state of Iowa, the person's domicile will be considered. A person who comes to Iowa from another state and enrolls in any institution of postsecondary education for a full program or substantially a full program shall be presumed to have come to Iowa primarily for educational reasons rather than to establish a domicile in Iowa.

C. A student who was a former resident of Iowa may continue to be considered a resident provided absence from the state was for a period of less than 12 months and provided domicile is reestablished. If the absence from the state is for a period exceeding 12 months, a student may be considered a resident if evidence can be presented showing that the student has long-term ties to Iowa and reestablishes an Iowa domicile. A person or the dependent of a person whose domicile is permanently established in Iowa, who has been classified as a resident for admission, tuition, and fee purposes, may continue to be classified as a resident so long as domicile is maintained, even though circumstances may require extended absence of the person from the state. It is required that a person who claims Iowa domicile while living in another state or country will provide proof of the continual domicile as evidence that the person:

1. Has not acquired domicile in another state;
2. Has maintained a continuous voting record in Iowa; and
3. Has filed regular Iowa resident income tax returns during absence from the state.

D. A student who moves to Iowa may be eligible for resident classification at the next registration following 12 consecutive months in the state provided the student is not enrolled as more than a half-time student (6 credits for an undergraduate or professional student, 5 credits for a graduate student) in any academic year term, is not enrolled for more than 4 credits in a summer term for any classification, and provides sufficient evidence of the establishment of an Iowa domicile.

E. A student who has been a continuous student and whose parents move to Iowa may become a resident at the beginning of the next term provided the student is dependent upon the parents for a majority of financial assistance.

F. A person who is moved into the state as the result of military or civil orders from

the government for other than educational purposes, or the dependent of such a person, is entitled to resident status. However, if the arrival of the person under orders is subsequent to the beginning of the term in which the student is first enrolled, nonresident fees will be charged in all cases until the beginning of the next term in which the student is enrolled. Legislation, effective July 1, 1977, requires that military personnel who claim residency in Iowa (home of record) will be required to file Iowa resident income tax returns.

G. A person who has been certified as a refugee or granted asylum by the appropriate agency of the United States, who enrolls as a student at a university governed by the Board of Regents, State of Iowa, may be accorded immediate resident status for admission, tuition, and fee purposes where the person:

1. Comes directly to the state of Iowa from a refugee facility or port of debarkation, or
2. Comes to the state of Iowa within a reasonable time and has not established domicile in another state.

Any refugee or individual granted asylum not meeting these standards will be presumed to be a nonresident for admission, tuition, and fee purposes and thus subject to the usual method of proof of establishment of Iowa residency.

H. An alien who has immigrant status establishes Iowa residency in the same manner as a United States citizen.

I. At the Regent institutions, American Indians who have origins in any of the original people of North America and who maintain a cultural identification through tribal affiliation or community recognition with one or more of the tribes or nations connected historically with the present state of Iowa, including the Iowa, Kickapoo, Menominee, Miami, Missouri, Ojibwa (Chippewa), Omaha, Otoe, Ottawa (Odawa), Potawatomi, Sac and Fox (Sauk, Meskwaki), Sioux, and Winnebago (Ho Chunk), will be assessed Iowa resident tuition and fees. (Board of Regents, State of Iowa, Minutes October 15-16, 1997, p. 299)

Facts

A. The following circumstances, although not necessarily conclusive, have probative value in support of a claim for resident classification:

1. Reside in Iowa for 12 consecutive months, and be primarily engaged in activities other than those of a full-time student, immediately prior to the beginning of the term for which resident classification is sought.
2. Reliance upon Iowa resources for financial support.
3. Domicile in Iowa of persons legally responsible for the student.
4. Former domicile in the state and maintenance of significant connections therein while absent.
5. Acceptance of an offer of permanent employment in Iowa.
6. Other facts indicating the student's domicile will be considered by the universities in classifying the student.

B. The following circumstances, standing alone, do not constitute sufficient evidence of domicile to affect classification of a student as a resident under these regulations:

1. Voting or registration for voting.
2. Employment in any position normally filled by a student.
3. The lease of living quarters.
4. Admission to a licensed practicing profession in Iowa.
5. Automobile registration.
6. Public records; for example, birth and marriage records, Iowa driver's license.
7. Continuous presence in Iowa during periods when not enrolled in school.
8. Ownership of property in Iowa, or the payment of Iowa taxes.

Registration/Enrollment

In order to register for classes students must first accept their offer of admission by the university. Registration and the payment of assessed fees are required of all who attend classes. Enrollment is not complete until fees are paid, including room and board fees for those living in residence halls. See Index, *Registration*.

Enrollment Status

Enrollment status is defined for certification purposes as either full-time or half-time.

Full-time status, fall or spring semester

Undergraduates: 12 credits
Graduates: 9 credits

Half-time status, fall or spring semester

Undergraduates: 6 credits
Graduates: 5 credits

Summer status
Summer status depends on the number of weeks a student is enrolled. Always contact the Office of the Registrar to verify a student's status for a summer session.

With the exception of enrollment certification for veterans' benefits, credit hours are rounded up to the next whole number. For example, credit load of 11.5 credits is rounded up to 12 credits. Contact the Office of the Registrar for more information.

Credit by Examination (CBE)

It is Iowa State University policy to grant academic credit by examination in many of the undergraduate courses listed in the university bulletin. Credit is awarded primarily in the introductory level classes in mathematics, natural, physical, and social sciences, and the liberal arts. Students with superior high school backgrounds or those with college-level proficiency in certain subject areas are strongly encouraged to investigate and attempt testing in the CBE programs available.

Types of CBE Programs

Students may earn academic credit in any of four ways and have that credit recorded on their academic record when they enroll. Programs accepted at Iowa State include the Advanced Placement (AP) Program, the International Baccalaureate (IB) Examinations, departmental examinations, and the College Level Examination Program (CLEP). Iowa State's policies for awarding credit for each of these programs may be found at www.admissions.iastate.edu/cbe.

Advanced Placement (AP) Program of the College Board

This program allows students, while still in high school, to take examinations for credit at the college level. Iowa State University awards credit or advanced placement through the Advanced Placement Program in art, biology, chemistry, computer science, economics, English, environmental science, foreign languages, geography, government and politics, history, mathematics, music, physics, psychology and statistics. High school counselors and teachers will assist with testing arrangements.

Generally, students scoring 3 or better on the exams will be considered for course credit based on departmental review of the exams. In some departments, only scores of 4 or better will be considered for credit.

Correspondence concerning the Advanced Placement Program should be addressed to the College Board Advanced Placement Examinations, P.O. Box 977-IS, Princeton, New Jersey 08541, or visit their web site at www.collegeboard.com/student/testing/ap/about.html.

International Baccalaureate Examinations

The International Baccalaureate (IB) Program, offered at many high schools in the United States and abroad, allows students the opportunity to take examinations for credit at the college level. These examinations are offered at standard and higher levels.

Iowa State University awards credit for most higher level examinations and some standard level examinations. Students must receive a minimum score of 4 to qualify for academic credit in most subject areas. Some departments require higher scores. Official IB examination results must be sent directly to the Office of Admissions from the International Baccalaureate North America Office. Results listed on high school transcripts are not considered official.

Correspondence concerning the IB Program should be addressed to IB North America, 475 Riverside Drive, Suite 240, New York, NY 10115, ibna@ibo.org, or visit their website at www.ibo.org.

Departmental Examinations

Students may take locally constructed departmental examinations for undergraduate credit in specified subject areas for which they and the department feel they have the necessary preparation. These exams are generally

administered by the department which offers the course (for exceptions, see CLEP offerings below). Students interested in taking departmental (or CLEP) examinations should contact the appropriate department for specific information on the course covered by the exam and the exam itself. A nonrefundable fee is charged for each departmental examination requested. If an acceptable exam score is achieved, a grade of T will be reported to the Office of the Registrar. The T grade represents performance equivalent to a C or better in the course. T grades are not used in computing students' grade point averages; however, the credit does become part of their official academic record and may be applied toward their graduation requirements. For a listing of common departmental test-out exams, refer to www.public.iastate.edu/~stdtcouns/TestOuts2.html. Most examinations for credit are prepared by the departments offering the courses. In some cases, the examination used is part of the College Level Examination Program (CLEP), where the content of the CLEP test has been judged to be an equivalent to the content of the course.

College Level Examination Program

CLEP is available on computer only and Iowa State University only accepts the CLEP tests listed in this section, and does not accept College Mathematics or English Composition. Up to six semester credit hours in each of these three CLEP general tests is awarded: Social Sciences and History, Humanities, and Natural Sciences. In addition, the College of Engineering does not allow credit earned from CLEP Social Sciences and History, Humanities, and Natural Sciences tests to be used in their students' degree programs.

CLEP tests accepted at Iowa State University include American Government (Pol S 215); Financial Accounting (Acct 284; engineering majors should consult with their academic adviser before registering for this examination); Biology (Biol 101, not for biology or engineering majors); Introductory Psychology (Psych 101); Introductory Sociology (Soc 134); Principles of Macroeconomics (Econ 102); Principles of Microeconomics (Econ 101); and Calculus (Math 165).

In addition, Iowa State University will award up to 16 semester credit hours for CLEP French Language and up to 16 semester credit hours for CLEP Spanish Language. Please note that native or near native speakers of French or Spanish may not test out of the beginning or intermediate levels in these languages.

A nonrefundable fee is charged for each CLEP test requested, and all requests should be made one week prior to the test date. CLEP tests are administered by the Student Counseling Service Testing Office Monday through Friday. For information on whether to take any of the CLEP tests, contact your academic adviser. To obtain information on any of the CLEP tests, contact the SCS Testing Office, Rm. 2030 Student Services Building, Iowa State University, Ames, Iowa 50011, or send e-mail to scsclep@iastate.edu. To print a copy of the institutional CLEP registration form, go to www.public.iastate.edu/~stdtcouns/ and select Testing Services.

Policies and Procedures Governing CBE Tests

1. Departmental and CLEP tests are offered to newly admitted or currently enrolled students at Iowa State University. Former and future students will receive credit only if they enroll sometime during the twelve months immediately following the test(s).
2. Permission to take a departmental examination is obtained from the department. Students may be denied permission because (a) the nature of the course is such that proficiency cannot be measured by such a test, (b) the student does not appear to have adequate background to pass the examination for the course, or (c) the student would not otherwise be allowed to enroll in the course. Students may appeal such a denial to the dean of the college in which the department is administered and subsequently to the provost.
3. Students may ordinarily attempt a CBE test only once in any course or area. Under special circumstances a retest may be taken upon approval of the department in which the course is offered.
4. Departmental examinations and CLEP subject tests cover only a single course and students may not test out of independent study or special topic courses.
5. There is a nonrefundable fee for all departmental and CLEP tests. The fee is set by the Board of Regents, State of Iowa, and is subject to change.
6. Departmental examinations are usually given just prior to, or within two weeks of, the beginning of fall and spring semesters. For more information, students should contact the department that offers the class. CLEP tests are given throughout the year.
7. Credit for the CLEP examinations Social Sciences and History, Humanities, and Natural Sciences is not evaluated as equivalent to any specific course and cannot be used in place of specific course requirements for the major. All colleges (except Engineering, which does not accept these tests) allow these CLEP credits to be used for either general requirements (not in Liberal Arts and Sciences) or elective credit. Students are responsible for checking with their academic advisers to determine whether such credit is to their benefit.
8. Listed below are policies for transferring CBE from another college or university to Iowa State University:
   a. AP or CLEP credit which is earned at an Iowa public college or university may be transferred directly to Iowa State University provided it is accompanied by at least 12 semester credits earned in residence at the sending institution. AP or CLEP credit which is earned at any other college or university may not be transferred directly to Iowa State. However, the scores from these examinations may be sent to Iowa State University from the testing agency, and credit will be awarded based on Iowa State's AP and CLEP policies.
   b. IB credit earned at another college or university may not be transferred directly to Iowa State University. However, the scores from IB examinations may be sent to Iowa State from the testing agency, and credit will be awarded based on Iowa State's IB policies.
   c. Credit earned at another college or university through local test-out examinations may be transferred directly to Iowa State University provided it is accompanied by at least 12 semester credits earned in residence at the sending institution.
9. Credit earned from CBE will be posted to the student's academic record at the end of the term. CBE credits will be counted toward the projected year in school classification used to establish registration start dates.
10. Some professional programs do not accept T (test-out) credit in preprofessional courses. Students who anticipate applying to such programs should inquire about the acceptability of such credit before registering for such CBE tests.
11. Credit established at Iowa State University will usually transfer to other colleges and universities; however, the final decision rests with the institution reviewing the transcript.

Office of New Student Programs

Orientation

Orientation assists new undergraduates with the transition to Iowa State University. At orientation, students plan their academic programs, register for classes, learn about university policies and procedures, and prepare for personal and social adjustments to the university. The university Orientation Committee, composed of Iowa State University faculty, and staff, is responsible for the orientation programs; the undergraduate colleges of the university, in cooperation with the Office of New Student Programs, have responsibility for the implementation of orientation programs for new students and their families.

The Orientation Committee conducts an extensive orientation program during the summer, with additional programs held prior to each term. Special orientation sessions are conducted for transfer students during the spring. New students receive an invitation to attend an orientation program before their first semester at the university

Summer Orientation

Summer orientation for freshmen is a two-day program scheduled in June. As early as January, new freshman students and their family members are asked to select a convenient time from among a number of orientation sessions that are scheduled during June. In addition to preparing their class schedules for fall semester, new students with their family members participate in informational activities about policies and procedures at the university, and meet formally and informally with

faculty, staff, and other new students and their families. These sessions, held in a comfortable, informative atmosphere, lessen existing anxieties, assist in the development of a clearer understanding of the university environment, and make it possible for new students—with support from their family members—to begin to make the academic and social decisions that are faced by all students at the university.

Housing and meals are available at campus residence halls for a nominal fee during June freshman orientation.

Destination Iowa State

The Destination Iowa State program is held for all new freshman and transfer students on the Thursday, Friday, and Saturday before classes begin fall semester; and on the Saturday before classes begin spring semester. The program helps new students develop academic and social strategies to ensure a successful transition to Iowa State University.

WelcomeFest

WelcomeFest activities are scheduled during the first week of fall semester to welcome students to campus. All students, including transfer students, are invited to participate in WelcomeFest.

Information Disclosure

Iowa State University is required by law to make available to enrolled students, prospective students, and their parents certain information about the university. The information disclosure policy is available at www.iastate.edu/~disclosure. Students without electronic access can obtain the information from the Office of the Registrar, 214 Enrollment Services Center, 515-294-1840 or from the Office of Admissions, 100 Enrollment Services Center, 515-294-5836. A paper copy of the information will be provided upon request.

Student Records

Iowa State University maintains various records concerning students, to document their academic progress as well as to record their interactions with university staff and officials. In order that their right to privacy be preserved and to conform with federal law, the university has established certain policies to govern the handling of student records. All policies conform with FERPA, the Family Educational Rights and Privacy Act (also known as the Buckley Amendment).

Public Information

Certain information concerning students is considered to be open to the public upon inquiry. This public information is of two types: directory information and other information not included in the ISU Directory. ISU directory information includes local address, telephone number, campus e-mail address, home town, college, curriculum, year in school, and enrollment status. Other public information includes mailing address, date and place of birth, dates of attendance at Iowa State, expected date of graduation, names of advisers, awards and academic honors, Iowa State degree(s) and date(s) awarded, previous educational institutions attended, degrees received, dates of attendance, full- or part-time status, participation in officially recognized activities and sports, and weight and height of members of athletic teams.

Public information will be released by the registrar to anyone upon inquiry, unless students have requested that their information not be released. A request to have public information withheld should be made at the Office of the Registrar, 214 Enrollment Services Center. Once the request is processed, the registrar will notify the appropriate university offices.

For the purposes of FERPA, Iowa State University defines directory information to include both ISU directory information and public information as defined above.

It is the policy of the university to respect the privacy of students; therefore, only lists and labels containing names of students with directory information will be made available to members of the public. This directory information will be provided on a time-available basis for the cost of producing the information. Directories are also available in the bookstores for those persons needing directory information. Directory information is available on the World Wide Web using the online phonebook; and from printed directories, which may be purchased at the bookstores.

Confidential Information

With the exception of the information noted above, all student records are considered to be confidential and are open only to school officials .A school official is a person employed by the university in administrative, supervisory, academic or research, or support staff position (including law enforcement unit personnel and health staff); a person or company with whom the university has contracted; or a student serving on an official committee, such as a disciplinary or grievance committee, or assisting another school official in performing his or her tasks. A school official has a legitimate educational interest if the official needs to review an education record in order to fulfill his or her professional responsibility. Iowa State University's notification of rights under FERPA can be found at www. public. iastate. edu/~registrar/info/ferpanotice.html.

The following policies govern access to student records:

1. Each type of student record is the responsibility of a designated school official, and only that person or the dean or director to whom that person reports has authority to release the record. The following is a list of the responsible officials:
   a. Academic records: registrar
   b. Admissions records: director of admissions
   c. Financial aid records: director of student financial aid
   d. Business records: university controller
   e. Traffic and security records: director, ISU Department of Public Safety
   f. Medical records: director, Thielen Student Health Center
   g. Counseling records and test scores: director, Student Counseling Service
   h. Actions of Academic Standards Committees: college deans
   i. Disciplinary records: dean of students
   j. Residence hall records: director of residence
   k. Placement records: college placement officers.
   l. Evaluations for admission to ISU graduate or professional programs: deans or department chairs
   m. Special academic programs: faculty member in charge of the program and the dean of the college.
2. The designated official may release records to other school officials who have a legitimate need for the information. A list of those persons who normally have access to each type of student record is available in 214 Enrollment Services Center.
3. All student records are reviewed periodically. Information concerning the frequency of review and expurgation of specific records is available in 214 Enrollment Services Center.
4. Students have the right to review upon request any records that pertain directly to them, and may obtain a copy of the record for a fee. This provision does not apply to records to which the student has waived his or her right to review, nor does it apply to medical and counseling records.
5. A student may waive the right to review a specific record by submitting in writing a statement to this effect to the official responsible for that record.
6. A file containing copies of records pertinent to advising is maintained on each student for use by the student's adviser. This file may be maintained in hard copy or electronic format. Ordinarily this file is kept in the possession of the adviser, but for convenience it may be stored elsewhere such as in the dean's office or department office. When the student changes majors, or changes advisers within the same major, the file is transferred to the new adviser. Under the university's student records policy, the student is considered to have the right of access to this file.
7. Medical and counseling records shall be released at the written request of the student to medical or psychological professionals outside the university or to university officials.
8. University personnel who have access to student records in the course of carrying out their university responsibilities shall not be permitted to release the record to persons outside the university, unless authorized in writing by the student or unless one of the exceptions stated earlier is involved.

9. Confidential information may be released by students to their parents or other trusted third parties through the AccessPlus third party system. Confidential information may also be released by obtaining the student's written consent or by having the parent establish the student's dependency as defined by the Internal Revenue Code of 1954, section 152, by furnishing a certified copy of the parent's most recent federal income tax return.
10. The officials responsible for custody of student records will maintain records of requests and disclosures of personally identifiable nonpublic information. The records of requests, whether granted or not, shall include the person or agency requesting the information and the purpose of the release. These records of requests and disclosures will be available to the student on request. Records of requests and disclosures are not necessary for requests made by the student, by school officials in carrying out their official responsibilities, by persons employed by agencies and offices conducting audits and accreditations of university programs, or any of the other exceptions listed previously.

Posting Grades and Test Scores

Instructors who wish to inform students of their performance may post grades and test scores on a secure course web site as long as individual students may only access their own grades. The test scores or course grades of students may not be posted in any public location (World Wide Web or hard copy posting) unless the instructor posts the information using a code for each student that is known only by the instructor and the student.

Release of Grades

Students who choose to release their grades to parents or other trusted third parties may do so using the AccessPlus third party system. Reports of a student's grades are not routinely sent to the student's parents. Parents of students under 18 years of age may obtain grades by writing to the Office of the Registrar. The grades of other students will be sent to their parents only with written permission of the student, or by establishing dependency as outlined in item 9 under Confidential Information.

When Records May Be Withheld

The appropriate university official may request that a student's record not be released if that student is delinquent in an account with the university or an affiliated organization. The effect of this action is that a transcript will not be released and registration will be withheld.

The appropriate official may also request that records be withheld in instances when official disciplinary action has been taken against a student. Authorization for these actions is supported by The Iowa Code and The Iowa Administrative Code.

In order for such an action to be rescinded, the Office of the Registrar must receive written authorization from the official who originally requested the action, indicating that the student has met the obligation. Further information about this policy can be obtained from the Office of the Registrar.

Review and Challenge of Records

A student may challenge the accuracy of handling of records maintained by the university on grounds that the records are inaccurate, misleading, or otherwise violate the privacy or other rights of the student. The university has established the following procedures to provide an opportunity for the student to correct or delete inaccurate records, or to insert into the record a written explanation of the content. Students who question their records should discuss the issue first with the individual staff person who established or maintains the records. Presumably most issues can be resolved at this level. If a satisfactory resolution cannot be reached, the student should submit the question to the head of the department in which the record is maintained.

The department head will discuss the issue with the staff person and the student challenging the record. If resolution cannot be reached after meeting with the department head, the student may submit the question to the dean or director to whom the department head is responsible. The dean or director will investigate, and will respond in writing.

If the record has not been reconciled through these measures, the student may direct a written request to the president of the university. The president will convene an Ad Hoc Hearing Panel of Access and Confidentiality of Educational Records, composed of two faculty members, two students, and one administrator, appointed by the president for a period of one year, with the president or a designee serving as nonvoting chairperson. The student shall be given an opportunity to present to the panel evidence relevant to the issues raised, and the panel will issue a written response.

ISUCard and Identification Number

Each student is assigned a random university identification number on entry to the university. This number appears on the ISUCard that is provided to each student at the time of first registration. The ISUCard, may be required for some services and/or activities. At the time the ISUCard is issued each student also selects a university password, which is required for electronic access to personal student information.

Loss of an ISUCard should be reported immediately to the ISUCard Office, where the lost card will be invalidated and replaced for a charge. Disciplinary sanctions may be imposed for improper use of the ID card or attempts to obtain, by fraudulent means, any form of identification.

Social Security Number

Social security numbers are collected from prospective and current students, for administrative coordination and record identification purposes only. Although procedures have been established by the registrar for assignment of an alternative number upon request, students who wish to be employed on campus, desire to claim federal educational tax benefits, or are applying to receive financial aid, are required by law to provide their social security numbers for administrative use. The social security number is a confidential record and is maintained as such by the university in accordance with the Family Educational Rights and Privacy Act.

Policy on Student Names

Iowa Regent universities have a common policy regarding student names and name changes. The name on the student record should be the student's complete and legal name. In evaluating and processing all name change requests, the university reserves the right to require adequate and appropriate documentation as warranted.

Tuition, Fees and Expenses

For the most current and complete information see www.iastate.edu/~registrar/fees

All tuition, fees, and expenses, and policies listed in this publication are effective summer session 2009 and are subject to change without notice by Iowa State University and the Board of Regents, State of Iowa. Tuition and fees are based on credit load at 5:00 p.m. on the 10th day of class, which is the last day for adjustments downward in tuition and fee assessment.

Tuition

Enrollment is not complete until fees are paid. Tuition is charged based upon the number of credits in which a student is enrolled. Maximum charges start at 12 credits for undergraduate and veterinary medicine students. Maximum charges start at 9 credits for graduate students.

Students who are not residents of Iowa pay a higher tuition rate each semester. Nondegree undergraduate students and noncollegiate students pay the same fees as undergraduates. Tuition and fees are assessed in accordance with regulations of the Board of Regents, State of Iowa. Information about these regulations are found in this catalog under Admissions and Registrar.

Fees

Following are the descriptions of several commonly assessed fees for Iowa State University students. The list is not inclusive. All fees are subject to change without notice.

Activity, Services, Building and Recreation: The activity, services & building fee is a mandatory fee that supports a variety of activities and services for all students. It is not based on whether or not a student uses an individual activity or service. This fee provides several benefits such as student admission rates to concerts and athletic events and, unlimited use of CyRide, the Ames bus system. In addition, the fee provides support for campus recreation facilities, the Memorial Union, and campus organizations and services as allocated by the Government of the Student Body. All students will be charged a maximum of $226.35 each fall and spring semester, and $113.75 per summer semester. Exemptions are granted for students exclusively registered for the following: distance education courses (sections beginning with X); courses for which no tuition is assessed; continuous registration status courses, and high school students enrolled under the Post-Secondary Enrollment Options Act. Students in exemption categories named above may elect to pay this fee and will be assessed based upon their enrollment status.

For students who withdraw or change to an exempt status as defined above, the tuition adjustment schedule will also be used for the activity fee.

Tuition Schedule Per Semester

In effect for Fall 2009. Subject to change without notice.

Full Time Rates	Resident	Nonresident
Undergraduate (12 or more credits)	$2,878	$8,488
Business Juniors and Seniors (Includes $250 differential tuition)	$3,128	$8,738
Engineering Juniors and Seniors	$3,815	$9,406
Graduate (9 or more credits)	$3,358	$8,908
Engineering Graduate:	$3,869	$9,414
Veterinary Medicine (12+ credits)	$7,841	$18,630

For students enrolled for less than a full course load and for the most current and complete information, see the Fee Schedule Per Credit list at www.iastate.edu/~registrar/fees.

Additional information:

Audits and zero credit courses: assessed according to contact hours; maximum charge for zero credit courses is three credit hours

R credits: assessed for the minimum fee only if no other credits are taken.

Continuous registration fee for graduate students: $70.

Partial credits (.5): assessed on the next larger whole number of credits, e.g., 6.5 credits is assessed as 7 credits.

Saturday MBA/Des Moines MBA classes: MBA students are assessed the graduate rate plus $113 per credit supplemental tuition fee (supplemental tuition fee subject to change without notice).

Summer session: based on per credit as indicated in the fee schedule.

Tuition assessment for study abroad credits: up to a maximum of 12 credits, is above and beyond tuition for other courses taken during the same term.

Application: The application fee for domestic undergraduates and graduate students is $40, the fee for international undergraduate students is $50, while the fee for international graduate students is $90. All applicants for Veterinary Medicine pay an application fee of $60. This is a nonrefundable fee and must accompany the application for admission. This fee does not apply to special students or workshop applicants, and is subject to change without notice.

Applied Music (Private Instruction): The music fee is charged to students receiving private music instruction and is in addition to regular tuition. The fee offsets the costs of one-on-one instruction. One credit of instruction is $150; the fee for two credits is $190.

Camp: A special tuition rate is assessed to students participating in camp programs. The undergraduate assessment is $240 per credit and the graduate rate is $374 per credit. Summer camp programs entitled to the special rate are Anthropology and Geology. Students will be charged other fees in addition to tuition for enrolling in these programs. To obtain total fee information, students should contact the director of the individual program.

Career Services: The career services fees vary among college-based career services offices ranging from $0 - $25 per student.

Catalog: First semester students (transfer or incoming freshmen) receive complimentary copies of the catalog. Catalog information is also available on the Web at http://www.iastate.edu/~catalog/ or provided to high school guidance offices or community college student service areas. Individuals and organizations may purchase a catalog from the University Bookstore for a cost of $5 plus shipping.

Computer: All students will be charged a computer fee each semester.

Full-time graduate and undergraduate students enrolled in the College of Engineering (including Systems Engineering) are charged $223 per semester.

Full-time graduate and undergraduate students majoring in Computer Science are charged $223 per semester.

Full-time undergraduate students enrolled in the College of Business are charged $135 per semester, while full-time graduate students are charged $112 per semester.

All other full-time undergraduate students are charged the standard computer fee of $115 per semester. Full-time graduate students are charged an $92 per semester computer fee.

Students enrolled less than full-time are assessed prorated computer fees according to the number of credits for which they are enrolled.

High school students enrolled under the Postsecondary Enrollment Options Act; or students enrolled exclusively in courses for which no tuition is assessed are not assessed a computer fee.

For students who withdraw, computer fee adjustments will be made according to the tuition adjustment schedule. Adjustments for a reduction in credits below a full time load is 100 percent through the second week, with no refunds after the second week. Students who change their major will be charged the full computer fee for the major into which they transfer if the change occurs before the end of the second week. If the change occurs after the second week, then no change in the computer fee assessment will occur.

Delivery: Some distance education courses charge a delivery fee to offset additional expenses incurred in offering a course at a distance. Applicable delivery fees are listed with the specific course in the Schedule of Classes available at http://classes.iastate.edu. Delivery fees also appear on each student's schedule detail available on AccessPlus.

Developmental: A developmental course fee is charged in addition to the tuition charged for other courses on the student's schedule. For example: A student taking 12 credits plus a developmental course will pay full-time tuition for the 12 credits, *plus* the developmental course fee(s). These fees are intended to cover the direct costs of offering these developmental courses. Developmental course fees are listed with the specific course in the Schedule of Classes available at http://classes.iastate.edu/

Diploma Replacement: Individuals who have lost their diploma may request a replacement for $25.

Graduation: Undergraduate and graduate students are charged a $50 nonrefundable graduation fee the term they receive their degree.

Health Facility: All students are charged an $8 Health Facility Fee each semester except for students exclusively registered for the following: distance education courses (courses with sections beginning with X); courses for which no tuition is assessed; continuous registration status courses; and high school students enrolled under the Postsecondary Enrollment Options Act. These exceptions do not apply to international students (except where noted) or graduate students on graduate assistantships. For students who withdraw or change to an exempt status as defined above, the refund schedule for tuition will be used for the health facility fee.

Students who carry the ISU sponsored student health insurance must also be assessed the health facility fee.

Health (Student Health): A $98 student health fee, which partially finances the services of the Thielen Student Health Center, is charged to all students each semester. This fee is not assessed to students enrolled for four or fewer credits or students exclusively registered for the following: distance education courses (courses with sections beginning with X); courses for which no tuition is assessed; continuous registration status courses; weekend MBA courses; Lakeside Laboratory courses; and high school students enrolled under the Postsecondary Enrollment Options Act. (These exemptions do not apply to international students or to graduate students on graduate assistantships.) Students who are exempt from the mandatory health fee may use the services of the Thielen Student Health Center on a fee for service basis, or may elect to pay the $98 Health Fee and $8 Health Facility Fee, which allows participants to receive services at the Thielen Student Health Center for the same rate as students who pay the mandatory health fees. Spouses/domestic partners of students who wish to use the Thielen Student Health Center must pay the $98 Health Fee and $8 Health Facility Fee.

Students who withdraw or change to an exempt status as defined above will receive a credit adjustment of 100 percent during the first two weeks, with no credit adjustment after the second week. Students who add courses at any time during the semester will be assessed the student health fee if applicable according to the guidelines stated above. Students who carry the ISU sponsored insurance must also be assessed the student health fee. If spouse or domestic partner is covered under the insurance plan, the spouse (domestic partner) must also be covered under the Health Fee and Health Facility Fee.

Health Insurance: All international students and their accompanying dependents must enroll in the ISU Student and Scholar Health Insurance Program. ISU requires nonimmigrant international students and their dependents to purchase and maintain coverage through the ISU health insurance plan for the duration of their tenure at the university. Insurance plans purchased outside the university may be used for supplemental coverage, but cannot be substituted for the ISU plan. Students not assessed the mandatory Student Health Fee and spouses of students should contact the Student Health Insurance Office at 515-294-4820 for more information.

Identification Card (ISUCard) Replacement: All students receive their first identification card free of charge. Those cardholders who have lost or misplaced their identification cards are assessed a $25 fee to cover the cost of replacement.

Late Fee Payment: If payment of the minimum due is not made by the deadline printed on the billing statement, all fees become due immediately. A one-percent finance charge will be assessed on the total amount due at that time. These students will also have a hold placed on their registration until payment of the total amount due has been made.

Late Registration: Undergraduate students who do not complete their registration before the first day of classes are charged a $20 late registration fee. Graduate students who do not complete their registration before the first day of classes are charged a late registration fee of $20 during the first week of classes, $50 the second week of classes, and $100 the third week of classes or anytime later.

New Student Programs: A nonrefundable fee of $190 is assessed to all new degree-seeking undergraduates (including new direct from high school and new transfer students). The fee covers full costs associated with orientation and Destination Iowa State programming, including publications, mailings, programming, and student assistants who provide services to students and their families during orientation and Destination Iowa State.

Returned Check/Direct Debit Charge: This $30 fee is a charge against the person who writes a dishonored check or authorizes a direct debit to an account that has been closed or has insufficient funds.

Schedule Change: Starting the sixth day of classes a $10 fee is charged for course drops, additions, and section changes. One fee is assessed for multiple changes processed at the same time for the same term.

Senior: A $2 fee covers the cost of special senior activities. This fee is optional and is assessed spring term only.

Special Course: Some courses have expenses above the cost of tuition that enhance the instruction. These fees may cover the cost of field trips, use of equipment, materials or supplies, or professional support. Applicable special course fees are listed with the specific course in the Schedule of Classes available at http://classes.iastate.edu/. Special course fees also appear on each student's schedule detail available on AccessPlus.

Sponsored International Student: This fee is assessed to the sponsor of international students as a way to compensate for the special record keeping, billing requirements, correspondence, and the deferred payment option extended to sponsoring agencies. The current fee will be 5 percent of the total tuition charge billed the sponsor. In succeeding years, the fee may be raised after 90 days advance notice to the sponsoring agency.

Study Abroad: Tuition assessment for study abroad credits, up to a maximum of 12 credits, is above and beyond tuition for other courses taken during the same term.

Thesis Fee: This $100 nonrefundable fee is charged to any student who submits a master's degree thesis or doctoral dissertation to the Graduate College.

Transcript: Students may obtain an official transcript of their student academic record for $15. An additional $5 service charge for each transcript is assessed for same day service.

Workshops: The fee for one-credit workshops, with no other course enrollments, is $240 for undergraduate students and $374 for graduate students.

Fee Payment

The Accounts Receivable Office bills students for tuition, room, meal plan, and various other university charges. A statement of new charges is available on the first of each month on Access Plus and each student will receive an email message at that time at their Iowa State e-mail address telling them that their bill is available. It is the student's responsibility to ensure that the university has a correct e-mail address and to regularly check their Iowa State e-mail account. Students who do not receive a billing statement before the term begins or are unable to use AccessPlus to view their bill, should contact the Accounts Receivable Office to learn the amount of their account balance due. Failure to receive a billing statement or view their account on AccessPlus will not exempt students from late penalties or from having a hold placed on their registration. Payments for fall semester are due August 20. Payments for spring semester are due January 20. Payments for summer semester are due May 20.

Students may pay their university bill by direct debit through AccessPlus. They may also pay by mail by sending a check or money order (along with the bottom portion of the billing statement printed from AccessPlus) to Iowa State University, Treasurer's Office, 1220 Beardshear Hall, Ames, IA 50011-2044. Payments may also be made in person in the Treasurer's Office.

Deferred Payment

Each term, students who do not pay their first installment in full by the due date will automatically select the deferred option, and will be charged a $20 administrative fee.

University fees may be paid in three installments each academic term. Payments for fall semester will be due August 20, September 20, and October 20. Payments for spring semester will be due January 20, February 20, and March 20. Summer fees will be due May 20, June 20 and July 20.

Monthly Payment Plan

Under the Monthly Payment Plan, students pay the academic costs for fall and spring semesters in 12 installments beginning April 20 and ending the following March 20. A $50 enrollment fee is due with the first monthly payment. All payments are deducted from a designated bank account. For more information about the Monthly Payment Plan, contact the Accounts Receivable Office.

Past Due Accounts

If students have past due accounts receivable charges prior to the beginning of classes, they may be dropped from enrollment if these past due charges are not paid by the Friday before the first day of class. Students that are subject to being dropped will be notified via their Iowa State e-mail account.

Refunds

Refunds are available for students who cancel or withdraw their registration within the appropriate time period. To cancel their registration, students must notify the Office of the Registrar before the first day of the semester to avoid tuition assessment. Beginning on the first day of the semester, it will be necessary for students to formally withdraw from the university to terminate their registration. More information about canceling registration and withdrawing from classes can be found at www.iastate.edu/~registrar/registration/

Tuition adjustments for all students are made for withdrawals of registration according to the following schedule:

Withdrawal Date	Student Pays
Before first day of classes	0%
During class days 1-5	10%
During class days 6-10	25%
During class days 11-15	50%
During class days 16-20	75%
After the twentieth day of classes	100%

Students who wish to appeal tuition and fee assessment for withdrawals should contact the fees section of the Office of the Registrar. Decisions of the Office of the Registrar will be based on the existence of extenuating circumstances beyond the control of the student.

Students who wish to appeal the decision of the Office of the Registrar must do so in writing within 10 calendar days after receiving the decision. Such appeals will then be reviewed by the Tuition Appeals Review Committee. Students who wish to appeal the decision of the Tuition Appeals Review Committee may make a request to do so in writing to the Office of the Provost.

Fee refund for students with a reduction in credits below full-time:

100 percent if change is made during first two weeks. No adjustment is made after the second week. Prorated adjustments in the tuition adjustment schedule are made for summer session courses, or any courses which are less than one semester in length (79 days).

Workshop and Short Courses Refunds

Students who drop workshops or short courses of one or two weeks on or before the first class meeting receive a 100% tuition adjustment for the course. No tuition adjustment will be made after the first day of classes. Students who drop three-week courses receive a 100% adjustment if they drop on or before the first day of classes, a 90% adjustment if they drop on the second day of classes, and no adjustment after the second day of classes.

Student Financial Aid

The Office of Student Financial Aid helps families afford Iowa State University. Grants, scholarships, loans, and part-time employment opportunities are available to assist students and families in meeting their college expenses.

Eligibility for financial aid is determined by the Free Application for Federal Student Aid (FAFSA). Students can apply online at www.fafsa.ed.gov beginning January 1 for the coming academic year. Students should submit the FAFSA before to March 1 to receive consideration for most grants and scholarships. A new application must be completed each academic year.

The priority deadline for financial aid is March 1. Priority financial aid is awarded to eligible students who complete the FAFSA prior to March 1 each year. Students who apply after this date will be considered for the Federal Pell Grant and student loans. New students enrolling spring semester or summer session should complete the current year's aid application to apply for any available financial aid.

To be eligible for most financial aid programs, a student must be a U.S. citizen or permanent resident, enrolled at least half-time, and making satisfactory academic progress toward a degree.

Students may use their financial aid for study in other countries if they have clearance for the transfer of credit to their degree programs and have made financial aid arrangements prior to departure. For further information, contact the Study Abroad Center, 3224 Memorial Union, or the Office of Student Financial Aid, 0210 Beardshear Hall.

There are three general types of financial aid programs: gift aid (scholarships and grants), loans, and part-time employment. Laws, regulations, and policies governing these programs are subject to change.

I. Gift Aid

A. Scholarships

1. ISU Scholarships. Scholarships are awarded on the basis of achievement, although many also require demonstrated financial need. Find out more about scholarships at www.financialaid.iastate.edu.

2. Military Officer Education (ROTC) Scholarships:

   Army. The Military Science Department offers 2-, 3-, and 4-year Army ROTC scholarships to qualified students on a competitive basis in virtually any academic discipline. These scholarships provide monies for tuition, all required fees (except student health), books and supplies allowance, and a monthly cash subsistence allowance. For applications or additional information, contact the Military Science Department at 132 Armory or call 515-294-1852.

   Navy. The Naval Science Department offers several scholarship programs to qualified students. The scholarships cover payment of tuition, fees, books, and a monthly stipend. Information is available from the Naval Science Department, 3 Armory, or by calling 515-294-6050.

   Air Force. The Air Force offers Air Force ROTC scholarships for periods of 2, 3, or 4 years, with up to 1 additional year for qualified applicants in selected majors. The scholarships provide payment of tuition and fees. In addition, scholarship cadets receive between $250-$400 monthly subsistence allowance and $510 per year book allowance. Express scholarships are also available to students qualified in certain technical academic majors. Details on scholarship qualification, application procedures, and eligibility are available from the Department of Air Force Aerospace Studies, 515-294-1716.

3. Other Scholarship Sources: Students are encouraged to pursue scholarship opportunities from outside agencies and private organizations. Check the financial aid Web site for current postings and additional resources.

B. Grants

1. Federal Pell Grant. This federal grant is for undergraduates working toward their first bachelor's degree. The amount of Pell Grant is based on the Estimated Family Contribution (EFC) as calculated using a federal formula.

2. Federal Supplemental Educational Opportunity Grant. This federal grant is awarded to high-need students who also qualify for the Pell Grant. Students who file their FAFSA prior to March 1 are considered for this award.

3. ISU Grant. This university grant is for undergraduate students who show financial need. The FAFSA must be filed prior to March 1 to be considered for this award.

4. Academic Competitiveness Grant. This federal grant will provide up to $750 for the first year and up to $1300 for the second year of undergraduate study to students who are U.S. citizens, eligible for the Pell Grant, and have completed a rigorous high school program as determined by the student's state of residence.

5. SMART Grant: The National SMART Grant will provide up to $4000 for the third and fourth years of undergraduate study to students who are U.S. citizens, eligible for the Pell Grant, have a cumulative GPA of at least 3.00, and are enrolled in an eligible major.

6. Officer Education (ROTC) Financial Assistance Grants. All students enrolled in Advanced ROTC (third and fourth years) in the Army, Navy, and Air Force programs are provided a monthly stipend. For further information, contact the appropriate ROTC department in the Armory.

7. Tuition Assistance Grant for Undergraduate International Students. Undergraduate international students who have been at Iowa State University for at least a year and are faced with financial hardship resulting from unforeseen circumstances may apply for this grant. Apply via the International Students and Scholars Web site (www.iastate.edu/~internat_info).

8. International Student Financial Aid. International students raise money through cross-cultural activities toward a scholarship fund. These monies will be used to assist international students who have unforeseen financial emergencies. For further information, contact the International Student Council at www.stuorg.iastate.edu/isc/.

II. Loans

A. William D. Ford Federal Direct Loan Program. These student loans are obtained through the U.S. Department of Education by filing the FAFSA.

1. Federal Direct Subsidized Loan. The interest on this need-based loan is paid by the federal government as long as the student remains in school at least half-time. Borrower repayment and interest charges begin six months after graduation or less than half-time enrollment. The interest rate will range from 3.4% to 6.8% depending on the year in which the loan was borrowed.
2. Federal Direct Unsubsidized Stafford Loan. The interest on this non-need based loan is charged to the borrower from the time the loan is disbursed until paid in full. Interest may be paid while you are in school or added to the principal balance of the loan. Borrower repayment begins six months after graduation or less than half-time enrollment. The interest rate is fixed at 6.8%.

B. Federal Perkins Loan Program. The interest on this need-based loan is paid by the federal government as long as the student remains in school at least half-time. Borrower repayment and interest charges begin nine months after graduation or less than half-time enrollment. The interest rate is fixed at 5 percent.

C. Federal Health Professions Loans. This student loan is limited to students enrolled in the College of Veterinary Medicine. The FAFSA is required, and parental information must be provided, regardless of age or dependency of the student. The interest rate is fixed at 5 percent, and interest does not accrue while the student is enrolled full-time. Borrower repayment begins twelve months after graduation or less than half-time enrollment.

D. Federal Direct PLUS (Parent Loan for Undergraduate Students). This loan is for parents of a dependent student and the loan is subject to credit analysis. A parent may borrow up to the cost of attendance less any other financial aid. The interest rate is fixed at 7.9 percent. Interest on this loan is charged to the borrower from the time the loan is disbursed until paid in full. Borrower repayment begins 60 days after the loan has been disbursed in full unless the parent requests a deferment until after the student graduates. This loan is not need-based, and does not require filing the FAFSA.

E. Federal Direct PLUS Loan for Graduate & Professional Students (Vet Med). This loan is for Graduate and Professional Students (such as Vet Med students) and is subject to credit analysis. Students may borrow up to the cost of attendance less any other financial aid. The interest rate is fixed at 7.9 percent. Interest on this loan is charged to the borrower from the time the loan is disbursed until paid in full. Borrower repayment can be deferred as long as the student is enrolled at least half-time.

F. Private Loan Options. Private loans supplement the federal loan programs and are subject to credit analysis. These loan programs do not require filing the FAFSA.

III. Part-time Employment

There are many part-time employment opportunities available for students, both on campus and off campus. Students who secure part-time jobs gain valuable experience to aid in job placement after graduation. Part-time employment can also help reduce loan indebtedness.

A. Federal College Work-Study. Work-study positions provide hourly employment for students with financial need, as determined by filing the FAFSA. Students with work-study eligibility are able to view work-study positions on the Student Job Board on AccessPLUS.

B. Other Part-Time Employment. The Student Job Board on AccessPLUS lists positions which do not require filing the FAFSA. All students can view these listings for current job openings.

IV. Other Financial Aid

Many other forms of financial aid are available to students who qualify, including Vocational Rehabilitation, Veterans Benefits, and Department of Human Services programs. For further information on these programs, contact the appropriate government office.

Student Housing and Dining

Director of Residence: Pete Englin

Director of ISU Dining: Nancy Levandowski

Associate Directors:

Virginia Arthur (Residence Life)

Darryl Knight (Facilities Operations)

Jill Arroyo (Residential Dining)

Assistant Directors:

Karen Larson (Catering)

Kristi Patel (Retail Operations)

Lisa Ludovico (Residence)

Jamie Lenz (Food Stores / Vending)

The university provides housing for more than 8,000 students in on-campus residence halls and apartments. Housing is available for undergraduate and graduate students; single students and families.

Each student who accepts admission to the University is eligible to submit a housing contract. Acceptance of admission to the university is necessary before a housing contract will be accepted. Contracts can be submitted on-line using AccessPlus. Housing priority for new students is based upon the date the completed contract is received in the Department of Residence Administrative Services Office.

Questions and correspondence concerning on-campus housing and dining should be directed to the Department of Residence Administrative Services Office, 2419 Friley Hall, Iowa State University, Ames, Iowa 50012. E-mail: housing@iastate.edu. Phone: (800) 854-9050. Additional information may be obtained at http://housing.iastate.edu/.

Undergraduate Residence Halls

Most residence hall rooms are double occupancy; however, a limited number of triple and single occupancy rooms are also available. All rooms are furnished with extra-long twin beds and mattresses, closet or wardrobe, clothing drawers, desks and chairs, expanded basic cable and high-speed university Ethernet. Students provide their own bedding, towels, study lamps, etc. Students are responsible for cleaning their own rooms.

All students who live in an undergraduate residence hall are required to purchase one of seven convenient, flexible Weekly or Semester meal plans. Weekly plans range from seven to an unlimited number of meals allotted per week, while Semester plans include 175 or 225 meals allotted each semester. Weekly and Semester plans also include Dining Dollar$, a cash equivalent that can be used in all ISU Dining locations. Students can use their meals to eat in one of ISU Dining's "all-you-care-to-eat" dining centers or to purchase a meal bundle in one of ISU Dining's cafés, restaurants or dining centers.

All housing and dining contracts are for the full academic year, both fall and spring semesters, or the remainder thereof, if the contract is signed after fall semester begins. With the exception of Linden Hall, all undergraduate Residence Halls close during Winter Break. For a complete listing of rates, please visit the Department of Residence web site: http://housing.iastate.edu/rates/.

Housing and dining contracts are "academically friendly." Students who leave the University as the result of graduation, withdraw, dismissal or participation in a University approved study-abroad, internship, co-op, or student teaching program are eligible to cancel their contract without penalty. For reasons other than those listed, students who cancel their housing contract after the cancellation deadline (March 1 for current ISU students, May 1 for newly admitted ISU students) may be responsible for paying for 80 percent of the remaining value of their entire contract, both housing and dining. For additional information concerning the residence hall contract, students should contact the Administrative Services Office

In addition to the basic necessities, several special services are available for use by residents. These include house dens for informal get-togethers and relaxation; lounge areas for meeting and entertaining guests; vending areas for snacks; hall desks with recreation/entertainment items, recreational equipment, and mail delivery; laundry facilities; study areas; meeting rooms and offices for student organizations; computer labs; and parking lots assigned to the residence halls.

The residence halls are organized geographically into two neighborhoods: Richardson Court and Union Drive. The students in each of these neighborhoods elect a group of executive officers to be responsible for coordinating neighborhood events and activities. Each neighborhood funds and maintains a social program, an intramural program, and numerous committees that supplement the total social and educational development of the individual residents. The neighborhoods are joined in an Inter-Residence Hall Association (IRHA), with an all-residence hall parliament, which jointly sponsors Residence Hall Week, Free Friday Flicks, scholarships, leadership conferences, and more.

Each neighborhood is further organized into smaller living groups called houses. These houses of 40 to 60 residents are the foundation of Iowa State University's residence hall program. Members of the houses elect their own officers, and the majority of programs are planned on a house participation basis. Participation in the house program is a great way for students to receive full benefit from the residence hall experience.

Students may choose to live in single-gender or coed houses. Coed houses have male and female students living at opposite ends of the house or on separate levels of the house. They have separate bathroom facilities but share lounge facilities and house activities.

Residential Learning Communities, which bring together students with similar academic focus, are also available in the residence halls. These communities offer a collaborative living and learning environment, increased student/faculty interaction, social and academic networks essential to student success, and a sense of membership in the ISU community.

Currently, the following learning communities are available: ACES (Agriculture Community Encourages Success); ABE (Agricultural and Biosystems Engineering); BEST (Biology Education Success Team); BLT (Business Learning Teams); Chemical Engineering; Common Threads (Textiles and Clothing); CLUE (Community Learning for Undeclared Engineers); Computer Science; Design Exchange; Entrepreneurship and Innovation; FSHN (Food Science and Human Nutrition); Honors; LEAD (Leadership through Engineering Academic Diversity); NREM (Natural Resource Ecology and Management; and WiSE (Women in Science and Engineering). Theme houses are also available, including cross-cultural, Army ROTC, and Air Force ROTC. For the most up-to-date information on learning community opportunities at Iowa State, visit http://www.lc.iastate.edu/.

Upper-Division Residence Hall

Two residence halls, Buchanan Hall and Wallace Hall, offer the convenience of residence hall living with a more mature environment for older students. To be eligible to live in Buchanan or Wallace, students must minimally have sophomore classification or be at least 19 years of age. In Buchanan, two floors are reserved for students who are 21 years of age and older. There is no age requirement for students living on the Entrepreneurship and Innovation Learning Community floor in Buchanan.

Buchanan rooms offer a suite-style set-up with two rooms joined by a private bathroom. Double suites have a sink in each room and share a bathroom with the adjacent room that includes a toilet and shower. Single suites share a bathroom with the adjacent room that includes sink, toilet, and shower. Each room is furnished with a lofted bed, desk with bookcase and file, desk chair, wardrobe/dresser unit, expanded basic cable and high-speed university Ethernet. Student lounges and kitchenettes are available on most floors. Residents living in Buchanan must purchase a meal plan.

All Wallace rooms are super-singles. That is, a double-sized room furnished for and occupied by only one student. Each room is furnished

with a bed, desk, desk chair, futon, dresser, wardrobe, micro-fridge, expanded basic cable, and high-speed university Ethernet. Student lounges are available on each floor. Residents living in Wallace are not required to purchase a meal plan.

Both Buchanan and Wallace halls remain open during Winter Break at no additional charge. All Buchanan and Wallace hall contracts are for the full academic year, both fall and spring semesters, or the remainder thereof, if the contract is signed after fall semester begins. In Buchanan, summer contracts are also available. For a complete listing of rates, please visit the Department of Residence web site: http://housing.iastate.edu/rates/.

Undergraduate and Graduate Single Student Apartments

Apartments for single students are offered in two on-campus neighborhoods: Frederiksen Court and Schilletter and University Villages (SUV). To be eligible to live in these areas, students must minimally have sophomore classification or be at least 19 years of age. All Frederiksen Court and SUV contracts are for the full academic year, both fall and spring semesters, or the remainder thereof, if the contract is signed after fall semester begins. Both Frederiksen Court and SUV remain open during Winter Break at no additional charge. Summer contracts are also available in both locations. For a complete listing of rates, please visit the Department of Residence web site: http://housing.iastate.edu/rates/.

Frederiksen Court apartments accommodate four persons of the same gender in either two or four bedrooms. Each apartment is furnished with living room and bedroom furniture and the kitchen has a full-size refrigerator, stove, microwave, dishwasher and garbage disposal. A washer and dryer are also included in each apartment.

Rent, which is billed on a semester-basis, includes all utilities: electricity, water, garbage pickup, basic phone service, expanded basic cable, and high-speed university Ethernet.

The Frederiksen Court Community Center features meeting rooms and lounge space, a fitness center, business center and Hawthorn Market and & Café a retail dining facility that offers hot meals, snacks, beverages, and convenience items.

In SUV, single students typically live in University Village. All apartments contain two bedrooms, one bathroom, a living room, and a kitchen furnished with a cook top, oven, workspace, refrigerator, and sink. The majority of University Village apartments are unfurnished, but a limited number of furnished units are available.

Rent, which is billed monthly by the university, includes include expanded basic cable television, high-speed Internet connectivity, water, and garbage removal service. Residents pay for their own gas, electricity, and telephone.

The SUV Community Center features large meeting rooms and lounge space, a community kitchen and a computer lab.

Apartments for Families

Family Housing is available in the SUV area in Schilletter Village. Students must be married/domestic partners and/or have dependent children in order to be eligible for family housing.

All Schilletter Village contracts are for the full academic year, both fall and spring semesters, or the remainder thereof, if the contract is signed after fall semester begins. Schilletter Village remains open during Winter Break at no additional charge. Summer contracts are also available in both locations. For a complete listing of rates, please visit the Department of Residence web site: http://housing.iastate.edu/rates/.

All apartments contain two bedrooms, one bathroom, a living room, and a kitchen furnished with a cook top, oven, workspace, refrigerator, and sink. Students provide their own furniture and window coverings. Hook-ups for personal washer and dryer are available in the basement of each unit as are private, lockable storage closets.

Rent is billed monthly by the university. Rental rates include expanded basic cable television, high-speed Internet connectivity, water, and garbage removal service. Residents pay for their own gas, electricity, and telephone.

The SUV Community Center features large meeting rooms and lounge space, a community kitchen and a computer lab. The community also boasts a bike/walking path and several playgrounds.

Off-campus Housing for Students

Off-campus housing information may be obtained through real estate agents, local newspapers, or by contacting individual owners.

Dining Options for On- and Off-Campus Apartments

ISU Dining offers a variety of convenient, flexible meal plans to students who live in on-campus and off-campus apartments. Plans include traditional Weekly plans, ranging from seven to an unlimited number meals allotted per week, to Semester plans with 175 or 225 meals allotted each semester. Weekly and Semester plans also include Dining Dollar$, a cash equivalent that can be used in all ISU Dining locations. Students in non-meal plan required areas can also choose to purchase Meal Blocks (small allotments of meals without Dining Dollar$) or Dining Dollar$ only.

All dining contracts are for the full academic year, both fall and spring semesters, or the remainder thereof, if the contract is signed after fall semester begins. Summer contracts are also available. For a complete listing of meal plans and rates, please visit the ISU Dining http://www.dining.iastate.edu/. Questions and correspondence concerning meal plans should be directed to the Department of Residence Administrative Services Office, 2419 Friley Hall, Iowa State University, Ames, Iowa 50012. E-mail: housing@iastate.edu. Phone: (800) 854-9050. Additional information may be obtained at http://housing.iastate.edu/.

Fraternities and Sororities

Of the 50 fraternity and sorority chapters on the Iowa State University campus, 42 have chapter houses, and provide housing for about 1,800 undergraduate students. Eight multicultural Greek fraternities and sororities do not provide residential facilities for members, but are active in scholastic, service and social projects.

The chapter house facilities are similar to a private residence: living room, den, kitchen, dining room, laundry room, etc. The staff in the Office of Greek Affairs, a department in the Dean of Students Office, provide advising, programs, and services for the Greek chapters and organizations. Local alumni work with each fraternity and sorority to ensure that the chapter structure meets all the state and local building, safety, and fire codes that are required with incorporation under the State Law of Iowa.

The average cost of living in a fraternity or sorority chapter house ranges from $2,800-$3,400 per semester. The cost includes room, board, social expenses and membership dues.

Most men may move directly into a fraternity house at the beginning of an academic year if they pledge a chapter that has a house. Typically, they continue living there throughout their college years. Women pledging a sorority during formal recruitment or informally throughout the year generally live in the residence halls for the academic year. However, as space becomes available in a chapter house, sorority members often move into the house as sophomores or upper-class women.

Student Services

The University Library

Dean of the Library:

Olivia M. A. Madison, M.L.A.

General Information–(515)-294-3642

Library Hours–(515)-294-4849

The University Library provides a wide array of print, non-print, and electronic information resources, which are housed in the main Parks Library, the e-Library, the Veterinary Medical Library, and three subject-oriented reading rooms (design, mathematics, and physical sciences). The library's extensive collections support research and study for all ISU graduate programs, with the strongest support at the Ph.D. level. These collections are nationally recognized for their strengths in basic and applied fields of biological and physical sciences. Library holdings include more than 2,529,920 volumes and approximately 66,195 current serial titles.

The library encourages use of its collections and many services, and assistance is provided at five public service desks. These desks include the Learning Connections Center, Interlibrary Loan/Document Delivery, the Circulation Desk, the Media Center (incl. Maps, Media, Microforms, and Course Reserve collections), and Special Collections. In addition, instruction in the use of library resources is offered to graduate and undergraduate students.

The library's e-Library, accessed through the Internet, provides access to the local online catalog; online indexes; electronic journals and books; and selected Internet sites. Assistance in using this vast body of electronic resources is available at the Learning Connections Center, digital reference services, and through individually arranged appointments with reference librarians.

The Parks Library has a limited number of semiprivate study rooms available for faculty, graduate students, and professional and scientific staff. They are intended for research and other scholarly activities that require extensive use of library material. Normally, assignments are made for a semester at a time.

Student Answer Center

www.public.iastate.edu/~registrar/AnswerCenter/

Students who have questions but are not sure where to find an answer may contact the Student Answer Center located on the ground floor of Beardshear Hall. A staff member will answer campus-related questions on the spot or provide referrals to other university departments as needed. Information may include registration instruction, financial aid status, or classroom directions. Students can pick up forms, information brochures, campus maps, or use one of the computers to log on to AccessPlus or e-mail. Questions can be answered by email at answercenter@iastate.edu or by phone 515-294-4469 or online at: www.public.iastate.edu/~registrar/AnswerCenter/homepage.html

Student Counseling Service

Assistant Vice President and Director of Counseling: Terry W. Mason, Ph.D.

Associate Director: Joyce A. Davidson, Ph.D.

Professional Staff: Cara Armstrong, Ph.D.; Mark R. Becker, Ph.D.; Jonathan H. Brandon, Ph.D.; Janet A. Croyle, M.Ed.; Jeffrey K. Ellens, Ph.D.; Ronald A. Jackson, Ph.D.; Marty I. Martinez, Ph.D.; Martha S. Norton, M.S.; Erin L. Pederson, Ph.D.; Todd Pietruszka, Ph.D.; Michelle M. Roling, M.Ed.

The Student Counseling Service (SCS) assists students in enhancing their academic success and personal well-being with a staff of professional psychologists and counselors. Services are available to help students sort through their feelings, strengths, and options to develop new perspectives and coping skills.

Services include:

•One-on-one counseling for any issue of personal concern, such as depression, anxiety, stress management, relationship issues, identity issues, and other forms of personal challenge. Students may also receive therapeutic services to deal with more severe mental health issues.

•Couples counseling for ISU students and their partners during times of relationship difficulty.

•Eating disorders assessment and treatment for students concerned with eating or body image issues. Students receiving treatment for eating disorders might also work with physicians, nutritionists, and personal trainers as their needs require.

•Substance abuse assessments to help students determine the nature and extent of their alcohol or other drug use and the impact of this use on their well being. Counselors offer recommendations and referrals for any concerns identified through the assessment.

•Career counseling to assist students having difficulty choosing a major or making decisions about their future after college.

•Group counseling is offered to facilitate personal growth and social skills learning. A list of the current semester's groups is available on the SCS web site.

•A variety of outreach programs are also available.

Counseling services are offered at no cost to ISU students. However, a nominal fee for testing may be required. Nominal fees are also charged for uncancelled missed appointments. Counseling is strictly confidential. SCS staff will not release any information to anyone outside of the Student Counseling Service without the written permission of the client unless an imminent harm condition exists.

In addition to providing counseling and outreach services to students, SCS provides training and consultation to faculty and staff to assist them in addressing the psychological needs of students.

SCS hours are Monday through Friday 8 a.m. - 5 p.m. The Student Counseling Service phone number is 515-294-5056.

Thielen Student Health Center

Interim Director: Penni McKinley, R.N., B.A.

Providers: Robin Engstrom, M.D.; Rebecca Fritzsche, M.D.; Malhar Gore, M.D.; Scott Meyer, M.D.; Pauline Miller, M.D.; Robert Nathanson, M.D.; Carver Nebbe, M.D.; Maria Pringle, ARNP; Mary S. Raman, ARNP; Cosette Scallon, M.D.; Marc Shulman, M.D.; Lee Wilkins, M.D.

Thielen Student Health Center is located on the corner of Sheldon Avenue and Union Drive, just west of Beyer Hall. Services include physician, nurse practitioner and nurse consultations, physical exams, laboratory and x-ray services, sports medicine and physical therapy, immunizations, pharmacy, diet and nutrition consultation, fitness consultation, stress management, smoking cessation, workshops, free and confidential HIV testing, and referral services.

The student health fee partially finances the services of the Thielen Student Health Center and is charged to all students taking 5 or more credits each semester. Those taking 4 or fewer credits may access services by paying the health fee. Spouses/domestic partners of students who opt to pay the health fee also have access to services. Students with less than 5 credits who elect not to pay the health fee may still be seen at the Thielen Student Health Center, but will be charged for the services provided. International students are required to pay the health fee. The health fee is not a substitute for health insurance.

Clinic hours:

Monday, 8 a.m.-6 p.m.
Tuesday, Thursday and Friday, 8 a.m.-5 p.m.
Wednesday, 9 a.m.-5 p.m.
Saturday, 9 a.m.-12 noon.

Hours vary during breaks and summer session. The Thielen Student Health Center is closed during all University Holidays. Patients are seen by appointment. Please call 515-294-5801. Each patient has the option of seeing the provider he/she requests.

Thielen Student Health Center phones are automatically switched to the First Nurse at Mary Greeley Medical Center so urgent health questions can be answered during the hours the Thielen Student Health Center is closed.

Service is available for urgent or emergency problems after regular clinic hours at McFarland Urgent Care Clinic or Mary Greeley Medical Center Emergency Room. The cost is the responsibility of the student and/or the student's insurance plan.

Career Services Offices

Agriculture and Life Sciences:
141 Curtiss Hall
Business: 1320 Gerdin Business Building
Design: 297 College of Design
Engineering: 308 Marston Hall
Graduate Business/MBA:
1360 Gerdin Business Building
Human Sciences: E105 Lagomarcino Hall
Liberal Arts and Sciences: 351 Catt Hall
Veterinary Medicine: 2270A Veterinary Medicine Complex

Career Services is a coordinated network of career services offices offering a broad range of programs and services for undergraduate, professional, and graduate students, faculty, staff, alumni, and employers. These services include career exploration, career development, experiential learning, and professional career search assistance programs. The goal is to provide constituents with life-long skills to assist with career development and exploration.

A broad range of programs and services are offered including online registration, position listing and interview scheduling; résumé referral; coordination of co-op and internship programs; workshops and seminars on career exploration, résumé preparation, letter writing, job search techniques, interview skills, applying to graduate and professional schools, and adjusting to the first job.

Each year career services sponsors multiple career fairs, which bring to the ISU campus hundreds of employers. The career services offices also coordinate on-campus interview opportunities. Each college career services office serves as a point of entry for students, alumni, and employers to the entire ISU network of coordinated, decentralized career services.

In addition to the college-based career services offices, the Career Exploration Service provides a variety of services to students who are unsure about their major or future career path. Students can work one-on-one with a trained career counselor, use the many books and electronic resources in the Career Exploration Center, or enroll in LAS 104, Personal Career Choice. All services are free for students and confidential.

Additional information on career services is available at www.career.iastate.edu.

Child Care

Child Care Administration, a unit of Human Resource Services, supports Iowa State University families by linking them with programs and services that can help meet their child care needs. The university child care coordinator is available to assist families in accessing services available both on the campus and in the community.

Child care programs located on campus include:

• Center for Child Care Resources: Assistance in locating campus and community child care services, 100 University Village, Suite 1010, 515-294-8833 or 1-800-437-8599

• University Community Childcare, Family Resource Center, 100 University Village, 515-294-9838

• The Comfort Zone: Childcare for kids who don't feel so good, 100 University Village, 515-294-3333.

• Flex-Care: Part time care for children of ISU students, 100 University Village, 515-294-9838.

• University Child Care Center at Veterinary Medicine, 1700 Christensen Drive, 515-294-2273.

• ISU Child Development Laboratory School, Palmer HDFS Building, 515-294-3040.

For more information about child care options, contact the university child care coordinator at 515-294-8827.

International Students and Scholars

http://www.isso.iastate.edu

Director: James Dorsett

Coordinator of Administration: Deborah Vance

Program Coordinators: Virginia McCallum, Dilok Phanchantraurai, Ali Soltanshahi, Becky Zama

Program Assistant: Arlis Penner

Systems Analyst: David Morgan

Administrative Specialist: Lana Seiler

International Students and Scholars Office (ISSO) is committed to providing courteous, accurate, timely service and informative programs for international students, visiting scholars, faculty, staff, and citizens of Iowa interested in international education and exchange. ISSO staff members orient and advise international students and scholars on university procedures, community resources, U.S. visa issues, and nonacademic personal concerns. ISSO intercultural programs, such as the Culture Corps, Friendships International, Conversational English Program and activities developed with the International Student Council and dozens of international student organizations, bring international students and Americans together for mutual learning. We welcome volunteers to join these and other programs.

Dean of Students Office

Dean of Students:
Dione Somerville, Ed.D.

Academic Success Center
Associate Dean of Students and Director:
Mary Jo Gonzales, Ph.D

Interim Assistant Director: Craig Chaitrand M.A.

Coordinator, Learning Enhancement:
Jill Kramer, M.Ed.

Coordinator, Supplemental Instruction:
Craig Zywicki, M.A.

Greek Affairs
Assistant Dean of Students and Director:
Jenn Plagman-Galvin, M.P.A.

Hixson Opportunity Awards
Director: Debra Sanborn, M.A.

Judicial Affairs
Assistant Dean of Students and Director:
Michelle Boettcher, M.Ed.
Assistant Director: Sara Kellogg, M.S.

Multicultural Student Affairs
Assistant Dean of Students and Director:
Santos Nunez, Ph.D.

Program Assistants: Carmen Flagge, B.S., Richard Barjas, M.P.A., Lynn Lundy Evans, B.S.

Lesbian, Gay, Bisexual, and Transgender Student Services
Director: Brad Freihoefer, B.A.

Margaret Sloss Women's Center
Director: Penny Rice, M.S.

National Student Exchange
Director: Debra Sanborn, M.A.

Parents Association
Interim Coordinator: Laura Lascio, M.A.

Recreation Services
Director: Mike Harvey, M.S.
Associate Director: Scott White, M.S.
Associate Director: Garry Greenlee, M.S.
Coordinator, Intramural Sports:
Linda Marticke, M.S.: Randy Heimerman, M.Ed.
Coordinator, Fitness Programs: Nora Hudson, M.S.
Coordinator, Sports Clubs: TBA
Coordinator, Outdoor Recreation Center and Programs: Jerry Rupert, M.S.
Assistant Coordinator, Outdoor Recreation Center and Programs: Chad Ward, B.A.
Coordinator, Facility Operations: Doug Arrowsmith, M.S.
Administrative Specialist: Pamela Lyon, B.A.
Program Assistant II, Facility Operations:
Andy Laughlin, B.A.

Student Assistance and Outreach Services
Interim Coordinator: Laura Lascio, M.A.

Student Disability Resources
Director: Steve Moats, M.A.
Assistant Director: John Hirshman, M.A., Ed.S

Student Legal Services
Student Legal Adviser: Paul Johnson, J.D., Michael Levine, J.D.

Student Support Services Program -
Director: Japannah Kellogg, M.S.
Program Assistant: Kim Everett, M.S., Zach Wiser, M.A.

Vocational Rehabilitation –
Counselor: Lynette Plander
Rehabilitation Assistant: Kristi Frohwein,

www.dso.iastate.edu/
The Dean of Students Office (DSO) provides a wide array of services and programs that enhance each student's education at Iowa State University. DSO departments are located in numerous locations on the ISU campus. The mission of the Dean of Students Office is to enhance the quality of life of ISU students by supporting the university's commitment to the academic success and holistic development of each individual student.

The DSO coordinates a variety of services that are each distinct and different, but nonetheless similar in their orientation toward maximizing students' educational opportunities and challenging students intellectually, physically, and socially.

Academic Success Center

www.dso.iastate.edu/asc
1060 Hixson-Lied Student Success Center
(515) 294-6624; TTY (515) 294-6635

The Academic Success Center (ASC) encompasses several academic assistance programs. The services available at the ASC include the following: resources for students with disabilities (see Disability Resources); course-specific Tutoring Services and Supplemental Instruction; general assistance through the Learning Lab, individual consultation for those with needs related to study skills/time management; and a one-credit study skills class (Psychology 131). All programs are focused on helping students learn how to learn and achieve their academic goals.

Tutoring Services' mission is to enhance academic growth and success. Tutoring is the process by which students can get more individualized instruction for undergraduate courses offered at ISU. Staff members recruit and screen tutors, schedule convenient times to meet, collect fees, and pay tutors.

Supplemental Instruction (SI) is a free academic assistance program for difficult selected 100 and 200 level courses. Peer SI leaders who have demonstrated competence in the course attend classes and conduct biweekly sessions to help students learn and study the course material. A complete schedule can be viewed online.

The Learning Lab is a "learning how to learn" center. A service to students, the Learning Lab helps them with tips on how to succeed in the classroom. The Learning Lab is staffed by academic consultants who work with students to pinpoint areas in their study strategies that might need improvement.

Psychology 131, a one-credit study skills course, addresses academic success strategies as well as a variety of reading and study strategies and tactics from time management to test taking. It is offered each semester. Class size is limited to allow for group interaction as well as individual attention.

Greek Affairs

www.greek.iastate.edu
B0355 Memorial Union
(515) 294-1023

Greek Affairs provides advising, consultation, and educational services to the fraternities and sororities at ISU. Professional staff and graduate assistants work with student leaders, members, and chapter advisers to provide support to the chapters and to advise Collegiate Panhellenic Council, Interfraternity Council, National Pan-Hellenic Council, Multicultural Greek Council, Greek Week, Fall/Spring Blood Drives, Order of Omega, Junior Greek Council, and other student organizations and activities affiliated with the Greek Community.

Fraternities and sororities have been active at ISU since 1875. The over 50 fraternities and sororities at ISU have more than 2,000 student members and represent about 11 percent of the undergraduate student population. The Greek Affairs staff and local alumni work with each fraternity and sorority to ensure that the chapter is meeting the educational objectives of the university, their national affiliations and the developmental needs of the students.

Hixson Opportunity Awards

www.dso.iastate.edu/hixson
1080 Hixson-Lied Student Success Center (515) 294-6479

The activities and programs offered to Hixson Scholars are designed to promote the retention and success of these students. These programs and resources aim to develop a community of students and friends within the larger Iowa State community. Programs include the Hixson Seminar (University Studies 111), Hixson News (a monthly newsletter), monthly activities, community service, Hixson Mentors, and the Hixson Leadership Seminars (University Studies 311 & 312).

Judicial Affairs

www.dso.iastate.edu/ja
1010 Student Services Building
(515) 294-1021

The Office of Judicial Affairs is responsible for the university's Centralized Judicial System. Representatives from the Office of Judicial Affairs interpret university policies and conduct student disciplinary hearings for academic and nonacademic violations of the Iowa State University Student Disciplinary Regulations. As members of the ISU community, all students have certain rights and responsibilities. When an alleged violation of the Student Disciplinary Regulations occurs, a representative from the Office of Judicial Affairs investigates the complaint, interprets general university regulations and guidelines, conducts student discipline hearings which ensure the standards of due process, and consults with faculty, staff, and students regarding student conduct issues.

Student discipline hearings are conducted in accordance with the rules and regulations as set forth in university policies and procedures. Disciplinary hearings are administered by a member of the Judicial Affairs staff, the All Greek Judicial board, or by members of the All-University Judiciary (AUJ) committee. The Office of Judicial Affairs serves as a resource for anyone with questions regarding a student conduct issue.

Lesbian, Gay, Bisexual and Transgender Student Services

www.dso.iastate.edu/lgbtss
1034 Student Services Building
(515) 294-5433
lgbtss@iastate.edu

Lesbian, Gay, Bisexual, & Transgender Student Services (LGBTSS) is a resource center for all members of the university community to learn more about aspects of sexual identity and gender identity/expression. LGBTSS is committed to providing information and education that enhances the educational experience and overall quality of student life on the ISU campus. LGBTSS strives to increase the awareness of Lesbian, Gay, Bisexual, Transgender, Queer, and Ally (LGBTQA) issues on campus by providing a safe space, as well as informational and educational programming, resources, and support services. Our vision is to promote a welcoming and inclusive campus climate for LGBTQA persons and their allies and to eliminate homophobia, heterosexism, and sexism at Iowa State University.

LGBTSS services and programs include:

Speaker's Bureau – Panel discussion presentations where LGBTQA people and allies share their own experiences and present on a vast array of LGBTQA issues.

Safe Zone Program – Initiative to increase the visibility of allies on our campus. Displaying a safe zone symbol sends an important message of a willingness and commitment to provide an atmosphere of acceptance, understanding, and support to the LGBTQA community at ISU.

Library – Information center with over 1,000 resources (non-fiction & fiction books, magazines, videos, and magazines) available for confidential checkout.

Support Groups – Ongoing, confidential, peer-facilitated groups designed to provide a safe, supportive place for talking about important issues.

Referrals – Contact information available for various campus and community resources for personal, legal, health services.

Celebration Events – Programs where we recognize the accomplishments of LGBTQA campus members. The Small Victories Celebration takes place early in the spring semester and Lavender Graduation is in May.

Margaret Sloss Women's Center

www.dso.iastate.edu/mswc
Sloss House
(515) 294-4154

The Margaret Sloss Women's Center promotes the educational, personal, and career development of all women in the ISU/Ames community. Along with other departments, the Women's Center shares the university's responsibility of creating a safe and supportive environment for all individuals. The purpose of the Women's Center is to promote and sustain women through assistance, programs, and information and referral services.

The Women's Center provides:

- Assistance and support for women who work toward making change, on both personal and institutional levels.
- A safe space for women to meet, study, eat, network, discuss, find support, watch a video or just relax.
- A clearinghouse of information including a lending library, resource files, a calendar of events, and a variety of videos and audio tapes.
- Educational programming that focuses on helping students, staff, and faculty thrive in an academic environment by motivating them toward a greater understanding of, and involvement with, gender issues. Educational programs presented in residence halls, departments and organizations include workshops on a variety of topics.
- Coordination and co-sponsorship of special events including Women's Week, National Coming Out Days, Sexual Assault Awareness

Month, and Women's History Month. Throughout the year, the Women's Center also sponsors a number of speakers on current issues, hosts conferences, and coordinates support and discussion groups.

• A place to gain experience and/or credit as a journalism or design intern, practicum student, student programmer, board member, or volunteer.

Other services include an electronic breast pump, lockers to rent, free condoms, meeting space for campus and community organizations, kitchen facilities, a TV and VCR.

Multicultural Student Affairs (MSA)

www.dso.iastate.edu/msa
2080 Student Services Building
(515) 294-6338

Multicultural Student Affairs was established to assist the university in keeping its commitment to equal educational opportunity. The mission of MSA is to provide and share leadership in the holistic development of African American, Latino/a-Hispanic, Asian American/Pacific Islander, and American Indian/Alaskan Native students. In supporting university spirit and commitment to a high quality of life, academic success and graduation of all Iowa State University students, MSA is dedicated to collaboration with all university departments, offices, and related organizations in the delivery of programs and services that respond to the ever changing needs of all students.
MSA staff work closely with all units of the university to achieve the following objectives:
• Increase the number of students of color entering and graduating from ISU.
• Ensure access, choice, and persistence with all departments and organizations interested in the growth and development of students of color.
• Maintain liaison and coordinate programs with all departments and organizations interested in the growth and development of students of color.
• Develop students for a future beyond their undergraduate college experience – professionally, intellectually and culturally.
• Provide leadership for diversity awareness education regarding race and ethnicity.
These objectives assist in the achievement of the Office of Multicultural Student Affairs' mission. This is accomplished through the following services and programs:
• Academic Program for Excellence (APEX)
• Carver Academy Program
• George Washington Carver Scholarship
• Multicultural Vision Program (MVP) Scholarship
• MSA Emergency Loan Program
• MSA Tutoring
• First Year Student of Color Experience programming
• Race Relations programming

National Student Exchange (NSE)

www.dso.iastate.edu/nse
1080 Hixson-Lied Student Success Center (515) 294-6479

Since 1968, National Student Exchange has offered students a domestic alternative to study abroad. What began with three campuses exchanging seven students is now 190 universities placing 4000 students a year. Iowa State University is pleased to offer exchanges in this program.

Since its founding, more than 80,000 students have participated in NSE. The National Student Exchange was founded as a counterpart to study abroad programs, recognizing that not every student is seeking a study opportunity outside the United States. NSE offers low-cost options for ISU students to study out-of-state, at culturally diverse campuses, with program compatibility to our campus.

Features of the National Student Exchange include:

• Access to additional courses and programs

• Exchange among university honors programs

• Multicultural opportunities

• Resident assistant exchange options

• Credits applied toward degree

• Tuition reciprocity across the United States

Exchange features and requirements:

• NSE campuses in 48 states, three U.S. territories, and six Canadian provinces

• Duration of exchange can range from one semester to one calendar year

• Exchanges can occur in different academic and calendar years

• Students must be full-time during application and exchange

• GPA of 2.5 on a 4.00 scale required

Parents Association (ISUPA)

www.dso.iastate.edu/pa
1010 Student Services Building
(515) 294-6054

All parents of Iowa State University undergraduate students are automatically considered members of the ISU Parents' Association. The ISUPA serves as a link between the university and parents and families. Its mission is to serve and inform parents and to enhance the quality of student life at ISU.

There are no membership fees collected by the ISUPA. It is funded exclusively by contributions and fundraisers, such as the annual tuition raffle. The ISUPA Board of Directors, along with members of the Dean of Students Office staff, sponsors programs which include:

• Family Handbook, which is distributed to parents of all new ISU students at June orientation

• Parents' Advisory Line (PAL), 1-800-772-8546, a toll free assistance line for families

• Parent Calling Project, a phone-a-thon to parents of new ISU students each fall

• Cyclone Family Weekend, the university's premiere event for families largely funded by the ISUPA

• Involvement in ISU Admissions events

Parents interested in volunteering on the ISUPA Board of Directors can find the application form at the ISUPA web site.

Recreation Services

www.recservices.iastate.edu
2220 State Gymnasium
(515) 294-4980

Recreation Services is dedicated to the provision of quality recreational opportunities for the campus community. Programs include intramural sports, sport clubs, informal recreation, outdoor recreation, special events, fitness programs, and recreation facility management. Assistance for other recreational services is provided.

The Informal Recreation program includes the opportunity for recreational sports activity in Beyer Hall, State Gymnasium, Forker Building (east campus), Lied Recreation/Athletic Center, outdoor tennis courts near the Forker Building, recreation fields east of the Towers and Maple-Willow-Larch Residence Halls, and the Southeast Field Complex east of the football stadium. Two regulation golf holes north of the Armory are open for ISU recreation golf use at no charge. The Ames/ISU Ice Arena is also available for drop in open skating or organized events.

The Group Fitness program provides nearly 60 classes per week for staying fit. The types of aerobics classes available include: high/low impact, step, toning and aqua. We also offer personal trainers for those that would like to have one-on-one assistance with their workout. The Rec Milers Program is designed to help students stay interested and involved in a regular exercise program. Participants have the flexibility to choose their own activities and can exercise at their own pace and convenience. Participants keep track of their recreational mileage for each month. To get mileage credit, progress slips must be deposited in the Rec Miler's boxes at the Recreation Services Office, 2220 State Gym, or at the Lied Recreation/Athletic Facility. Monthly totals for each participant are posted at State Gym. Participants may earn awards for specific milestones. Aerobic activities for Rec Miler credit include: bike, walk, basketball, handball, cross country skiing, stationary bike, fitness class, jump rope, soccer, jog/run, swim, racquetball and tennis.

The Outdoor Recreation program is composed of four basic elements: the camping-outdoor equipment checkout program; the organized trip program; basic instruction activity workshops; the Resource Center and Library. All of these programs and activities are designed to provide opportunities for natural environment experiences.

The Sports Club program is designed to serve individual interests in different sports club activities and is student-oriented in every aspect. Sports clubs offer team or individual recreational opportunities. Following are the sports clubs: archery, badminton, ballroom dance, baseball, bowling, boxing, canoe and kayak, cycling, equestrian, fencing, flying, hapkido, hockey, judo, karate, kum do, lacrosse, motorcycle, mountaineering/rock climbing, paintball, pool, racquetball, rifle and pistol, rodeo, roller hockey, rugby, running, sailing, scuba, shotokan karate, ski and snowboard, skydivers, soccer, table tennis, tae-kwon-do, tennis, trap and skeet, triathlon, ultimate frisbee, unicycle, volleyball, water polo, water ski and weightlifting.

These clubs offer instruction and competition at the local and intercollegiate levels. The club members set dues, and most clubs receive financial subsidy from the Government of the Student Body to enable students to participate regardless of their financial situation.

The Intramural Sports program involves competition among participants who enter as teams or individuals and play according to specific schedules. There are more than 50 intramural sport activities ranging from football to inner tube water basketball and curling. Activities include men's, women's and co-rec divisions. Numerous special events add spice to the recreation program. These activities are of an endless variety and usually take place in a short time span. In general, they encompass demonstrations, performances, special contests, mass group participation, social occasions, excursions, displays, or special instruction.

Other physical, cultural, and social recreation programs are sponsored in coordination with various departments, organizations, and groups on and off campus. Contact us for more information.

Student Assistance and Outreach Services

www.dso.iastate.edu/sa
1010 Student Services Building
(515) 294-1020

Student Assistance Services (SAS) staff members provide guidance for students who are dealing with issues that affect their personal, academic, and family lives. They help students understand university policies and navigate processes and procedures on campus in order to enhance their academic experience at ISU.

Consultation and assistance is provided with concern for each student's personal well being and educational objectives. SAS staff members coordinate the notification of faculty members for students who miss classes due to emergencies. They also advise students who wish to file formal academic grievances. SAS staff members work closely with ISU faculty and staff to identify the best possible options for ISU students who are seeking to help themselves. Personalized referrals to other University resources and services are used to provide proactive and comprehensive assistance to students.

Student Disability Resources (SDR)

www.dso.iastate.edu/dr
1076 Student Services Building
(515) 294-7220; TTY (515) 294-6635

Staff members in the Student Disability Resources office coordinate support services that students may need in order to reach their fullest academic potential. SDR staff members coordinate accommodations and serve as a resource within the university community concerning students who have qualifying disabilities. SDR provides assistance, information, support, counseling, education, referral, and promotes disability awareness in students, faculty, staff, the Ames community, and the state of Iowa.

Student Legal Services

www.dso.iastate.edu/sls
B0367 Memorial Union
(515) 294-0978

Funded entirely by the Government of the Student Body, Student Legal Services (SLS) is a legal aid office for students currently enrolled at Iowa State University and registered Iowa State University student groups. It is staffed by two attorneys who advise and often represent students in a variety of cases and are available for consultation with respect to most legal concerns.

The types of cases most often handled include:

- Family Law and Divorce
- Criminal Law
- Landlord - Tenant Problems
- Off-campus Employment Problems
- Consumer Issues
- Administrative Issues
- Notary Services

The services of SLS are available to students and registered Iowa State University student groups free of charge. Students must pay their own court costs and any out of pocket expenses.

SLS cannot represent students in fee generating cases, controversies involving student vs. student or student vs. ISU, ISU student judicial matters and generally does not handle felony defense or cases involving excessive time. However, consultation with an attorney regarding these matters is available.

Student Support Services Program

www.dso.iastate.edu/sssp
2010 Student Services Building
(515) 294-0210

Student Support Services Program (SSSP), a federally funded program, provides academic support to eligible students and is designed to increase the retention and graduation rates of low-income individuals who are first-generation college students or individuals with disabilities. The needs of the students who are accepted into SSSP are thoroughly assessed through testing and counseling. SSSP participants receive personal and career counseling, along with academic advice, tutoring, and assistance in receiving financial aid.

Participants in SSSP are encouraged to work with an SSSP student mentor to become acclimated to the ISU environment. These relationships also encourage participants to fully access ISU resources. Study skills improvement sessions and basic skills instruction are provided in the areas of math and writing. In addition, cultural enrichment (i.e. theatre, dance, and musical events) and educational activities (leadership conferences, graduate/professional, etc.) are planned. These services are provided free of charge to eligible students after they are accepted into the program.

Vocational Rehabilitation

www.dso.iastate.edu/vr
1045 Student Services Building
(515) 294-5059

The State of Iowa Division of Vocational Rehabilitation Services Office provides services to students who based on medical documentation, have a disability and it is a substantial impediment to employment. Rehabilitation services may include the following: medical assessment; vocational evaluation; counseling and guidance; special adaptive equipment or devices; financial assistance toward training; and job placement assistance. No direct fees are charged, but there may be some costs through involvement with services.

Student Activities and Honor Societies

Memorial Union Activities and Services

The Memorial Union is an historic building that is regarded as the heart of campus life and the center of informal education at Iowa State University.

515-296-6848; www.mu.iastate.edu

Arts, Entertainment, Recreation:

- Underground (bowling, billiards, video arcade, Nintendo Wii)
- Maintenance Shop: live music
- Student Union Board: weekly films, comedy, hypnotists, special events, much more
- Art exhibits and art-for-rent
- Workspace (art and crafts classes for fun, studios for work in wood, photo, pottery; button maker, screen printing, die cut machine)
- Big screen TVs; pianos to play
- Lectures

Student Organizations

- Student organization offices and meeting space; recognition process.

Dining & Shopping

- Food Court & MU Market & Café
- University Book Store

Study Spots

- Browsing Library & Computer Lab; Chapel; Multicultural Center
- Lounges: Main, West, Pride, Commons & more

Services

- Hotel, meeting rooms, catering
- Parking ramp
- Copy Center
- Soults Family Visitor Center
- ATMs, Ticket Office, Lockers
- U.S. Post Office – full service
- Student Legal Service

Distinctive Feature

- Gold Star Hall, an active memorial to Iowa State service personnel lost in the nation's conflicts

Student Activities Center

Director of Student Activities
George Micalone

Coordinator for Leadership and Service
Jennifer Garrett

Coordinator for Art Programs
Letitia Kenemer

Coordinator for Entertainment Programs
Steven Satterlee

Underground Recreation Center Manager
Doug Swanson

The Student Activities Center (SAC) in the Memorial Union is committed to helping students learn inside and outside the classroom by offering countless ways to get involved at Iowa State through leadership, service, arts, entertainment and recreation activities.

The Student Activities Center includes: the Workspace (arts studio), the Maintenance Shop (entertainment venue), the Underground (recreation center/ bowling alley), leadership and service programs, art galleries in the MU, and management of the recognition of over 700 campus and student organizations. For a complete list of recognized organizations visit www.stuorg.iastate.edu.

The staff provides assistance to student and campus organization leaders, members and advisers on an individual or group basis. This office produces Newsline, an online newsletter distributed twice a month to officers and advisers of recognized student and campus organizations. Available on the SAC website are resources for student and campus organizations including the event authorization process, publicity and promotion ideas, constitution writing guidelines, and officer transition information. The Student Activities Center offers a 1-credit course called Leadership ISU where students learn leadership skills through a series of activities and seminars.

Annual SAC events include: ClubFest I & II (organization involvement fair), WelcomeFest (Ames and ISU opportunity fair), Coach Talks (hear from Men's and Women's head basketball coaches), Iowa State Leadership Experience (one-day leadership conference), Social Justice Summit, and Winterfest (celebration of all things winter). Student Activities Center staff advise key student organizations including: Student Union Board, Dance Marathon, Freshmen Council, Student Volunteer Services, The 10,000 Hours Show, and VEISHEA.

More information is available at the Student Activities Center, located in the East Student Office Space in the Memorial Union (across from the Food Court); online at www.sac.iastate.edu; or by calling (515) 294-8081.

Lectures

http://www.lectures.iastate.edu/

Throughout the academic year, the Committee on Lectures brings to the campus a number of speakers eminent in national and international affairs, the sciences, and the arts. In addition to giving formal lectures, a number of these speakers meet with students informally for discussions. Through these lectures and discussions the students are given a well-rounded presentation on subjects and areas affecting their culture, educational and economic philosophy, and scientific development. Past speakers include scholars E.O. Wilson and Stephen J. Gould; activists Gloria Steinem and Anita Hill; actor and comedian Bill Cosby; poet Maya Angelou; and astronaut Sally Ride.

The Institute on World Affairs is an annual series of speakers and on a topic of international interest held in the fall. Spring semester, the Institute on National Affairs is held with a topic of national concern as its focus. Focus, an annual fine arts festival with emphasis on student creativity in the arts, is held in the spring. The Committee on Lectures also sponsors or co-sponsors dramatic, dance, and musical events.

Students are encouraged to contact the lectures program office and become involved in the planning of these events.

Motor Vehicles and Bicycles

Students are permitted to own and operate motor vehicles - automobiles, motor scooters, and motorcycles. However, motor vehicles are in no way necessary for an Iowa State University student. Iowa State University is primarily a pedestrian campus. Those who operate a motor vehicle or bicycle on campus must abide by the rather extensive traffic and parking regulations. Fines are levied for infractions of these regulations. All motor vehicles and bicycles owned or operated by students on university property must be registered with the Parking Division Office located in the Armory. Copies of the traffic and parking regulations also are available at this office or online at http://www.dps.iastate.edu/parking/.

Honor Societies

Honor societies at Iowa State University provide opportunities for students who excel in the classroom and want to network with others in their major. Below is a list of honor societies followed by a brief description.

Members of these honor societies are eligible for transcript recognition through the Office of the Registrar. More information, including the complete list of honor societies, can be found on the student organization database at www.stuorg.iastate.edu.

Alpha Epsilon—Agricultural Engineering
The purpose is to promote the high ideals of the engineering profession, to give recognition to those agricultural engineers who manifest worthy qualities of character, scholarship, and professional attainment, and to encourage and support such improvements in the agricultural engineering profession that make it an instrument of greater service to humanity. Membership is based on scholarship, leadership, and character.

Alpha Kappa Delta—Sociology
Members share interest in the field of sociology, research of social problems, and such other social and intellectual activities as will lead to improvement in the human condition.

Alpha Lambda Delta/Phi Eta Sigma — Freshmen
First-year students who achieve at least a 3.5 GPA for one or more semesters their first year may be members of these national honor societies. These societies encourage superior scholastic attainment among students in their first year at institutions of higher education.

Alpha Pi Mu—Industrial Engineering
Members are chosen for character, achievement, and scholarship in industrial engineering. The group provides social and educational interaction for industrial engineering.

Alpha Upsilon Alpha—Education
An educational honorary, this group recognizes and encourages scholarship and leadership in the field of reading.

Alpha Zeta—Agriculture
Members must have completed three semesters of study in the College of Agriculture and Life Sciences or Veterinary Medicine and be in the upper two-fifths of their class. Meetings are held to foster high standards of scholarship, character, and leadership. Alpha Zeta sponsors lectures, service projects, and promotes the agricultural programs at ISU.

Beta Alpha Psi – Accounting
A national honorary for students in accounting, Beta Alpha Psi recognizes academic excellence and complements members' formal education by providing interaction between students, faculty, and professionals, and fosters lifelong growth, service and ethical conduct.

Beta Beta Beta Biological Honor Society
A national organization for students in the biological sciences with a purpose to recognize undergraduates with exceptional scholarship, leadership and character.

Beta Gamma Sigma
An honor society for collegiate schools of business, Beta Gamma Sigma recognizes high academic achievement.

Cardinal Key—Senior Leadership
The Senior Honor Society of Cardinal Key recognizes those persons who have been outstanding leaders in college life, who have rendered noteworthy service to Iowa State University, who are of high moral character, and who rank high scholastically. Members are selected by application and interview.

Chi Epsilon—Civil Engineering
The purpose of this honorary is to develop the profession of civil engineering through the interaction of members, fellow civil engineering students, and faculty. Scholarship, character, practicality, and sociability are the fundamental requirements for membership.

Epsilon Pi Tau—Education in Technology
Members are selected from the upper one-fourth of the juniors, seniors, and graduate students in industrial technology. The group strives to promote skill, social and professional efficiency, and research.

Eta Kappa Nu—Electrical and Computer Engineering
An International Honor Society for primarily juniors and seniors, as well as graduate students and professional engineers. The organization recognizes scholarship, personal character, useful voluntary services, and distinguished accomplishments. It assists its members throughout their lives in becoming better professionals and citizens.

Gamma Sigma Delta—Agriculture
The honorary encourages a high degree of excellence in the practice of agricultural pursuits and encourages high standards of scholarship in all branches of agricultural science and education. Membership includes junior and senior students, graduate students, faculty, and alumni.

Golden Key—All University
A national nonprofit academic honors organization, Golden Key is dedicated to recognizing and encouraging scholastic achievement in all undergraduate fields of study and to uniting collegiate faculty and administrators.

Kappa Delta Pi—Education
In an effort to promote excellence in and recognize outstanding contributions to education, Kappa Delta Pi maintains a high degree of professional fellowship among its members, quickens professional growth, and honors achievement in educational work. Membership invitations are extended to second semester sophomores, juniors, and seniors with a GPA of 3.25 or above.

Kappa Omicron Nu, Gamma Chapter
Objectives of the honor society are to promote graduate study and research, and to stimulate scholarship and leadership toward the well-being of individuals and families throughout the world. Top 10 percent of junior and top 20 percent of senior students maintaining at least a B average, and outstanding graduate students in family and consumer sciences, are eligible for selection. Research within the college is shared at monthly meetings.

Kappa Tau Alpha—Journalism
Kappa Tau Alpha is the national society dedicated to the recognition and promotion of scholarship in the field of journalism. Members are selected from the upper 10 percent of the senior class. Graduate students and faculty who qualify are also eligible for membership.

Mortar Board
Members are recognized for superior academic achievement and community service.

National Society of Collegiate Scholars
The purpose is to recognize and celebrate high achievement in all academic disciplines, to provide opportunities for personal growth and leadership development, and to organize and encourage learning opportunities through community service.

Omega Chi Epsilon—Chemical Engineering
Membership is open to chemical engineering juniors in the top 20 percent of their class, or seniors in the top 30 percent. The purpose is recognition and promotion of high scholarship, original investigation, and professional service in chemical engineering.

Order of Omega—Fraternity and Sorority Honorary
A national Greek honorary, the Order of Omega was founded at Iowa State in 1957. Criteria for membership include character; scholarship; leadership; service to the individual chapter, the Greek system, the university, and the Ames community. Membership is limited to junior and senior students who comprise one percent of the Greek population.

Phi Alpha Theta—History
Students who have a B average in at least 15 hours of history are eligible for membership. The local branch sponsors social activities, co-sponsors prizes for undergraduate essays in history, and encourages students' participation in state wide, regional, and national Phi Alpha Theta conferences.

Phi Beta Delta, Alpha Delta Chapter
The honor society recognizes and encourages high professional, intellectual and personal achievements in the field of international education.

Phi Beta Kappa—Liberal Arts and Sciences
Phi Beta Kappa is a national honorary society, founded in 1776 "to recognize and encourage scholarship, friendship, and cultural interests." Membership is by invitation to students enrolled in the LAS curriculum. To be eligible, juniors must have at least a 3.80 cumulative grade point average and seniors, at least a 3.60 average. Other criteria for membership include requirements in the mathematical disciplines and a foreign language.

Phi Kappa Phi—All University
This national honor society recognizes and encourages superior scholarship in all academic disciplines. Membership is open to qualified undergraduates and graduates by invitation and occasionally to faculty and alumni.

Phi Upsilon Omicron—Family and Consumer Sciences
Members are selected from junior and senior family and consumer sciences students who have demonstrated academic excellence and professional leadership qualities. Membership is a means of furthering professional goals. Outstanding graduate students are also eligible for selection.

Pi Mu Epsilon—Mathematics
Pi Mu Epsilon is the national mathematics honorary society whose purpose is the promotion of scholarly activity in mathematics among students and staff. Members are students and faculty who have completed at least two years of college-level mathematics with honor (at least 3.33 GPA) and have maintained an overall GPA of at least 3.0.

Pi Sigma Alpha—Political Science
Pi Sigma Alpha is the national honor political science honor society.

Pi Tau Sigma—Mechanical Engineering
Members are juniors and seniors in the upper ranks of their classes in mechanical engineering. Meetings and social functions are held to recognize and encourage outstanding scholastic achievement.

Psi Chi—Psychology
This national honor society in psychology recognizes and honors individuals maintaining high scholarship and documented interest in psychology.

Sigma Delta Pi—Spanish

Honor society for high-achieving students of the Spanish language at Iowa State University.

Sigma Gamma Tau—Aerospace Engineering
Sigma Gamma Tau is the national honorary for aerospace-aeronautical engineering students who have displayed outstanding scholarship, leadership, and personal characteristics. Members are selected from the upper fourth of the junior class and upper third of the senior class who have maintained a 3.00 or better cumulative grade point average.

Sigma Lambda Chi—Construction Engineering
The purpose is the recognition of outstanding students in construction engineering. Upperclass students in construction engineering may be initiated into the society providing they have an overall scholastic average in the upper 20 percent of their class.

Sigma Phi Omega, chapter Alpha Omega—Gerontology
National academic honor and professional society that recognizes excellence in the study of gerontology/aging, and serves as a link between gerontology educators, alumni, and local professionals. The mission of SPO is to promote scholarship, professionalism, friendship, and services to older persons, and to recognize exemplary attainment in gerontology/aging studies and related fields.

Sigma Tau Delta—English
An international English honor society, the purpose of this honorary is to confer distinction upon outstanding students of the English language and literature in undergraduate, graduate, and professional studies.

Sigma Xi—Research
Sigma Xi, the scientific research society, is a broad-based scientific honor society with over 500 chapters and clubs at universities and nonacademic scientific institutions. Sigma Xi awards associate membership to undergraduates and graduate students who have demonstrated research potential through participation in an original scientific research activity. Full membership in Sigma Xi recognizes a significant scientific research contribution.

Tau Beta Pi—Engineering
Tau Beta Pi honors engineering undergraduates, graduate students, and outstanding alumni who have distinguished themselves in scholarship and by exemplary character. Members are selected from engineering juniors in the upper eighth and seniors and graduate students in the upper fifth of their classes.

Upsilon Pi Epsilon—Computer Science
An honor society for computer science students.

Xi Sigma Pi—Forestry
An honor society that recognizes outstanding juniors, seniors, graduate students and faculty members in forestry. The objective is to encourage high professional standards in the profession of forestry and to promote fraternal relationships among foresters.

Distance Education

Iowa State University remains true to the land-grant tradition of extending knowledge far beyond campus borders. Faculty members provide cutting-edge information that helps people continue to learn and meet the demands of careers and society. Annually thousands of students enroll in Iowa State courses without setting foot in Ames. In addition to the traditional method of instructors traveling to classrooms off campus, Iowa State University faculty teach distance learning courses online, by video conferencing, streaming media, CD, and on the Iowa Communications Network (ICN).

Courses are the same as those offered on campus, carry residential credit, and are taught by Iowa State faculty. Credit earned becomes a part of the academic record at Iowa State University and may be used to meet degree requirements the same as credit earned on campus.

College distance education staff provides leadership in helping faculty identify the needs of Iowans and methods to reach adult learners. They also help students access services and information at the university.

For a list of courses and programs, visit www.distance.iastate.edu. Information on registering for distance education courses is available from the web site or from the Office of Registrar at 515-294-1889 (8am-4pm CT).

Certificate and Degree Programs Offered through Distance Education

College of Agriculture and Life Sciences

The College of Agriculture and Life Sciences Distance Education at Iowa State University provides the flexibility to enhance your career through online learning. Online courses and graduate programs allow you to remain at your present job and location while continuing your education and advancing in your field. You learn at a premier university from the most respected professors in their field through web-based interaction, streaming media or CD-ROM.

For more information contact College of Agriculture and Life Sciences distance education staff by email at agdecontact@iastate.edu or call (515)294-7656 or (800) 747-4478.

Master of Agriculture

via Web-based interaction, streaming media or CD-ROM

This program is the oldest on-line degree program in the College of Agriculture and Life Sciences. The goal of this program is to prepare individuals for proactive roles in addressing and responding to personal, professional, and societal issues and challenges in a changing food, agriculture and natural resources system through education and outreach in public and private agencies, and through training and development in business and industry. The intent of the program is to enable individuals to grow and develop as professionals, positioning themselves for emerging opportunities within or outside of their current employment.

This is a broad-based agricultural degree which includes courses in animal sciences, plant sciences, agricultural economics, agricultural education, research design or statistics, and sociology. Up to 10 credits may be transferred into the program. The degree is 32 credits including a creative component project.

Students are accepted from any part of the United States and Canada. Call (800) 747-4478 to learn more.

For more information contact:

Wade Miller, Professor & Coordinator of PROAG Program

Department of Agricultural Education and Studies

217 Curtiss Hall, Iowa State University, Ames, Iowa 50011

(515) 294-0895 or
e-mail: wwmiller@iastate.edu

Master of Science in Agricultural Education

via Web-based interaction, streaming media or CD-ROM

The program can be completed completely at a distance as there are no required on-campus courses or meetings. The program is designed for agriculture teachers in secondary and post-secondary settings, extension professionals, educators in public and private settings, and agricultural communicators. The flexibility of the program makes it possible for working professionals to obtain a master's while continuing to meet personal and professional responsibilities.

The curriculum is 30 semester hours and is flexible allowing you to create a program best suited to your needs, interests, and aspirations. You may choose to earn a specialization in agricultural extension education. Fifteen credits of required courses include: Foundations of Agricultural Education (AgEdS 550), Program Development and Evaluation in Agricultural and Extension Education (AgEdS 524), Introduction to Learning Theory in Agricultural Education (AgEdS 533), Instructional Methods for Adult and Higher Education in Agriculture and Natural Resources (AgEdS 520), and Introduction to Research in Agricultural Education (AgEdS 510). The curriculum also includes 13 credits of electives, 2 credits of creative component, and a final oral examination. Up to 8 credits may be transferred from another university. A thesis option is available if you wish to pursue a Ph.D. or a research-oriented career.

Students are accepted from any part of the United States and Canada. Call (800) 747-4478 to learn more about the program.

For more information contact:

Greg Miller, Professor & Director of Graduate Education

Department of Agricultural Education and Studies

201Curtiss Hall, Iowa State University, Ames, Iowa 50011

(515) 294-2583 or
e-mail: gsmiller@iastate.edu

Master of Science in Agronomy

via Web-based interaction, streaming media or CD-ROM

Designed for professionals who are working in industry and government. The degree ensures you have an advanced knowledge of agronomic systems and superior problem-solving skills. The program emphasizes practical, professional, and technical skills involved in crop management, soil and water management, and integrated pest management.

The curriculum consists of 12 courses plus a one-credit workshop and a three-credit creative component, for a total of 40 credits. The workshop is the only course that requires attendance on campus—three or four days one summer. The course prerequisites for admission to the program are limited to fundamental agriculture courses, recognizing that many potential students will not have majored in agronomy as undergraduates.

Generally, students who have completed a degree from a College of Agriculture and Life Sciences will meet the requirements. Call (866) MSAGRON to learn more about the program.

For more information contact:

Jesse Drew, Department of Agronomy

2206 Agronomy, Iowa State University, Ames, Iowa 50011

(515) 294-2999 or e-mail: jd250@iastate.edu

Graduate Certificate in Food Safety and Defense

via Web-based interaction, streaming media or CD/DVD-ROM

The Food Safety & Defense Graduate Certificate Program is an inter-institutional certificate program offered in cooperation with Kansas State University Food Science Institute, University of Nebraska-Lincoln Food Science, and University of Missouri Food Science programs. These universities have established a multi-state agricultural consortium to develop and deliver high-priority collaborative distance education programs in the food and agricultural sciences. To find out more information about the online community development master's degree program, please visit www.fshn.hs.iastate.edu/grad/foodsafetycert.php.

For more information contact:

Suzanne Hendrich, Professor

220 MacKay, Iowa State University, Ames, Iowa 50011

(515) 294-4272 or
e-mail: shendric@iastate.edu

College of Engineering

Engineering Distance Education (EDE) and the College of Engineering have provided distance education since 1968. In 1969, Iowa State University received the National Extension Program Award for pioneering video based continuing education to working engineers. EDE offers streaming media based educational content accessible to anyone with a computer and connection to the Internet. For more information, send an e-mail to ede@iastate.edu or call (515) 294-7470 or (800) 854-1675.

Master of Science in Computer Engineering or Electrical Engineering

via streaming media

Study topics of emerging research and interest. Areas of emphases include communications and signal processing, computing and networking systems, electric power and energy systems, secure and reliable computing, software systems, and advanced materials and electronics. Each master's program totals 30 graduate credits; a thesis or non-thesis option may be selected.

Graduate Certificate in Environmental Engineering

via streaming media

Environmental engineering is a rapidly growing field. Graduate courses in the certificate program help practicing professionals update and acquire new skills. The technology-based studies prepare engineers for the challenges posed by an expanding industrial base and help ensure sustainable agricultural practices and quality municipal services.

The curriculum explores the theory of environmental chemistry and biotechnology, methodologies of environmental engineering, and applies conceptual and technical knowledge to real-world applications. The certificate is 12 credits including four courses and a seminar program. Seminar program can be substituted for an approved program of conference attendance and presenting a paper or seminar. For more information, send an email to leeuwen@iastate.edu or call 515-294-5251.

Master of Engineering in Industrial Engineering

via streaming media

The industrial engineering program combines engineering and business considerations. Engineers learn advanced concepts, theories, and methods for the design and analysis of complex systems. The program focuses on fundamental issues that relate directly to the economic health of industry; namely productivity, cost, quality, and lead time. Areas of specialization available by distance learning are applied operations research, enterprise informatics, advanced manufacturing, and ergonomics. The degree is 30 credits of coursework.

Master of Science in Mechanical Engineering

via streaming media

The mechanical engineering graduate program offers internationally acclaimed research programs in biological and nanoscale sciences, clean energy technologies, complex fluid systems, design and manufacturing innovation, and simulation and visualization. A student may apply instrumentation design of experiments, and computational methods to any of these areas. The program is 30 credits and has a thesis and non-thesis option

Our research and graduate programs are built upon a strong foundation comprising the core of mechanical engineering– thermal-fluid sciences, design and manufacturing, materials and mechanics, dynamic systems, and control. Our faculty members are experienced researchers and educators who are grounded in these fundamental disciplines and focused on solving timely problems that address important national global societal needs.

Graduate Certificate in Power Systems Engineering

via streaming media

Iowa State University has a long-standing international reputation for education and research in electric power engineering. The electrical and computer engineering department designed the 12-credit graduate certificate for power engineering specialists in government, private sector, and academia.

Upon completion of the program, power engineering specialists will be proficient in theory and modeling plus have the tools to perform engineering tasks related to planning and operating electric power generation, transmission, and distribution systems, plus knowledge of related public policy.

Master of Engineering in Systems Engineering

via streaming media

The systems engineering program develops the management capabilities needed in today's work environment. Engineers, regardless of undergraduate discipline, develop the analytical abilities needed to design, evaluate, and build complex systems involving many components and demanding specifications. The degree is 30 credits, typically including 24 credits of engineering courses distributed among three broad groups (systems engineering core courses, elective engineering courses, and area of specialization courses), and 6 credits of elective non-engineering courses.

Graduate Certificate in Systems Engineering

via streaming media

Certificate in Systems Engineering: The systems engineering certificate program develops the management capabilities needed in today's work environment. Engineers, regardless of undergraduate discipline, develop the analytical abilities needed to design, evaluate, and build complex systems involving many components and demanding specifications. The certificate is 13 credits consisting of two basic courses in systems engineering, a course in requirements development, a course in project management and a one-credit capstone project.

Master of Science in Civil Engineering specializing in Construction Engineering and Management

via streaming media

Construction Engineering and Management specialty provides a unique blend of technical and management education that will help you solve problems and compete in the ever-changing construction environment. The program focuses on the three functional areas of construction engineering and management: management techniques, construction operations, and construction methods.

The degree requires thirty credits. Fifteen credits are selected from the construction engineering and management specialty. With the remaining credits, students may explore related engineering, business, architecture and planning topics. Students will execute a two to four credit creative component related to their professional interest. Up to nine credits may be transferred with approval of the students plan of study committee.

College of Human Sciences

Master of Education or Science Principal licensure

Preparation for Leadership (PreLEAD) via a combination of methods at various sites around the state with some work online and via the Iowa Communications Network (ICN)

A master's program of 36 credits leads to licensing as a school administrator. Courses are structured to build leadership skills in organizational processes, scope and framework of schools, and interpersonal dimensions. Students are paired with practicing administrators, experiencing leadership roles firsthand. For more information, send an e-mail to educadmin@iastate.edu or call (515) 294-9734.

Doctor of Philosophy Superintendent licensure (Certificate of Advanced Studies)

via a combination including online, the Iowa Communications Network (ICN) and video conferencing

A post master's curriculum of 30 credits provides training for the school superintendent license. The program emphasizes leadership skills, child and adolescent development, curriculum and instruction, school law and ethics, resource management, community relationships, and data-driven decision making. For more information, send an e-mail to educadmin@iastate.edu or call (515) 294-9734.

Master of Education with specialization in curriculum and instructional technology
via blend of online and on campus

Designed to meet the needs of K-12 teachers and other educational practitioners, the three-year program is 32 credits offered in a learning community environment. The program is designed for those who want to earn a master's and are seeking leadership positions for infusing technology into teaching and learning environments. For more information, send an e-mail to citmed@iastate.edu or call (515) 294-5926.

Master of Family and Consumer Sciences
online

Delivered off-campus since 1994, the non-thesis master's is designed for working professionals to enhance skills in a current position and increase chances for promotion. The comprehensive degree requires a minimum of 18-21 credits from two or more family and consumer sciences departments. With electives, the degree program totals 36 credits. For more information, send an e-mail to mfcsinfo@iastate.edu or call (515) 294-0211 or (877) 891-5349.

Master of Family and Consumer Sciences with specialization in Dietetics
online

Dietetics is the study of nutrition and how food impacts our health and well-being. Dietitians work in a variety of settings including hospitals, businesses, community health and wellness areas.

The program is inter-institutional and is designed for the Registered Dietitian. Topics include nutrition across the lifespan, nutrigenomics, medical nutrition therapy, business and management, and professional leadership. The 36-credit master's program includes 15 elective credits to tailor the program. For more information, send an e-mail to mfcsinfo@iastate.edu or call (515) 294-5186 or (877) 891-5349.

Master of Family and Consumer Sciences with specialization in family financial planning

Graduate Certificate in Family Financial Planning
online

Financial planners are increasingly in demand as Americans seek help managing their income, assets, and debts. Iowa State joined other universities to create an inter-institutional program. After being admitted to one of the participating universities, students take online courses from all the universities.

Courses cover financial counseling, personal taxation, insurance, retirement planning, and employee benefits. The non-thesis program is 42-credits. The graduate certificate is 18 credits. Completing either the master's or the certificate meets the educational requirements for the Certified Financial Planner™ examination. For more information, send an e-mail to mfcsinfo@iastate.edu or call (515) 294-2731 or (877) 891-5349.

Master of Family and Consumer Sciences with specialization in gerontology

Graduate Certificate in Gerontology
online

Gerontology is the multidisciplinary study of the aging processes and individuals as they grow from middle age through later life. People enter gerontology from many areas such as social work, nursing, counseling, recreation, public policy, long-term care administration, medicine, architecture, psychology, adult education, and rehabilitation therapy.

The program is inter-institutional. Topics include adult development, family relations, economics and public policy, environmental considerations, and health and nutrition. The 36-credit master's program includes 12 elective credits to tailor the program. The certificate is 21 credits. For more information, send an e-mail to mfcsinfo@iastate.edu or call (515) 294-5186 or (877) 891-5349.

Leadership Academies
via blend of online and several intensive summer weeks on campus

Master of Science or Master of Education or Doctor of Philosophy in Family and Consumer Sciences Education
The leadership academy for a longstanding, prestigious graduate program was begun in 2002. Visiting professors from across North America teach. Either master's degree is 30 credits. The doctorate is 72 credits. For more information, send an e-mail to haus@iastate.edu or call (515) 294-5307 or (877) 891-5349.

Doctor of Philosophy in Foodservice and Lodging Management
The Child Nutrition Program Leadership Academy is a new delivery format for the longstanding and prestigious graduate program in Foodservice and Lodging Management (formerly Hotel, Restaurant, and Institution Management). The Leadership Academy is designed to meet the needs of professionals employed in the school foodservice industry. The doctorate is 78 credits; up to 30 credits may be accepted from a master's degree.

For more information, send an e-mail to jsneed@iastate.edu or call (515) 294-8474.

College of Business
Master of Business Administration in Des Moines
Students progress through the core curriculum in a cohort, allowing camaraderie with colleagues from a variety of businesses and industries.

The program is 48 credits. The first four semesters help build a strong foundation of core business knowledge; the final four semesters are tailored to academic and career goals.

Students may concentrate on a general management MBA or specialize in finance, information systems, or marketing. A double degree, MBA and Master of Science in Information Systems, is also offered. For more information, send an e-mail to busgrad@iastate.edu or call (515) 294-8118 or (877) 478-4622.

College of Liberal Arts and Sciences
Bachelor of Liberal Studies
via a combination of distance learning options

The Bachelor of Liberal Studies (BLS) is a general studies degree in the liberal arts. It provides the flexibility to choose courses based on interests and goals. Course work is selected from three of the following five distribution areas: humanities, communications and arts, natural sciences and mathematical disciplines, social sciences, and professional fields.

The BLS degree is offered with similar requirements by all three Iowa public universities, and provides a framework to assemble the educational opportunities locally available. Up to three-fourths of the degree requirements may be transferred from accredited institutions. For more information, send an e-mail to las@iastate.edu or call (515) 294-4831.

Master of Public Administration

Graduate Certificate of Public Management
via web conferencing and streaming media

Prepare for public service leadership in public administration, whether with government, nonprofit agencies, or private organizations working with governments. The public administration programs are designed to prepare or improve the performance level of mid-career public managers and administrators.

Iowa State's Master of Public Administration is accredited by the National Association of Schools of Public Affairs and Administration. This degree program requires 37 credits. Select an area of concentration from e-Government and management of information technology, public management, and policy analysis. The certificate requires 15 graduate credits. For more information, send an e-mail to mpa@iastate.edu or call (515) 294-3764.

Master of School Mathematics
via distance learning

This program, administered by the Department of Mathematics, is designed for secondary mathematics teachers. The degree is built on three objectives: enhanced knowledge of algebra, geometry, calculus, statistics, and discrete mathematics; effective strategies for creating a student-centered classroom emphasizing problem solving; and computing technology in learning and teaching mathematics.

The program requires 33 credits and includes a creative component. For more information, send an e-mail to msm@math.iastate.edu or call (515) 294-0393.

Master of Science in Statistics
via distance learning

The Department of Statistics offers courses and the degree to employees of companies who sign a letter of agreement with Iowa State. The degree is the same as on campus; the program requirements are the same including the written master's exam, creative component, and a final oral exam. For more information, send an e-mail to statistics@iastate.edu or call (515) 294-3440.

Interdisciplinary – Multiple Colleges

Graduate Certificate in Biorenewable Resources

via streaming media

Through a series of twelve credit hours of graduate coursework, the Biorenewable Resources and Technology certificate will offer students from a wide variety of science and engineering backgrounds an exposure to advanced study in the use of plant- and crop-based resources for the production of biobased products, including fuels, chemicals, materials, and energy. The program aims to train professionals to serve the emerging bioeconomy, and in so doing to serve state, national, and global needs in moving toward a more sustainable industrial economy.

Coordinated by College of Engineering; For more information, send an e-mail to ede@iastate.edu or call (515) 294-7470 or (800) 854-1675.

Master of Science in Biorenewable Resources

via streaming media

Iowa State University recently established the first graduate program in biorenewable resources and technology in the United States; and is happy to announce that the Masters Program is now 100% online! The Biorenewable Resources and Technology program offers students from a wide variety of science and engineering backgrounds advanced study in the use of plant- and crop-based resources for the production of biobased products, including fuels, chemicals, materials, and energy.

Coordinated by College of Engineering; For more information, send an e-mail to ede@iastate.edu or call (515) 294-7470 or (800) 854-1675.

Graduate Certificate in Human Computer Interaction

via streaming media

Human computer interaction is the interdisciplinary study of the relationship between humans and increasingly powerful, yet portable computers. The accelerating integration of technology into every aspect of society demands professionals who employ novel solutions needed to integrate usefulness and usability while minimizing intrusiveness.

The curriculum in human computer interaction provides an understanding of emerging interface technologies; explores human cognition, behavioral methods, and usability techniques; and highlights the latest research. The interdisciplinary program draws courses from industrial, computer, and mechanical engineering; psychology; computer science; and management information systems among other disciplines. The certificate program is 12 credits, which includes four graduate courses.

Coordinated by College of Engineering; For more information, send an e-mail to ede@iastate.edu or call (515) 294-7470 or (800) 854-1675.

Master of Science in Human Computer Interaction

via streaming media

The accelerating integration of technology into every aspect of society will demand professionals trained with information technology skills that are augmented by an understanding of the human user. This interdisciplinary degree program was created from the growing demand from business and industry for a masters program that provides education in the field of Human Computer Interaction. The curriculum in human computer interaction is very flexible. Students are required to take three core courses and elective courses from disciplines of their interest. The program consists of 27 credits of coursework plus 3 credit Capstone Course. The Capstone Course project will use the knowledge gained from the course work to demonstrate that the student has mastered important HCI related skills.

Coordinated by College of Engineering; For more information, send an e-mail to ede@iastate.edu or call (515) 294-7470 or (800) 854-1675.

Master of Science in Information Assurance

Graduate Certificate in Information Assurance

via streaming media

Faculty members from six academic departments contribute to securing information in application areas ranging from software to networks to electronic democracy. Computer engineering is the home department for the distance learning graduate programs which meet the needs of information system security specialists in government, the private sector, and educational institutions. The master's program is 30 credits. The certificate is four computer engineering courses.

Coordinated by College of Engineering; For more information, send an e-mail to ede@iastate.edu or call (515) 294-7470 or (800) 854-1675.

Master of Science in Interdisciplinary Studies, Community Development specialization

via Web-based interaction, streaming media or CD/DVD-ROM

Global economic restructuring and the devolution of government services have created significant challenges for communities, particularly those in rural areas. This specialization in community development provides the skills, information, and networks to facilitate sustainable and prosperous community change. The program is designed for those seeking a career in community development and practitioners who wish to augment their training.

In 2005 Iowa State joined five other universities to offer a master's in community development. The 36-credit program has three tracks: natural resource management, working with native communities, and building economic capacity.

Coordinated by the College of Agriculture and Life Sciences.

For more information contact:

Cornelia Flora, Professor
107 Curtiss Hall, Iowa State University
Ames, Iowa 50011

(515) 294-1329 or e-mail: cflora@iastate.edu

Master of Science in Seed Technology and Business

via Web-based interaction, streaming media or CD-ROM

The program is specifically oriented to prepare students for management roles. Designed for professionals working in industry and government, the degree ensures an advanced knowledge of seed science, technology and basic business and problem-solving skills. It emphasizes decision making for application to practical and technical issues in all aspects of the seed business.

The curriculum consists of 15 courses and a three or four-credit creative component. The program is a non-thesis degree. The admission requirements are a four year degree in either agriculture or business; graduation in the top quarter of your class; and GRE (Q) 570 or better, GRE (V) 500 or better or GMAT 570 or better. Appropriate four year degrees in biological sciences or related fields may also be accepted.

Coordinated by the College of Agriculture and Life Sciences.

For more information:

Paul Christensen, Manager Seed Technology and Business Program
102a Seed Science Building
Iowa State University,
Ames, Iowa 50011-3228
(515) 294-8745 or
e-mail: seedsci@iastate.edu

Continuing Education and Professional Development

The mission of Continuing Education and Professional Development (CEPD) is to provide high-quality continuing education and lifelong learning opportunities for professional development, personal enrichment, career transitions, and academic growth.

CEPD supports Iowa State University's outreach mission and to facilitate access to excellence in education for a diverse community of adult learners within Iowa and beyond by utilizing technologies that expand access.

CEPD offers both Continuing Education Units (CEUs) and non-CEU courses, workshops, conferences and other educational activities sponsored by Iowa State University. While these programs do not carry academic credits, they are designed to ensure that a student's continuing education and professional needs are met.

For a list of courses and programs, or to request specific courses and programs, visit cepd.iastate.edu, or call (515) 294-6222. Information also is available at the Iowa State University Extension offices across the state.

Research and Extension

Research

Research is an important activity at Iowa State University. Faculty members engage in research pursuits as well as teaching. Graduate students, and in some cases undergraduates, play an active part in this search for new knowledge.

Support for research at Iowa State University comes from state and federal appropriations as well as from contracts and grants involving the federal government and nonfederal organizations. As part of its total program, the university also operates extension services, special laboratories, centers, and institutes.

Official Research, Outreach, and/or Instructional Centers and Institutes at ISU as Recognized by the Board of Regents, State of Iowa, are listed at http://www.vpresearch.iastate.edu/docs/centers.pdf. Additional information concerning any of these organizations and student research opportunities they support may be obtained from their administrative offices.

Iowa State University Extension

Iowa State University Extension builds partnerships and provides research-based learning opportunities to improve quality of life in Iowa. ISU Extension continues to lead the university-wide effort to engage Iowans with education and information about their issues and priorities for healthy people, healthy environments, and healthy economies

Iowa State University is the state's land-grant institution with the mission of creating, sharing, and applying knowledge. Historically, ISU Extension has led the university in its formal engagement mission to Iowans. With an active partnership and presence in every county, ISU Extension engages the people of Iowa with education and information in the following areas:

Agriculture and Natural Resources. ISU Extension provides unbiased, research-based information and education to agricultural professionals to grow the economic base of Iowa agriculture.

Business and Industry. Extension's Center for industrial Research and Service (CIRAS) enhances the performance of Iowa business and industry through research, education, and technical assistance.

Community and Economic Development. ISU Extension helps organizations and local governments make Iowa communities better places to live and work, with programs and services in community leadership, management, and policy and design development.

Families. ISU Extension reaches out to families across the lifespan, providing research-based information and education to help families make decisions that improve and transform their lives.

4-H Youth Development. ISU Extension helps kids and teens develop communication skills, give back to their communities, and learn to be leaders for Iowa's future.

Continuing and Distance Education. Through Continuing Education and Professional Development (CEPD), ISU Extension provides high-quality continuing education and lifelong learning opportunities for professional development, personal enrichment, career transitions, and academic growth.

Academic Life

Academic Advising

Academic advising is an intentional, collaborative relationship based on trust and mutual respect that promotes the student's development of competence, autonomy, and sound decision making skills. Adviser-student interactions are grounded in teaching and learning and are vital in promoting student growth and personal development through learning, discovery, and engagement. Academic advising supports the mission of the University.

Academic Advising Process

All undergraduate students are assigned an academic adviser based on their major/ curriculum. A new adviser assignment is made when a student changes majors/curricula. Advisers serve as a primary resource for students, connecting them with the wide variety of services and academic opportunities available to them. The advising experience begins during the prospective student stage and continues through graduation. The goal of academic advising is an individualized academic experience for each student developed through a mentoring relationship.

Academic Advising Responsibilities

A successful academic advising relationship involves fulfillment of responsibilities on the part of both the student and the academic adviser.

Student responsibilities include:

- knowing Iowa State University policies and procedures
- knowing graduation requirements for degree program
- understanding and accepting the consequences of their academic decisions
- seeking, evaluating, and acting upon advising assistance
- taking responsibility for accomplishing his/her degree plan

Academic Adviser responsibilities include:

- assisting students in achieving the learning outcomes of their academic program, their college, and the university
- referring students to appropriate campus resources
- empowering students to develop an academic plan appropriate to the student's abilities, interests, academic and career goals
- communicating university policies and procedures accurately

Learning Communities

www.lc.iastate.edu

Learning communities are a university-wide initiative providing students the opportunity to connect with peers who have similar academic goals. Students in learning communities typically take one to three courses together and may live together (or near each other) in the same residence hall. Although many of the learning communities are focused on first-year students, opportunities are available for sophomores, juniors, and transfer students.

In addition to developing academic and social networks, advantages of joining a learning community include: getting to know people and making friends in your major or area of interest, getting to know faculty and staff members, making a smooth transition from high school to college, making connections between in-class and out-of-class learning, applying classroom learning to real world situations through hands-on experiences, exploring career opportunities, and having fun! Most learning communities employ an upper-division student as a peer mentor who organizes various activities for the students, ranging from study groups to social events. We have found that students in learning communities are more satisfied with their overall experience at Iowa State, earn higher first-term grades, are more likely to remain enrolled at Iowa State after one year, and are more likely to graduate.

First-year students are offered the opportunity to sign up for learning community courses during summer orientation. For learning communities that offer a residential living environment the sign up takes place online with the housing contract.

Any student interested in joining a learning community should contact the learning community coordinator for more information. A list of coordinators, along with current opportunities, can be found at www.lc.iastate.edu.

AccessPlus Information System

accessplus.iastate.edu

AccessPlus is a secure and confidential campus information system that is available via the World Wide Web. Students, employees, and affiliates view personalized menus from campus and home workstations. For public convenience, AccessPlus stations are available in the Memorial Union and at the Visitors Information Center. Students can use AccessPlus to register for classes, view and print current term schedules, view class meeting rooms, class instructors, academic records, final grades, financial aid status, current university bill, academic adviser assignment and projected date of graduation. University employees use the system to view personal information such as pay history and insurance. Some employees also perform business-related functions. Information about and access to AccessPlus may be found at www.iastate.edu/~registrar/info/access.html or accessplus.iastate.edu.

Third Party Access on AccessPlus

Third party access is an option in AccessPlus that allows students to grant access to selected personal information to a trusted third party. For example, Third Party Access allows a student to set up a special account for a parent or family member to view their grades and/or pay their university bill. More information on creating third party accounts is available from Help after signing onto AccessPlus at https://accessplus.iastate.edu/frontdoor/tpa-info.jsp

Policies for Graduate Students

The Graduate College has specific policies approved by the Graduate College body. The *Graduate College Handbook* is the official source for all policies related to graduate students. See http://www.grad-college.iastate.edu/publications/gchandbook/ for the latest updated information.

Scholastic Recognition

The university recognizes those students who are doing exceptionally well in several ways, including the following.

1. Dean's List. Each semester the university issues a dean's list made up of those students who have carried at least 12 hours of graded or S-F courses with a 3.50 grade-point average or above for the semester. Courses taken on a P-NP basis do not count as part of the 12-hour requirement. No dean's list is issued for summer school. The list can be viewed at http://www.iastate.edu/~registrar/info/deanslist.pdf
2. Annual Scholars and Leaders Ceremony. In the spring the university sponsors a ceremony at which exemplary student leaders and high scholarship students in all classes are recognized.
3. Graduation with Distinction. Undergraduates who have a cumulative grade point average of 3.50 or higher at the beginning of their final term are eligible to graduate "with distinction" provided they have completed 60 semester credits of coursework at Iowa State University at the time they graduate, including a minimum of 50 graded credits.

   Students who graduate with a cumulative grade point average of 3.90 or higher will graduate Summa Cum Laude; those who graduate with a cumulative grade point average of 3.70 to 3.89 will graduate Magna Cum Laude; and those who graduate with a cumulative grade point average of 3.50 to 3.69 will graduate Cum Laude. This recognition appears on the student's official transcript and diploma and in the commencement program.

   Candidates for the bachelor of liberal studies degree may be graduated with distinction providing that they (a) have completed 45 semester credits of coursework at the three Iowa Regent universities at the time of graduation, (b) have earned at least a 3.50 cumulative grade point average at ISU, and (c) their combined grade point average for coursework taken at the three Iowa Regent universities meets the honors cutoff specified above.

4. Honors Program. Students who are full members of the University Honors Program have a cumulative grade point average of 3.35 or higher at the beginning of their final term. In addition, they will have completed an approved honors program of study and an honors project prior to graduation. This recognition appears on the student's permanent record and diploma, and in the commencement program.

Academic Privileges and Opportunities

Credit by Examination

Academic credit may be earned by means of special examinations. The Credit by Examination (CBE) program is available to current Iowa State students as well as prospective and entering students. Students with college-level proficiency in particular areas are encouraged to investigate credit by examination early in their college careers. For more information, see Index, Credit by Examination.

Pass-Not Pass Grading

Students may choose to take a maximum of 9 semester credit hours on a Pass-Not Pass basis, meaning that only a P or NP will be recorded as their final grade in the course. The purpose of P-NP grading is to encourage students to broaden their education by taking courses outside the usual program of study for their major and minor disciplines. The following policies apply:

1. Undergraduate students who have earned at least 40 semester credits and who are not on academic probation (P) at the beginning of the semester are eligible. A special student must obtain approval from their academic adviser and college dean.
2. Only elective courses may be taken on a P-NP basis. In specific majors, some restrictions may apply, so students should consult with their academic adviser.
3. Except for restrictions on its own undergraduate majors, a department may not deny the availability of any of its course offerings on a P-NP basis.
4. Courses offered on a satisfactory-fail basis may not be taken P-NP.
5. Students should register for a P-NP course in the same manner and at the same time that they register for their other courses. Students should then change to P-NP by processing a schedule change form with their academic adviser's signature in the P-NP approval section of the form.
6. Students who elect to change back to a graded basis should process the change using the P-NP section of the schedule change form.
7. Changes to or from a P-NP basis must be made before the last day to drop (usually the Friday of week 10 of the term). If the change from P-NP to a graded basis is made after the first 10 class days of a semester (first five days of summer session), the course will count toward the total P-NP credits allowed.
8. Registration on a P-NP basis is not indicated on the instructor's class list. Students will receive a P if their grade is D minus or better and an NP if their grade was F.
9. Neither P (earned grade of D minus or better) nor NP (earned grade of F) is counted in calculating a student's grade point average (GPA).
10. Students who pass a course taken under the P-NP system may not repeat the course. When students have taken a course and received a grade, they may not repeat it for P-NP credit.
11. When students change their curriculum, any P credits that they have accumulated will be accepted by the new department if such credits are in courses normally accepted by the department.
12. Credits taken on a P-NP basis at another institution and transferred to Iowa State may be applied as electives in a student's degree program if the credits are otherwise acceptable in that program. The number of P-NP transfer credits that can be accepted depends on the number permitted by the institution from which the student is transferring. If a student transfers more than nine semester P-NP credits, no additional Iowa State P-NP credits can be applied to the student's degree program.

Auditing

To audit a course means to enroll in the course without receiving credit for the course. The instructor of the course approves the audit request.

Students are assessed fees as though they are taking the course for credit, but the audited course does not count in determining full-time student status. However, an audited course does count towards the maximum allowable credits per semester. Audited courses do not apply toward V.A. benefits.

Graduate students: An audited course counts as one credit in the graduate student's allowable course load; however, fees will be assessed for the full number of credits for the course. See Index, Graduate College.

Changing status to audit: Changing a course from credit to audit requires dropping the course for credit and adding it as an audit on a schedule change request form. After day 5 of the semester, the drop will count toward the total allowable ISU drops. The drop appears on the student's permanent record and a drop fee will be assessed to the student's university bill.

Rights and privileges: Once enrolled in an audited course, auditors have the same rights and privileges as any student taking the course for credit. Their names appear on the class list with a notation that they are auditing the course. Audited courses do not appear on the student's permanent record except by special request from the student. A request form can be downloaded from the Office of the Registrar web site at www.iastate.edu/~registrar/forms.

Undergraduate students need approval from the instructor as well as their adviser, and college; graduate students need approval from the instructor as well as their major professor and the Graduate College.

Audit Deadlines
In addition to the deadlines provided below, note that instructors must approve all audits.

- Full semester courses:
  Adding an audit–day 10 deadline:
  –Through day 5 of classes: instructor approval required.
  –Day 6-10: instructor, adviser approval required; schedule change fee applies.
  –After day 10: only with extenuating circumstances, instructor, adviser, college approval required; schedule change fee applies.

  Changing status, from credit to audit–day 10 deadline:
  –Through day 5 of classes: instructor approval required.
  –Day 6-10: instructor, adviser, college approval required; schedule change fee applies.
  –After day 10: only with extenuating circumstances, instructor, adviser, college approval required; schedule change fee applies.

  Changing status from audit to credit–day 5 deadline:
  –Through day 5 of classes: instructor approval required.
  –After day 5: instructor, adviser, college approval required; schedule change fee applies.

- Partial semester or summer courses: Deadlines are determined based on the length of the course. For deadlines concerning partial term or summer courses, contact the Student Scheduling Office, 515-294-2331.

Independent Study

Most departments offer opportunities for independent study through a 490 course listing. Usually a minimum of 6 to 10 credits of coursework in the department is required before independent study is permitted. Students who are interested in this kind of experience in a particular department should check the catalog to determine the department's prerequisites to register for 490. 490H sections are reserved for students in the University Honors Program.

Students should check with the department about procedures, in addition to meeting the prerequisites, for registering for 490. A written plan of study is prepared in advance with a faculty member who has agreed to supervise the student's work, to evaluate progress and the final product, and to assign a grade. Initiation of the plan of study should occur prior to the semester in which enrollment is desired. Both the student and the instructor should agree on the number of credits for which the student will enroll, the amount and kind of work he or she will do for that credit, and the system by which she or he will be graded (A-F or S/F). Students should not expect to register for or add 490 credit without an instructor's permission. Some colleges and/or departments have limits on the number of credits of 490 that may be applied toward graduation.

Progressing Toward a Degree

Classification

Classification (year in school) is determined by the number of credits completed and reported to the registrar, and is based on credit hours earned, not merely hours attempted. The grades F and NP and the marks I and X do not contribute toward credit hours earned and thus are not considered in determining year in school.

Classification in all colleges except Veterinary Medicine is as follows:

Sophomore: 30 credit hours earned

Junior: 60 credit hours earned

Senior: 90 credit hours earned

Students who have a bachelor's degree and are working toward another undergraduate degree, licensure, or admission to a specific graduate or professional program, are typically classified as a senior.

Transfer students without a degree are classified on the basis of credits accepted by Iowa State University.

Veterinary medicine students are promoted from the first- to the second-, third-, and fourth-year classes based upon satisfactory completion of the required courses for each year. To be promoted to the second-year class, students must have a cumulative grade-point average of at least 1.67 for all courses in the first year of the veterinary medicine curriculum. To be promoted to the third- and fourth-year classes, students must have a cumulative grade point average of at least 2.00 for all courses in the professional curriculum.

A student who is attending Iowa State and decides not to work toward an undergraduate degree, will be classified as a special student. Admission requirements and academic standards regulations are the same as regular students. Credits taken as a special student are applicable for undergraduate degree purposes if the student is admitted later as a regular undergraduate. Credits obtained as a special student may not, however, be applied toward a graduate degree.

Students enrolled in the Intensive English and Orientation Program (IEOP) are classified as special students in the College of Liberal Arts and Sciences and usually are not permitted to enroll in academic courses until they have satisfied requirements for admission as regular students. Permission to enroll in one academic course may be granted under special circumstances.

Transfer of Credits

Credits presented from another institution are evaluated initially by the Office of Admissions to determine whether the courses are acceptable for transfer credit. In addition, credits applied toward a particular degree will be determined by the student's college, based on relevance to the students' program requirements as well as the level of performance deemed necessary for successful progress in that program. For example, courses that are deemed important to a program but were earned with less than a C grade may or may not be approved for a program. This policy also applies to students already enrolled at Iowa State University and to new transfer students. Grades earned in courses transferred to Iowa State University will not be used in calculating a transfer student's Iowa State cumulative grade point average.

A student who is admitted as a transfer from another college or university is required to have at least a 2.00 cumulative grade-point average for all transferable work taken elsewhere. If, due to special circumstances, a student is admitted with less than a 2.00 average, that student has a transfer quality-point deficiency.

This deficiency will be added to any deficiency accumulated at Iowa State University and will be used to determine whether satisfactory progress toward a degree is being made. To graduate, students must earn sufficient quality points above a 2.00 at Iowa State University to offset any quality-point deficiency, including a transfer quality-point deficiency.

Students should consult with their academic advisers and the Office of Admissions before taking coursework at other colleges and universities to be certain the credits will transfer and will be applicable to their program of study. Students who believe that any transfer credits have not been correctly evaluated should consult with their academic adviser and with the Office of Admissions. Questions concerning how transfer credits are applied toward a degree program should be referred to the academic adviser and college office.

No more than 65 semester or 97 quarter credits earned at two-year colleges can be applied to a bachelor's degree from Iowa State University. While there is no limit to the number of credits that may be transferred from a four-year institution, the last 32 semester credits before receiving a degree from Iowa State University must be completed at Iowa State University.

Iowa State University students who attend one of the other Iowa Regent universities under the Regent Universities Student Exchange Program will have the credits earned at the other university counted as resident credit and grades received included in their Iowa State University cumulative grade point average, even if the credits are included in the last 32 semester credits. For information on applying to the program see Index, Regent Universities Student Exchange Program.

Degree Planning - ISU Degree Audit

In addition to being properly registered, students are responsible for knowing the requirements for their degree and planning their schedule to meet those requirements. One way to monitor progress toward a degree is with the ISU degree audit.

Students may access their ISU degree audit through AccessPlus. The degree audit shows courses that have been completed, courses in which the student is currently enrolled, and graduation requirements that need to be completed for the student's curriculum.

Students should use the degree audit information to help them review progress towards their degrees(s), plan their course of study to complete degree requirements, and select courses for the next term. Graduation evaluators in the Office of the Registrar use the degree audit during the term a student will graduate to determine if the student will have completed all degree requirements upon successful completion of the courses on the student's schedule that term.

In addition, through AccessPlus, students may request a "What If" degree audit for any major available at Iowa State. The audit results will show how their completed and in-progress courses apply toward other majors or options offered at the University.

For further information about how completed courses fulfill degree requirements or how other courses will apply toward their degree requirements, students should see their adviser.

Two Bachelor's Degrees

Students may receive two bachelor's degrees if the requirements for each major (curriculum) are met and the total number of semester credits earned is at least 30 more than the requirements of the curriculum requiring the greater number of credits. This rule applies whether or not the degrees are awarded at the same time. Students should have an academic adviser in each major (curriculum), with one adviser being designated as the registration adviser. Students should request approval to pursue two degrees by completing the form, Request for Double Major/Curriculum or Two Degrees. This form is available from advisers and classification offices. Each adviser will have access to the student's information after this form has been processed. The appropriate department and college must approve each degree program.

Students who have earned advanced degrees and wish to earn a second Bachelor's Degree may be eligible for a college waiver of certain basic and general education requirements. Students should contact the department offering the major for advice and appropriate planning.

Double Major/Curriculum

A double major is a program for a single degree in which all requirements for two or more majors (curricula) have been met. The majors (curricula) may be in different colleges or within the same college or department. The diploma and permanent record will designate all majors (curricula) that are completed at the same time.

To declare a double major (curriculum), students should complete the form, "Request for a Double Major/Curriculum or Two Degrees." This form, available from advisers and classification offices, should be completed at least one term prior to graduation. One major (curriculum) should be designated as primary and the other secondary for purposes of record keeping, but the student's rights and responsibilities are the same in both majors. The adviser of the primary major will serve as the student's registration adviser, but both advisers will have

access to the student's information. Degree programs must be approved for each major (curriculum) by the appropriate department and college. One of the majors may subsequently be canceled using the same form.

Students in the College of Engineering are able to earn a degree with a second major/curriculum as long as the second major/curriculum is within another college, meets all requirements of the additional programs and contains a minimum of 15 additional credits beyond the requirements for a B.S. degree in engineering for each additional area of study. A student with multiple curricula within the College of Engineering is permitted to earn only multiple degrees. All requirements for each curricula must be met plus an additional 30 credits for each curricula being pursued beyond the curriculum which requires the most credits.

Students with a primary major in another college who wish to take a second major in the College of Liberal Arts and Sciences are not required to meet the Liberal Arts and Sciences General Education requirements. They must, however, meet all requirements for the major, including complementary courses. Students in the B.L.S. curriculum in the College of Liberal Arts and Sciences do not have majors.

Second Major (Curriculum) Completed after the Bachelor's Degree

After receiving a bachelor's degree, a person may wish to complete all requirements for another major (curriculum). Approval of the department of the second major (curriculum) is needed before study for the program is begun. At the completion of the program a notation will be made on the permanent record (transcript), but no change will be made on the diploma received at the time of graduation. A degree program must be approved for the second major/curriculum by the department and by the dean's office.

Changing Curriculum or Major

A student's freedom to change their major, and the procedure that should be followed, depend on the student's academic standing and on policies of individual colleges as approved by the provost.

1. If students are not on academic probation (P) and have never been dismissed and reinstated, they may change their major by consulting first with their adviser. (If, however, they have been on academic probation in the past, they may also be subject to regulation 4, below.) Beyond that, they should follow these procedures:
   a. If the change involves majors within the same college, they should check with the college office to obtain instructions as to how to make the change.
   b. If the change involves majors in different colleges, they should obtain a Change of Curriculum/Major form and their file from their adviser, present these materials to the student services office of their present college, then to the student services office of the college to which they are transferring, and finally to the office of their new major.
2. Students on academic probation (P) must first obtain permission to enter the new major. Permission comes from the dean of the college responsible for that major in consultation with the department head. If permission is granted, students should then follow the procedures described above. If they are on academic probation and want to transfer to another college in the university, they must do so before the last day to drop a course in period 2 (see Index, Making Schedule Changes).
3. Students who have been reinstated may not transfer to another college during the first term following reinstatement, and they may not at any time transfer back to the college that originally dismissed them without the permission of the academic standards committee of that college.
4. Students who transferred from one college to another while on academic probation, (P) may not transfer back unless they have the permission of the academic standards committee of the college from which they originally transferred.

Declaring a Minor

Many departments and programs in the university specify requirements for an undergraduate minor. A record of requirements completed appears on students' transcripts. All minors require at least 15 credits, including at least 6 credits in courses numbered 300 or above taken at Iowa State. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement. Courses taken for a minor may not be taken on a pass-not pass basis. For additional information regarding policies which govern minors, see Index, Minor. To declare a minor, students must submit a completed Request for a Minor form to their college office at least one term before graduation. The minor may be from the catalog under which the student is graduating or a later catalog.

Undergraduate Certificates

An undergraduate certificate provides a way to give formal recognition of focused study in a specialized area that is less comprehensive than required for an undergraduate major.

An undergraduate certificate has the following requirements and understandings:

1. A minimum of 20 credits, with at least 12 credits taken at ISU which are applicable towards the undergraduate certificate requirements
2. At least 9 of the credits taken at Iowa State University must be in courses numbered 300 or above
3. At least 9 credits used for a certificate may not be used to meet any other department, college, or university requirement for the baccalaureate degree except to satisfy the total credit requirement for graduation and to meet credit requirements in courses numbered 300 or above
4. A student may not receive both an undergraduate major and a certificate of the same name
5. For students earning an ISU baccalaureate degree, a certificate is awarded concurrent with or after the ISU baccalaureate degree
6. A certificate is not awarded if the baccalaureate requirements are not finished
7. After receiving a baccalaureate degree from any accredited institution, a student may enroll at ISU to earn a certificate
8. Courses taken for a certificate may not be taken on a pass-not pass basis
9. A cumulative grade point average of at least 2.00 is required in all courses taken at ISU towards the certificate
10. A notation of a completed certificate will be made on a student's transcript

Graduation

Seniors must file a graduation application with the Graduation Office, 214 Enrollment Services Center, by the Friday of the first week of classes for students who plan to graduate in fall and spring semesters, and the last day of spring semester for students who plan to graduate in summer. Applications may be obtained from the adviser; college office; www.iastate.edu/~registrar/forms; the Student Answer Center, or the Graduation Office, 214 Enrollment Services Center. Students will be notified of their graduation status by mail approximately four weeks after the semester begins.

Individual college graduation activities take place at the end of fall and spring semesters. The formal commencement ceremonies are held at the end of the semester. For more information see www.iastate.edu/~registrar/graduation

Verification of satisfactory final grades will be completed approximately two weeks after the end of the semester and diplomas will be mailed to all successful degree candidates. Students must ensure the following before they can graduate:

1. Registration for the term has been completed and the date of graduation is correct on the degree audit printout.
2. Sufficient credits, acceptable toward graduation, have been earned to meet the minimum requirements for their curriculum. (Some examples of credit not acceptable toward graduation are: elective credits beyond those allowed in a curriculum, credits earned in passing the same course more than once, more than four credits of Athletics 101, and credit in two courses for which the catalog states that only one may count toward graduation.)
3. They have achieved a set of communication competencies established by the department as appropriate for the major.
4. A cumulative grade point average of at least 2.00 was earned in all work taken at Iowa State and have also met any special grade point averages required by their college, department, or program in specified groups of courses.
   a. Students admitted from another college or university with a quality-point deficiency, must have earned sufficient quality points above a 2.00 at Iowa State to offset their transfer grade point deficiency.

b. Students who have taken work at another college or university prior to or after having been a student at Iowa State, must have submitted a transcript of all such college study attempted to the Office of Admissions. This work must average 2.00 or the deficiency of quality points will be assessed against the student. Failure to submit such a transcript is grounds for dismissal.

5. Incompletes in courses required for graduation have been removed by midterm of the term of graduation.
6. At least 32 credits have been earned in residence at Iowa State University, and the final 32 credits were taken at Iowa State. (Six of the last 32 credits may be transferred to Iowa State, with prior permission of their major department.) Iowa State University must receive an official transcript of all transfer work by midterm of the term of graduation.
7. Outstanding financial obligations owed the university have been paid in full. Students who owe an outstanding obligation to the university will have a hold placed on their records and they will not receive their diploma or transcript. If students have questions about this policy, they should contact the graduation area of the Office of the Registrar.

Evaluation of Academic Progress

Evaluation Procedures

It is university policy that the instructor shall inform the students at the beginning of each course of the evaluation procedures planned for use in the course.

Retention of Records

Records of all graded work must be retained by the instructors until midterm of the semester following completion of a course or until all pending appeals and incompletes are resolved, whichever is later. Instructors leaving the university must file records of all graded work with their department office before departure.

Examinations

Examinations are one of the most common ways instructors assess student performance. In order that examinations can be a useful part of the educational process, the following policies have been instituted:

1. One purpose of examinations is to help students' learning. Therefore, examinations should be evaluated as soon as possible after they are given and the results should be made available to the students in a timely way to enhance learning.
2. All tests and examinations administered between the beginning of the term and final examination week shall be held during a regularly scheduled lecture or laboratory class period for that course. A department may obtain approval to administer a separately scheduled examination if all of the following criteria are met:
   a. The course is multi-sectioned.
   b. A common departmentally developed examination will be administered to all students in all sections at the same time.
   c. The test scores will be used as a basis for a uniform grading procedure for all sections of the course. Requests to hold separately scheduled examinations must be made to the registrar and approved by the provost in time to be announced in the Schedule of Classes to allow students to plan in advance. Only under unusual circumstances will a course be approved for separately scheduled examinations if the deadline is past to include notification in the Schedule of Classes. Whenever a separately scheduled examination is administered, a regular class meeting during that week shall be omitted.

Students who are unable to take a separately scheduled examination at the scheduled time indicated in the Schedule of Classes, because of a course conflict or other legitimate reason must notify the instructor in advance and must be given the opportunity to be examined at another time mutually convenient for the student and the instructor. The instructor shall determine whether to administer the same examination or an alternate examination, or use an alternate assessment procedure.

3. At the end of the semester, a week is set aside for final examinations or other term evaluations, with a two-hour period normally scheduled for each course. The following policies govern the responsibilities of students and faculty members during this week:
   a. Final exams may not be given at a time other than that for which the exam is scheduled by the registrar. An instructor may not give a final exam prior to final exam week nor change the time of offering of the final examination as it appears in the final exam schedule. Permission to change the time for which an exam is scheduled may be given only by the dean of the college. If the instructor elects not to give a final exam in a course of two or more credits, the class is required to meet at the scheduled final exam period for other educational activity such as a review of the course or feedback on previous exams.
   b. Final exam periods are determined according to the regularly scheduled meeting time of the class. However, certain courses are assigned special group exam times so that several sections of the same course may be tested together. The criteria for establishing special group exams are similar to those listed for separately scheduled exams listed in number 2 above. If this results in conflicting group examination periods, students should inform the instructor in charge of the first of the two conflicting courses as listed on the final exam schedule within the special groups in question; that instructor is responsible for arranging a special examination or making some other adjustment.
   c. Evening courses with lectures scheduled at 6:00 p.m. or later should give their examinations during finals week from 7:00-9:00 p.m. on the day the class normally meets. If this exam conflicts with an evening group exam, the instructor responsible for the latter must arrange a special examination for any students who have a conflict.
   d. If unusual circumstances involve the need for students to change the time of their final examination, they must obtain the approval of the instructor of the course.
   e. If a student has three examinations scheduled on the same calendar day and wishes to change one to another day, the instructor of the course having the smallest number of students is responsible for arranging an alternate examination time for the student unless make-up exam times are available in one of the other courses.
   f. All faculty members and teaching assistants with instructional or grading responsibilities are considered to be on duty throughout the entire final examination week and are expected to be available to students during that week for discussion of any matters pertaining to the final examination and final grade or to other aspects of the course.

Dead Week

The last week of fall and spring undergraduate classes has been designated Dead Week by the Government of the Student Body and Iowa State University. The intent is to provide students with time for review and preparation for final examinations. Therefore, no student organization registered with the Student Organization Office may hold meetings or sponsor events without the expressed permission of Program Coordinator in the Student Activities Center, Memorial Union. For academic programs, the last week of classes is considered to be a normal week in the semester except that in developing their syllabi faculty shall consider the following guidelines:

1. Mandatory final examinations in any course may not be given during Dead Week except for laboratory courses and for those classes meeting once a week only and for which there is no contact during the normal final exam week. Take-home final exams and small quizzes are generally acceptable. (For example, quizzes worth no more than 10 percent of the final grade and/or that cover no more than one-fourth of assigned reading material in the course could be given.)
2. Major course assignments should be assigned prior to Dead Week (major assignments include major research papers, projects, etc.). Any modifications to assignments should be made in a timely fashion to give students adequate time to complete the assignments.

3. Major course assignments should be due no later than the Friday prior to Dead Week. Exceptions include class presentations by students, semester-long projects such as a design project assignment in lieu of a final, and extensions of the deadline requested by individual students.

   Instructors are reminded that most students are enrolled in several courses each semester, and widespread violation of these guidelines can cause student workloads to be excessive as students begin their preparation for final examinations. Students are reminded that their academic curriculum is their principal reason for being in college and they have a responsibility to study in a timely fashion throughout the entire semester.

Grading System

Grades represent the permanent official record of a student's academic performance. The grading system at Iowa State operates according to the following regulations:

1. Student performance or status is recorded by the grades and marks described below. A student's grade point average is calculated on the basis of credits earned at Iowa State with the grades and quality points shown below. Credits earned with P, S, or T are not used in calculating the grade point average but may be applied toward meeting degree requirements. A cumulative grade point average of 2.00 is required for a bachelor's degree.

Grades	Quality Points
A	4.00
A–	3.67
B+	3.33
B	3.00
B–	2.67
C+	2.33
C	2.00
C–	1.67
D+	1.33
D	1.00
D–	0.67
F	0.00

P—Passing mark obtained under the Pass-Not Pass system. See Index, Pass-Not Pass.

NP—Non-passing mark obtained under the Pass-Not Pass system. See Index, Pass-Not Pass.

S—Satisfactory completion of a course offered on a Satisfactory-Fail grading basis. May also be reported to indicate satisfactory performance in R (required-credit) courses, and in courses numbered 290, 490, 590, and 690.

T—Satisfactory performance (equivalent to a grade of C or better in courses numbered 100-499, and a grade of B or better in courses numbered 500-699) in a special examination for academic credit.

X—The course was officially dropped by the student after the first week of the term.

N—No report was submitted by the instructor. This is not a recognized grade or mark; it merely indicates the instructor has not submitted a grade and that a grade report has been requested.

I—Incomplete. An incomplete mark may be assigned when the student is passing at the time of the request, but special circumstances beyond the student's control prevent completion of the course. In general, failing the final exam or project or not submitting course work as a result of inadequate preparation or learning are not valid excuses.

The student and instructor must complete and sign an incomplete contract (Incomplete Mark Report form) that states the reason for the I, the requirements for resolving it, and the date by which it must be resolved, not to exceed one calendar year. The instructor then submits an I for the final grade and sends the form to the Office of the Registrar. If the student is not available at the end of the term to sign the Incomplete Mark Report form because of ill health or other reasons, the instructor may assign an incomplete mark and submit the form without the student's signature. The Office of the Registrar will record the incomplete mark and mail a copy of the form to the student. If the student chooses not to accept the incomplete, the student has until midterm of the following semester to contact his or her instructor and request a grade be submitted to the registrar. If the student has not contacted the instructor by midterm, the student must resolve the incomplete according to the conditions set forth in the Incomplete Mark Report form.

When a student completes the requirements specified on the Incomplete Mark Report form, the instructor submits the appropriate grade, which becomes part of the student's cumulative, but not term, grade-point average. The grade does not replace the I on the record. The I remains on the record for the applicable term.

A final course grade, once submitted to the registrar, may not be changed to an Incomplete except to correct an error at the request of the instructor and with the approval of the instructor's department head and the dean of the instructor's college. The instructor should send a card (Grade Report to the Registrar) reporting the change, and an Incomplete Mark Report form to the appropriate dean who will forward them to the registrar if the change is approved.

Incompletes in all courses must be resolved by the middle of the student's term of graduation. Repeating a course will not resolve an I mark. A mark of I will automatically change to a grade of F after one calendar year (whether or not the student was enrolled during the period).

2. To change a grade or mark already reported to the registrar, the instructor submits a change card (Grade Report to the Registrar). This card is used for resolving an I with a grade, for correcting an instructor error, or for the late report of a grade.

3. Midterm Grades. The registrar will collect C-, D, and F midterm grades and nonattendance notifications from the instructor and report this information to students and their advisers using AccessPlus. In addition to submitting the midterm grades, the instructor is responsible for informing the class of the basis on which they were calculated.

   The purpose of midterm grades is to provide the student and adviser with a timely warning that the student's academic performance to that point in the course may be lower than desirable. Students who receive midterms are encouraged to discuss their academic performance with the course instructor and their adviser.

4. Grades in all courses attempted remain on each student's record. If a course is repeated, the record will show the grade obtained on the initial attempt as well as grades received on subsequent attempts.5. The cumulative grade point average is calculated by dividing the total number of quality points earned by the total number of credits in all courses attempted. Grades of S, P, NP, and T are not counted in calculating the grade point average. If a course is repeated, the cumulative grade point average is calculated according to the process described in item 6a below.

6. Repeating Courses.

   a. The most recent grade for a course a student repeats will be used in computing the student's cumulative grade point average rather than the previous grade(s), up to a limit of 15 credits. (This could result in a lowered grade point average if the second grade is lower than the first, or even loss of credit if the grade is lowered to an F.) All grades will remain on the student's record.

   b. Students may repeat any course for which an F grade or any passing grade except P or S was received, but they may not elect to repeat the course under the Pass-Not Pass system.

   c. Beyond 15 credits of repeats, both grades will be included in computing the cumulative grade point average.

   d. Courses should be repeated as soon as possible, preferably within three semesters in residence, because of changes that occur with course updating, change in course number, or revision in the number of credits.

   e. Approval to repeat a course in which the course number or number of credits has changed must be noted on a Designation of Repeated Course form, which can be obtained from departmental offices. This form must be signed by the head of the department offering the course and by the student's adviser, and then taken to the Office of the Registrar. Deadlines for filing repeated course forms for full-semester and half-semester courses are published in the university calendar.

   f. Transfer students may repeat courses at Iowa State University for which a D or F was received at another institution. They must process a Designated Repeat Form indicating they are repeating the course to reduce a transfer deficiency. Such repeated credits will count toward the 15-credit request limit and will affect only their transfer deficiency.

g. A student who has earned an F at Iowa State University may repeat the course at another institution and the credits earned may be applied toward graduation at Iowa State, but the grade earned will not be used in computing a cumulative grade point average.

7. Students who want to protest a grade submitted by an instructor should follow the procedures described in the section, Appeal of Academic Grievances.

Academic Progress

Each college has an academic standards committee that is responsible for monitoring the academic progress of all undergraduate students in that college, based on policies and minimum requirements set by the Faculty Senate Committee on Academic Standards and Admissions and ratified by the Faculty Senate.

Individual college faculties may, with the approval of the Faculty Senate Committee on Academic Standards and Admissions, set additional program admission and curriculum requirements that are more stringent than those established for the university. These additional requirements must be reviewed at least every third catalog by the college academic standards committee to determine if the requirements should be continued. Requirements approved by the college academic standards committees will then be forwarded to the Faculty Senate Committee on Academic Standards and Admissions for final approval.

The college committees are responsible for actions involving individual students with respect to placing students on academic probation, dismissing students from the university for unsatisfactory academic progress, and reinstating students who have been dismissed.

For questions concerning interpretation and application of the rules governing academic progress, students should contact the chair or secretary of their college academic standards committee in their college office.

The university's academic standards rules are presented below. In addition to taking action based on these rules, a college academic standards committee may also place a student on academic probation or dismiss a student from enrollment in the university when, in the college committee's judgment, the student's academic performance or progress toward a degree is exceptionally deficient. Likewise, a college committee may, under exceptional circumstances, exempt individual students from the application of these rules. Students who participate in the Regent Universities Student Exchange Program, or in a similar program where the credit taken at the other school will be considered as resident credit and the grades included in the student's ISU cumulative grade point average, are subject to Iowa State University's academic standards.

Academic Probation Policy

Students are placed on academic probation status as a warning that their academic progress is not satisfactory and that they should take steps to improve their academic performance to avoid dismissal from the university.

Students who are placed on academic probation should immediately seek assistance in academic improvement from such sources as academic advisers, instructors, the Student Counseling Service, and the Academic Success Center.

Academic Warning, Probation, and Dismissal

Continued enrollment at Iowa State University depends upon an undergraduate student maintaining satisfactory academic progress toward attaining a degree. To assist students in maintaining satisfactory progress, Iowa State University has adopted academic standards designed to provide early identification of students who are experiencing academic difficulty, and to provide timely intervention through academic advising and academic support programs.

Academic standing at Iowa State University is dependent upon the total number of credits a student has attempted or earned, the student's semester grade point average (GPA), the student's cumulative ISU GPA, and the student's transfer GPA (if below 2.00.)

Academic Warning

While a warning (W) is the least severe of the negative academic actions, it serves as a reminder that future academic performance below 2.00 could result in more serious consequences. In fact, a student on warning whose subsequent term GPA is below a 2.00 will be placed on probation (P) the following term.

Students who receive an academic warning are required to develop a plan for academic improvement in consultation with their academic adviser or the Academic Success Center.
A student who is subject to both academic warning and academic probation will be placed on academic probation. The academic warning is not a part of the student's permanent academic record.

Students will receive an academic warning (W) at the end of any fall or spring semester when they earn a GPA of 1.00 – 1.99 for that semester. At the end of the next fall or spring semester of enrollment, one of the following actions will be taken for students on academic warning status:

• Students will be placed on academic probation if they earn less than a 2.00 GPA for the next fall or spring semester, or

• They will be removed from warning status if they earn at least a 2.00 semester GPA for the next fall or spring semester and they are not subject to academic probation based on cumulative GPA (over 75 credits).

See Summer Academic Standards Regulations section for how summer grades affect warning, probation, or dismissal status.

Academic Probation

Academic probation is an indication of very serious academic difficulty which may result in dismissal from the university. Students may be placed on academic probation as a result of either semester GPA, cumulative GPA, or both.

Students who are placed on academic probation are required to develop a plan for academic improvement in consultation with their academic adviser which may include referral to the Academic Success Center. Academic probation status is not a part of the student's permanent academic record.

Students will be placed on academic probation (P) at the end of a semester/term for either of the following two reasons:

1. Semester GPA: Students who earn less than a 1.00 at the end of any fall or spring semester, or less than a 2.00 two consecutive semesters, will be placed on academic probation. Students will not be placed on academic probation at the end of the summer term due to summer term GPA only.

2. Cumulative GPA: Students with 75 or more credits attempted or earned, whichever is greater, will be placed on academic probation at the end of any fall or spring semester or summer term when their cumulative GPA is less than 2.00. Students with 75 or more credits attempted or earned who have a transfer GPA < 2.00 will be placed on academic probation at the end of any fall or spring semester or summer term when their combined transfer/ISU cumulative GPA is less than 2.00.

At the end of the next fall or spring semester of enrollment, one of the following actions will be taken for students on academic probation status:

• Students will be academically dismissed if they fail to earn at least a 2.00 semester GPA. At the end of any spring semester, students in dismissal status may enroll for summer term. (See Summer Option for Students in Dismissal Status in the Summer Academic Standards Regulations section.)

• Students will continue on academic probation if they earn at least a 2.00 semester GPA but are subject to continued academic probation based on their cumulative GPA (over 75 credits).

• Students will be removed from probation if they earn at least a 2.00 semester GPA and are not subject to continued academic probation based on their cumulative GPA (over 75 credits).

See Summer Academic Standards Regulations section for how summer grades affect warning, probation, or dismissal status.

Academic Dismissal
Students who do not meet the requirements of their academic probation are academically dismissed from the university. Each College Academic Standards Committee is responsible for final decisions regarding the academic status of students in that college, and any appeals to academic dismissal actions are considered by the college committee. Once dismissed, students are not allowed to reenroll at Iowa State University until they have been academically reinstated. (See section on reinstatement.) Academic dismissal is placed on the student's academic record as a permanent notation. The official transcript of a student who has been dismissed includes a "not in good standing" notation.

Summer Academic Standards Regulations

Students who are newly placed or continued on academic probation (P) at the end of the previous semester may enroll for the summer term without being in jeopardy of academic dismissal from the university at the end of that summer term.

Summer Combined Term GPA:
All students who attend summer session will have their academic status reassessed at the end of the summer based on the combined (not averaged) grade summaries of their previous term of attendance and summer term. Academic status (warning or probation) after summer session will be based on the resulting combined term GPA. The academic status resulting from the summer combined term GPA supersedes the academic status at the end of the previous term.

For students who have remaining designated repeat credits, courses taken in the previous semester and repeated in summer will be calculated as designated repeats in the combined term GPA.

The combined term GPA (summer plus preceding term) will not appear on the student's grade report or permanent record.

Summer term GPA alone cannot determine academic status. Students who initiate enrollment at Iowa State during the summer will not be placed on warning or probation regardless of their academic performance.

Summer Cumulative GPA:
A student who was on academic probation (P) at the beginning of summer term based only on cumulative GPA, who raises his or her cumulative GPA to over a 2.0 at the end of the summer term shall be removed from probation status at the end of the summer term.

A student with 75 or more credits attempted or earned, whichever is greater, will be placed on academic probation (P) at the end of the summer term if his or her cumulative GPA is less than 2.00.

A student with 75 or more credits attempted or earned who has a transfer GPA < 2.00 will be placed on academic probation (P) at the end of any summer term if his or her combined transfer/ISU cumulative GPA is less than 2.00.

Summer Option for Students in Dismissal Status:
A student considered for academic dismissal at the end of spring semester will be permitted to enroll for the summer term. The combined spring/summer GPA will be used to determine whether the student should be permitted to continue his/her enrollment after the summer term. If the resulting combined term GPA is not 2.00 or greater, the student will be academically dismissed.

Additional Academic Standards Regulations

Changing colleges: A student on academic probation (P) may transfer to another college within the university only with the permission of the department chair of the new department and the dean of the new college. For students on academic probation (P), transfer during period 3 (i.e., after the last day to drop a course) may be approved by the department chair of the new department and the dean of the new college only under exceptional circumstances.

A student who has transferred from a college while on academic probation (P) cannot transfer back unless permission is granted by the academic standards committee of the original college.

A student who is in dismissal status at the end of spring and chooses to exercise the Summer Option may not change colleges during the summer.

Withdrawal: A student on academic probation (P) who withdraws during period 3 will be academically dismissed at the end of term the student withdraws, except under extenuating circumstances as judged by the college academic standards committee.

Reinstated students: Reinstated students should also see the section on Reinstatement.

Veterinary Medicine: Additional rules for minimum satisfactory progress are in effect.

Special students: Students matriculated in this classification category are governed by the regular academic progress regulations. Furthermore, by special action of their college academic standards committee, additional standards may be required.

Reinstatement

The procedures delineated in this section apply to students who were dismissed from Iowa State for academic reasons. Students who left Iowa State in good academic standing and who are seeking reentry should see Index, Reentry for more information.

1. Reinstatement is not automatic. Students who have been dismissed for academic reasons should contact the dean's office in the college they wish to enter for instructions specific to that college.

   The college Academic Standards Committee reviews each petition and other relevant information, and reinstatement is based upon that review. As part of the petition process, students must submit a plan for academic success that identifies the causes of their poor academic performance and demonstrates that they have taken actions to avoid or eliminate these causes.
2. Students can only be reinstated after at least one academic semester has elapsed since they were academically dismissed. The summer session is not a semester for the purpose of being out of school one semester.
3. Students who have been dismissed from enrollment two or more times are not eligible for reinstatement until at least two academic semesters have elapsed since their last academic dismissal.
4. Students who were dismissed by one college and subsequently reinstated by another college cannot transfer back to the original college unless permission is granted by the Academic Standards Committee of the original college. This procedure applies regardless of the student's academic standing when the transfer is requested.
5. To be considered for reinstatement to the university, students must submit a petition to the Academic Standards Committee of the college in which they desire to enroll at least 45 days before the beginning of the semester. Students who have not been enrolled for a period of 12 or more months or who are international students must also file a reentry form prior to their return. http://www.public.iastate.edu/~registrar/info/ug-reentry.html (Students dismissed for the second time and requesting reinstatement in the College of Liberal Arts and Sciences must submit their petition 70 days before the beginning of the semester.)
6. As a condition of reinstatement, students will reenter on academic probation and must accept whatever additional requirements are stipulated by the college Academic Standards Committee. Examples include full- or part-time status, specified credit hours, specific courses, specific GPAs, restriction on choice of major, and required counseling.

Student Appeal

Students may appeal a decision regarding their academic status if they believe that new information can be provided or extenuating circumstances exist that would alter the application of any rule in this section. The appeal should be made in writing to the Academic Standards Committee of the college in which the student is enrolled. The written appeal must include the reasons for the appeal and the evidence to substantiate these reasons.

The student should initiate the appeal process by contacting the secretary of the college Academic Standards Committee in the administrative office of her or his college immediately upon receipt of notification of the committee's action, and at least ten calendar days before the beginning of the semester. The secretary will then inform the student of the deadline for submission of the written appeal.

If the student is dissatisfied with the committee's action, he or she may submit an appeal in writing to the dean of her or his college within seven calendar days after they are notified of the committee's action. The dean must respond in writing within seven calendar days of receipt of the appeal.

If the issue is not resolved within the college, further appeals may be made in writing to the provost and subsequently to the president of the university. Appeals beyond the college level will, however, be considered only if based on one or both of the following contentions: (a) appropriate procedures were not followed at the college level; (b) academic rules were not applied correctly at the college level.

Academic Renewal Policy

Students who are returning to Iowa State University to pursue an undergraduate degree after an extended absence may request permission to remove one or more of their complete academic terms from future degree and GPA considerations.

1. Eligibility. To be eligible for academic renewal consideration, students must meet these requirements:
   a. Students must not have enrolled at Iowa State University for five or more consecutive years.
   b. Students must not have graduated from Iowa State University.
   c. Students must currently be in good academic standing. (If the student was previously dismissed, he or she must be reinstated.)
2. Conditions. Academic renewal is based on the following conditions:
   a. All courses and credits that were taken during the chosen terms will be removed from consideration for GPA and degree requirements. Students may not combine courses from multiple terms to comprise the semester(s) or quarter(s) dropped. Degree requirements met during the dropped terms will ordinarily have to be repeated.
   b. Renewal may be applied only to academic terms completed prior to the students' extended absence.
   c. All courses and grades for the chosen terms will remain on the students' academic record.
   d. Designated repeats, drops and P/NP options will be reinstated for the terms dropped.
   e. Students who have used all of their drop options will be given one extra drop.
   f. Students may be granted only one academic renewal.

   To be eligible for a degree after academic renewal is granted, students must complete a minimum of 24 credit hours at Iowa State University.
3. Procedures.
   a. Students should discuss their desire to pursue academic renewal with an adviser in the college they wish to enter.
   b. The student must complete the Academic Renewal Petition form available from www.iastate.edu/~registrar/forms.
   c. After the form is signed by the student and academic adviser, it is submitted to the Records area in the Office of the Registrar, 214 Enrollment Services Center.

Satisfactory Academic Progress for Financial Aid Recipients

In order to remain eligible to receive financial aid from the student aid programs listed below, a student must meet both quantitative and qualitative academic standards as described within this policy. These standards are minimum expectations; specific aid programs may require a higher level of progress. A student not in compliance will be unable to receive aid from these programs until the deficiency has been corrected. Progress toward a degree will be reviewed each term and enforced at intervals no longer than one year. The programs affected by this policy are:

Federal, state, and institutional grants
Federal student and parent loans
Some private student loans

1. The qualitative academic standard for undergraduate students is to maintain a cumulative grade point average of a 2.0 or higher.
2. The quantitative academic standard for full-time undergraduate students is described below:
   a. Duration of eligibility. Students may receive federal, state, and institutional aid for a maximum of six academic years or twelve semesters. Students who have not accumulated sufficient credit hours at the end of this time period to complete their course of study will not be eligible to continue to receive financial aid.
   b. Annual credit hours to be earned. An undergraduate student who receives financial aid from one or more of the programs cited above must complete credit at a rate at least equal to the scale below, where the numbers in the top row indicate academic years completed, and those in the bottom row indicate credit hours required:

1	2	3	4	5	6
15	30	51	72	96	120

3. The quantitative academic standard for all part-time students is as follows:
   a. The duration of eligibility for part-time students is the same as above, but adjusted by the rate of attendance. For example, a student with a maximum duration of six years who is attending school half-time would have the duration of eligibility adjusted to twelve years.
   b. Part-time students who are otherwise eligible for financial aid must maintain the academic standards or rate of completion as stated above, adjusted by the number of hours attempted at the time the financial aid was disbursed.

      9 to 11 credit hours = 3/4 time

      6 to 8 credit hours = 1/2 time
4. Regaining eligibility. If a student is denied financial aid because of failure to comply with the above standards, the additionally required credit must be earned at the student's own expense at Iowa State University, or the student must transfer sufficient hours taken at another institution to make up the deficiency.
5. Transfer students. A student transferring to Iowa State University for the first time will be treated as a first-term student and will not be held responsible for previous terms or credit hours taken at former institutions. If a student attends Iowa State University, transfers to another institution, and then transfers back to Iowa State, the credits earned at the other institution will be added to the student's total earned credit hours.
6. Noncredit courses. Noncredit courses may be converted to credit hours by translating weekly contact hours as defined by the Office of the Registrar.
7. Appeals. Students ineligible for financial aid as a result of this policy, or ineligible for any other reason, may appeal this decision by submitting in writing extenuating circumstances beyond their control that affected their progress to the Office of Student Financial Aid. Forms for this purpose are available on the Student Financial Aid web site at www.financialaid.iastate.edu/.

   The appeal must be signed by the student's academic adviser. If this appeal is denied, a further appeal may be made to a committee composed of the chair of the University Financial Aid Committee, the chair of the University Academic Advising Committee, and the director of Student Financial Aid. Appeals of other financial aid decisions, including loss of athletic grants-in-aid, shall also follow this procedure.
8. General Information and Definitions
   a. Incompletes, repeated courses, withdrawals. A student who receives an Incomplete, repeats a course, or withdraws may continue to receive financial aid upon reentering the university as long as the student completes the required credit hours for each academic school year and maintains the minimum grade point average standards. However, the duration of eligibility will not be extended for a student who withdraws or repeats a course. (See the section Duration of Eligibility.)
   b. Exceptions to the policy.

      ((1) Veterinary Medicine students. For those students enrolled in the College of Veterinary Medicine, eligibility will be based on the academic criteria of the college.

      (2) All other Graduate students. For academic standing and time-to-degree standards please see the Graduate College Handbook.
   c. Academic school year. This includes the summer session and regular semesters within any 12-month period. Credits earned during the summer session will be included when totaling credit hours earned each academic year.
   d. Changes in program of study. The duration of eligibility will not be extended for a student who changes from one program of study to another. (See Duration of Eligibility, in the section, Satisfactory Academic Progress for Financial Aid Recipients.)

These academic progress criteria are defined in minimal terms. If the student earns only the minimum credit hours for financial aid eligibility, the student's total eligibility for particular programs may be exhausted prior to degree completion. (See the Duration of Eligibility and credit hour earning scale.) In addition, the student's college or department may require more credit hours than required by this policy.

Sources of Help with Academic Problems

If students are having trouble in a course, the following persons and places may be able to provide help:

1. The instructor of the course should be the primary sources of assistance to enhance the student's academic achievement in the course. Students are encouraged to visit the instructor during stated office hours and seek individual assistance from the instructor if that is not possible.
2. Another valuable source of support is the student's academic adviser, who often can help clarify academic issues and can recommend support services or remedial strategies.
3. The Academic Success Center in the Hixson-Lied Student Success Center has a collection of services such as tutoring, supplemental instruction (SI), the academic success course, learning lab, disability resources, and workshops designed to help students reach their academic goals.
4. The office of the department that offers the course may have a list of persons qualified to provide tutoring services for the course. They also may have help rooms or other support programs. The locations of the department offices are listed in the front of the ISU Directory.
5. The Student Counseling Service provides professional counseling services for students with problems which affect academic performance.

Appeal of Academic Grievances

Students who believe a faculty member (in his or her academic capacity) has behaved unfairly or unprofessionally may have their grievance reviewed through the procedure described below. A student may not initiate an appeal more than one year following completion of the course, and may not initiate the appeal of a course grade beyond midterm of the semester following completion of the course.

Prior to initiating a formal appeal, a student may wish to discuss the situation informally with the Dean of Students or designee, who can offer advice as to the most effective way to deal with it.

Grievances arising out of classroom or other academic situations should be resolved, if at all possible, with the student and the instructor involved. If resolution cannot be reached, or if the grievance involves sexual or racial harassment and the student prefers not to deal directly with the instructor, the student should discuss the grievance with the instructor's department chair and submit it in writing to him or her. The department chair will investigate the grievance, including discussing it with the instructor involved and/or referring it to a departmental grievance committee. The department chair should respond in writing within five class days of receipt of the written notice of the grievance.

If the student is not satisfied with the resolution of the grievance proposed by the department chair, the student may appeal in writing to the dean of the instructor's college. (In the case of a grievance involving a Graduate College policy or procedure, an appeal of the chair's decision should be directed to the Dean of the Graduate College rather than to the dean of the instructor's college.)

The dean will hear the explanations of the department chair and instructor, and should respond to the student in writing within ten class days of receipt of the written notice of the appeal. If the grievance cannot be resolved with the dean, the student may forward a written appeal to the provost, who will convene a Committee to Review Student Grievances (see below) to consider the appeal within ten class days of receipt of the written notice of the appeal.

Within five class days following the convening of the committee, the provost will make a decision with regard to the grievance and will transmit this decision in writing to the grievant, the dean, the department chair, and the instructor. An appeal of the provost's decision may be made to the president of the university. The time limit specified at each level may be extended by mutual agreement of all parties concerned.

The Committee to Review Student Grievances is composed of faculty members named by the president of the Faculty Senate and students named by the president of the Government of the Student Body. The provost may serve as a chairperson for the committee, or may designate another chairperson for a specific grievance hearing. A minimum of two faculty members, two students, and the chairperson shall constitute a quorum for the convening committee.

Academic Regulations

Class Attendance

In order to attend a given class, a student must be registered for that class for credit or audit. Exceptions to this policy are at the discretion of the instructor of the course. See Index, Validation of Enrollment for regulations concerning attendance to validate students' enrollment in a class.

Each instructor sets his or her policy with respect to class attendance, and excuses for absence from class are handled between the student and instructor. The instructor is expected to announce his or her policy at the beginning of the course. Generally, students are expected to attend all class meetings as scheduled.

Veteran Attendance

Students who receive benefits from the Veterans Administration required by the V.A. to attend class regularly to maintain their V.A. eligibility. If the instructor knows that a student receiving V.A. benefits is not attending class, the instructor is obligated to notify the Office of the Registrar and a notification will be forwarded to the Veterans Administration. More information about veteran benefits is available on the Web, www.iastate.edu/~registrar/info/vabeneft.shtml

Field Trips

Trips away from campus are sometimes arranged as a means of enriching the students' learning experience in a given course. Such trips may not take place during the first or last week of the semester, nor may they extend over more than two consecutive class days (Monday through Friday); these regulations may be waived only by special permission of the dean of the college in which the course is offered. Faculty should check with their college office to find out who is authorized to grant approvals or exceptions on behalf of the dean.

In order to go on a field trip required in one of their courses, students must first obtain permission from the instructors whose classes they will miss. If permission to miss class is not granted, students cannot be required to go on the field trip nor can they be penalized for missing the trip.

Special fees are often charged to cover the costs of field trips. Field trip fees are noted in the Schedule of Classes.

Ownership of Course-related Presentations

The presenter owns course-related presentations, including lectures. Individuals may take written notes or make other recordings of the presentations for educational purposes, but specific written permission to sell the notes or recordings must be obtained from the presenter. Selling notes by students without the required permission is a violation of the Conduct Code as published in the Student Disciplinary Regulations at www.dso.iastate.edu/regulations/homepage.htm.

Recording and Transmission of Classes

Recordings and transmission of classes may take place for a variety of legitimate reasons, including providing educational opportunities for those who cannot attend classes on campus, assisting students with disabilities that impair classroom note taking, and giving the instructor feedback on his or her classroom performance.

Because the lectures of faculty represent their intellectual labors, individuals are expected to obtain permission to make recordings of lectures and other classroom interactions. Recordings may be used for the purposes of the particular class, although in some cases the recordings may be preserved and used for other classes as well.

Credit Involving a Paid Activity

Students may obtain credit for an activity, either on- or off-campus, for which they are also paid, provided the activity is academically relevant. This policy does not apply to registrations for R credit.

In order for an activity to be defined as academically relevant, prior arrangements for receiving credit must be made with a faculty member in an appropriate department.

The arrangements must include agreement on (1) the academic objectives which the activity is expected to achieve, and (2) the procedure by which the student's learning will be assessed.

Academic Dishonesty

Academic dishonesty occurs when a student uses or attempts to use unauthorized information in the taking of an exam; or submits as his or her own work themes, reports, drawings, laboratory notes, or other products prepared by another person; or knowingly assists another student in such acts or plagiarism. Such behavior is abhorrent to the university, and students found responsible for academic dishonesty face expulsion, suspension, conduct probation, or reprimand. Instances of academic dishonesty ultimately affect all students and the entire university community by degrading the value of diplomas when some are obtained dishonestly, and by lowering the grades of students working honestly.

Examples of specific acts of academic dishonesty include but are not limited to:

1. Obtaining unauthorized information. Information is obtained dishonestly, for example, by copying graded homework assignments from another student, by working with another student on a take-home test or homework when not specifically permitted to do so by the instructor, or by looking at your notes or other written work during an examination when not specifically permitted to do so.
2. Tendering of information. Students may not give or sell their work to another person who plans to submit it as his or her own. This includes giving their work to another student to be copied, giving someone answers to exam questions during the exam, taking an exam and discussing its contents with students who will be taking the same exam, or giving or selling a term paper to another student.
3. Misrepresentation. Students misrepresent their work by handing in the work of someone else. The following are examples: purchasing a paper from a term paper service; reproducing another person's paper (even with modifications) and submitting it as their own; having another student do their computer program or having someone else take their exam.
4. Bribery. Offering money or any item or service to a faculty member or any other person to gain academic advantage for yourself or another is dishonest.
5. Plagiarism. Unacknowledged use of the information, ideas, or phrasing of other writers is an offense comparable with theft and fraud, and it is so recognized by the copyright and patent laws. Literary offenses of this kind are known as plagiarism.

   Plagiarism occurs when they do not credit the sources from which they borrow ideas, whether these ideas are reproduced exactly or summarized. The method of documentation will differ depending on whether the sources are written, oral, or visual. Ethically, communicators are responsible for providing accurate, detailed information about their sources. Practically, audiences need this information to comprehend and evaluate a message's content. The ***Student Guide: English 150 and 250***, available for purchase at the University Book Store, describes the process of documenting source materials as do many other reference guides.

Academic dishonesty is considered to be a violation of the behavior expected of a student in an academic setting as well as a student conduct violation. A student found responsible for academic dishonesty or academic misconduct is therefore subject to appropriate academic penalty; to be determined by the instructor of the course, as well as sanctions under the university Student Disciplinary Regulations. If an instructor believes that a student has behaved dishonestly in a course, the following steps are to be followed:

1. The instructor should confront the student with the charge of dishonesty and arrange a meeting with the student to discuss the charge and to hear the student's explanation.
2. If the student admits responsibility for academic misconduct, the instructor shall inform the student (a) of the grade on the work in which the dishonesty occurred, and (b) how this incident will affect subsequent evaluation and the final grade.

   Because academic dishonesty is also a student conduct violation under Section 4.2.1 of the Student Disciplinary Regulations, the instructor must report the incident in writing to the Dean of Students. After investigating the incident and discussing it with the instructor, the Dean of Students, or his/her designee, will meet with the student and depending on the severity of the offense as well as on the student's past conduct record, may handle the matter through an administrative hearing or schedule a hearing before the All University Judiciary (AUJ).

   This hearing, conducted according to the procedures outlined in the Student Disciplinary Regulations, is to determine the disciplinary action to be taken. In any case, the student's academic adviser will be informed of the incident but may not insert any record of it in the student's academic file.
3. If the student claims to be not responsible for the alleged violation of academic misconduct, the instructor may not assign the student a grade for the work in question until the question of responsibility is resolved, unless circumstances require that an interim grade be assigned. The instructor shall consult with his or her department chair and report the incident in writing to the Dean of Students.

   The Dean of Students will refer the case to the Office of Judicial Affairs for investigation. After reviewing the report and completing an investigation, the Office of Judicial Affairs will file a formal complaint against the student if it is determined that there is cause to believe academic misconduct occurred. The case may be adjudicated through an administrative hearing or referred to a hearing before the All University Judiciary (AUJ) depending on the nature and severity of the violation as set forth in the Student Disciplinary Regulations.

   If the case is referred to the AUJ both the student and instructor will be invited to attend an AUJ hearing and present pertinent information. If the Administrative Hearing Officer (in a minor case) or the AUJ (in a major case) finds the student responsible for the charge of academic misconduct, the instructor will inform the student (a) of the grade on the work in which the dishonesty occurred, and (b) how this incident will affect subsequent evaluation and the final grade. The Administrative Hearing Officer or AUJ will determine the appropriate disciplinary action with respect to the nature of the violation.

   If the Administrative Hearing Officer or AUJ finds the student "not responsible" for academic misconduct, the instructor will grade the student accordingly on the work in question and the student's grade in the course will not be adversely affected. If the student is found responsible the student's adviser will be informed of the decision but shall not insert any record of the action in the student's academic file.
4. If a student either admits dishonest behavior or is found responsible for academic misconduct by the AUJ, the Office of Judicial Affairs (OJA) or AUJ may impose any of the following sanctions:

   a) Disciplinary Reprimand: An official written notice to the student that his/her conduct is in violation of university rules and regulations.

   b) Conduct Probation: A more severe sanction than a disciplinary reprimand, to include a period of review and observation during which the student must demonstrate the ability to comply with university rules, regulations, and other requirements stipulated for the probation period.

c) Suspension/Deferred Suspension: The suspension is deferred subject to a definite or indefinite period of observation and review. If a student is found responsible for a further violation of the university Student Disciplinary Regulations or an order of a judiciary body, suspension will take place immediately.

- Definite - The student is dropped from the university for a specific length of time. This suspension cannot be for less than one semester or more than two years.
- Indefinite: - The Student is dropped from the university indefinitely. Reinstatement may be contingent upon meeting the written requirements of the AUJ specified at the time the sanction was imposed. Normally, a student who is suspended indefinitely may not be reinstated for a minimum of two years.

d) Expulsion: The student is permanently deprived of the opportunity to continue at the university in any status.

5. A student accused of academic misconduct has the option to stay in the class or to drop the class if the drop is made within the approved time periods and according to the regulations established by the university. If the student chooses to drop the class, the student will be required to sign a statement of understanding that if the student is later found responsible for academic misconduct, then the student will receive an "F" for the course.
6. Procedures for appeal of either the All University Judiciary's conduct decision or the instructor's grade are available from the Dean of Students Office.
7. In instances in which the student admits responsibility or is judged to be responsible by OJA or the AUJ, a staff member of the Dean of Students Office will counsel with the student in an effort to deter any further such incidents.

8 Student records concerning academic dishonesty are maintained in the Dean of Students Office for a period of seven years, after which the file records are purged. These student records are confidential; nothing from them appears on a student's academic transcript.8. In the event that an instructor is uncertain how to handle an incident of suspected academic dishonesty, the Dean of Students is available at any time to provide advice and assistance to the instructor in deciding a proper course of action to be taken.

9. Students enrolled in the College of Veterinary Medicine are bound by an honor code. A charge of academic dishonesty may be made by a student or instructor to the Interclass Honor Board chairperson according to the procedures outlined in the Honor Code, or the instructor may follow procedures outlined above. The Interclass Honor Board functions as the judiciary of the College of Veterinary Medicine for the allegations presented to it.

Response to Classroom Disruption

Should any student officially enrolled for credit or audit in a class disrupt the instructor's ability to ensure a safe environment, control the class agenda, and/or deliver the approved curriculum, the instructor has the right to ask that the disruptive action cease immediately. The instructor may find it useful to include general guidelines about disruptive behavior on the course syllabus; and in the event of a classroom disruption, the instructor may, if she or he finds it necessary, explain to the student and the class why the particular action is deemed disruptive. The instructor should also take into consideration complaints of disruptive behavior brought to their attention by students. The responsible student should cease the disruption and utilize non-disruptive means for expressing disagreement or concern. If the disruption continues, the instructor can pursue various forms of intervention, including suspension from class, use of student disciplinary regulations, or police intervention, as discussed in more detail in the Faculty Handbook. (See www.iastate.edu/, choose Index, Faculty Handbook.)

Although most situations are best resolved without resorting to requests for police intervention, the Department of Public Safety should be called when the disruptive behavior prohibits the continuation of the class. The Department of Public Safety may also be called if any person enters or remains in the classroom after being asked by the instructor to leave.

Other violations related to academic misconduct may include subsection 4.1.11 Misuse of Computers and subsection 4.2.20 Unauthorized Sale of Others' Intellectual Works. These subsections are located in the Iowa State University Student Disciplinary Regulations under section 4 of the Conduct Code.

Registration

Registration is a process by which students become officially enrolled in classes for a given term. The process involves consultation between the student and the student's academic adviser. All undergraduate students are assigned an academic adviser based on their major/curriculum. A new adviser assignment is made when a student changes majors/curricula. See Index, Academic Advising.

Students who attend classes must complete registration and pay their assessed fees. Registration is not complete until all fees are paid, including board and room fees for those living in residence halls. See Index, Fees and Expenses.

Disabled students who need assistance with any phase of registration should contact Disability Resources. See Index, Disability Resources.)

Dates and Deadlines

Dates for registration are published in the university calendar on the Web at www.iastate.edu/~registrar/forms/, the *ISU Directory*, and departmental bulletin boards.

Students are assigned a registration start date and time, which is the first day and time they can use the registration system. Registration start dates are assigned based on projected year in school classification (computed by combining total credits, current term credits, and current term test out credits). Then specific start dates within projected year in school are established by using the sum of total credits and current term test out credits.

Students may choose to delay their registration until a later date; however, courses will begin to fill on the first day of registration. Any delay in registration may reduce course selection options. A list of start dates by classification is available at www.iastate.edu/~registrar/registration.

Continuing students register for the following term during the middle of the current term. For example, registration for spring term begins the middle of fall term; registration for summer session is completed during the previous spring at the same time as registration for fall semester.

A late registration fee is assessed for registration initiated on or after the first day of classes for fall and spring terms. This fee is not charged for the summer term. If registration is not completed by the end of the fifth day of classes, students must obtain written permission from their advisers, the instructors for the courses they plan to take, as well as approval from the dean of the college in which they are registered. During the summer session, these approvals must be obtained in order to register after the third day of classes.

Students may not enroll in courses with time conflicts without the approval of the instructors concerned.

Students who participate in off-campus experiences for which they receive Iowa State University credit must register for that credit during the term when the experience is taking place, whether or not they are taking courses on campus during that time.

Registration Responsibilities

The registration process includes advising, enrollment in courses, and schedule changes. In addition to the student, this process may involves the student's adviser; the student services staff of the student's college; and the dean of the college. Each is responsible for knowing and following the academic policies and procedures.

The student is responsible for knowing and adhering to university policies and procedures that apply to registration and schedule changes; checking the accuracy of his/her schedule on AccessPlus, including schedule adjustments (i.e., adds, drops, section changes); knowing the degree requirements of his or her major and/or curriculum; planning course schedules to meet those requirements; and monitoring the accuracy of the degree audit.

The adviser is responsible for consulting with advisees during the advising/registration period; providing information about student's major and curriculum requirements; providing guidance in the student's course selection; assisting in monitoring the degree audit for accuracy; and for notifying the college student services office with corrections to the degree audit.

The college student services staff is responsible for assisting new and reentering students with the registration process; resolving unusual scheduling problems; and updating the degree audit or solving problems concerning the degree audit.

The dean is responsible for making decisions with respect to requests for deviations from university policies, deadlines, etc. Students and staff should check with the college office to find out who is authorized to grant approvals or exceptions on behalf of the dean.

Class Schedule Planner

The Class Schedule Planner is an application that allows students to plan their schedules using courses displayed in the Schedule of Classes. Students can select courses and/or sections they want to take for a particular term, as well as block out unavailable class days and times. Based on those selections, Class Schedule Planner can return all possible schedules to the student in a color coded grid format.

Though it is a Web-based application, the Class Schedule Planner does not require authentication (no user ID, PIN, or password). Therefore, it is essential that students understand this is a planner and as such, it does not register them in courses and cannot be used to complete their registration. The application requires that the user have Java on their computer. The first screen of the Planner provides information about how to use the planner and simple instructions for downloading the Java application. A useful Help link also has been provided. The Class Schedule Planner is available at http://planner.iastate.

Using AccessPlus Registration

Students enter the system via AccessPlus by using university ID and password. If required by their college, they also need to enter a registration access number (RAN).

The registration system provides messages after each entry indicating whether each request has been processed. Students also may review their current schedules at any time during registration. Students are held accountable for all changes made to their schedules.

All students are encouraged to register for courses through the AccessPlus registration system. However, students who are unable to use the system may register in person by processing their signed Registration Worksheet in the Registrar's Student Scheduling Office, 10 Enrollment Services Center.

Registration System Abuse

Using the AccessPlus registration system is a privilege, which may be revoked if abuse is detected. Abuse includes, but is not limited to, creating and using an automated program to search for course openings and/or enrolling in a section with the intent of reserving space in that particular section for another student. The Office of the Registrar, college office, and/or advisers have the right to determine abuse and revoke privileges for any type of registration system abuse.

Course Information

Prerequisite. A prerequisite indicates the specific academic background or general academic maturity considered necessary by the faculty for the student to be ready for maximum success in the course. See Index, Course Prerequisites.

Permission Required courses/sections. To register for these sections, students must obtain authorization on a Schedule Change/Restriction Waiver form and process the approved form in the Registrar's Student Scheduling Office, 10 Enrollment Services Center.

Restricted courses/sections. Some courses or sections are restricted to students who meet specified criteria including curriculum/major, college, and/or year in school. In addition, some sections may be restricted to new students to ensure that sufficient spaces are available when new students register during summer orientation. A department may waive a restriction for a student who has extenuating circumstances. The student must obtain the authorization from the department on a Schedule Change/Restriction Waiver form. The form is processed in the Registrar's Student Scheduling Office, 10 Enrollment Services Center.

Classrooms are listed for each course in the Online Schedule of Classes at http://classes.iastate.edu/ and on the student's class schedule on AccessPlus.

Cancelled courses/sections. In some cases, courses or sections may be cancelled due to low enrollment or departmental staffing considerations. Students who are registered for a cancelled course or section will be notified by the Office of the Registrar, the department, and/or on their AccessPlus schedule.

Textbook information. A link to textbook information, including the ISBN and retail price for assigned textbooks, is available from the Schedule of Classes. Textbook information for Iowa State University courses is posted as close to the start of registration as possible. Students may purchase textbooks from any source they choose.

Registration Process

To register for classes, students need the following materials and information:

• Registration Worksheet, available for download at www.iastate.edu/~registrar/forms/.

• A RAN (registration access number) if required by their college.

• Course information from the Online Schedule of Classes at http://classes.iastate.edu/.

• Other departmental information applicable to their curriculum, available from their adviser.

Students are expected to do the following in the advising and registration process:

1. Meet with their adviser, who will provide the following:
   a. degree audit
   b. guidance in course selection
   c. Registration Authorization form, with RAN, if applicable.
2. Choose specific sections of each course. Students are responsible for choosing their course sections. In most cases advisers will not be involved in selecting meeting times.
3. Review their registration start date/time information and any registration hold information on AccessPlus, under Current Information. Students in those colleges which require a four-digit registration access number (RAN) should meet with their adviser in advance of their start date, to obtain their Registration Authorization Card on which the RAN is printed.
4. Register for courses using the AccessPlus registration system.

Credit Limits

For fall and spring semesters, the credit limit is 18 credits for undergraduates and 15 credits for graduate students. For summer session, the limits are 12 credits for undergraduates and 10 credits for graduate students. A student may be required to drop credits before adding another course. In some cases, the college dean may approve a higher or lower credit limit for individual students. Students may request a change in their credit limit by contacting their adviser. Advisers should notify the student's college student services office if the credit limit needs to be changed.

Registration Holds

Students with holds on their registration will not have access to registration until the initiating offices have released the holds. Those who attempt to register before the holds have been released will receive a message indicating which offices have placed holds on their registration. Prior to their registration, students may check for holds on AccessPlus.

Drop Limit

Students are limited in the number of courses they may drop during their academic career. (This refers to drops processed after the fifth day of classes of each semester.) Students who entered Iowa State University as freshmen are allowed to drop a maximum of five courses during their undergraduate career. If they entered at a level above freshman classification or in the College of Veterinary Medicine, they are allowed to drop a maximum of four courses. Courses dropped during their first term at Iowa State are not included in this limit, nor does the summer count as a first term for this purpose. Students who enroll at Iowa State University as undergraduates after receiving a bachelor's degree are permitted two drops.

Exceptions to the drop limit may be made for courses that must be dropped for reasons beyond the student's control. These exceptions are granted only by the dean or other authorized person in the student's college.

The number of drops students have left is indicated on their grade report (available on AccessPlus) each term. Students are responsible for not exceeding their limit. Students who attempt to drop a course beyond the limit without special permission by the dean of the student's college will continue to be enrolled in the course and will receive a grade at the end of the term.

Making Schedule Changes

Schedule Changes. Students may make schedule changes through the first five days of class using the AccessPlus registration system.

Procedures for schedule changes vary by the time period of the semester. The effective date of a schedule change is the date when the change is entered into the registration system.

Schedule change periods are as follows:
Period 1 ends on the fifth day of classes in the fall and spring semesters. Schedule changes during period 1 are free and do not require adviser signatures. Instructor or departmental approval may be required for adds or section changes for some courses during period 1. Course drops during this period do not count toward a student's ISU course drop limit, and will not appear on a student's permanent record. Schedule changes during period 1 may be processed through the AccessPlus registration system or by presenting a Schedule Change form to the Registrar's Student Scheduling Office, 10 Enrollment Services Center.

Period 2 ends the Friday of week 10 in the fall and spring semesters. During this period, schedule changes require signatures of adviser and instructor and are processed on a Schedule Change form. A fee is assessed for adds, drops, and section changes during this period. Course drops after period 1 count toward a student's ISU drop limit and appear as an X on the permanent record. A section change does not require a drop.

Drops and other schedule changes that are judged to be beyond the student's control may be processed as administrative actions if approved by the college dean. There is no fee for administrative schedule changes. Administrative drops do not count toward a student's ISU drop limit and do not appear as an X on the permanent record. The effective date of an administrative action is the date it is approved by the college dean.

Period 3 is anytime after period 2. Schedule changes during this period are permitted only for extenuating circumstances, may require a written statement of support from the instructor and the student, and must be approved by the dean of the student's college.

Half-Semester and Partial Term Courses
Specific deadlines for adding and dropping half-semester courses are published in the university calendar. Prorated adjustments to add and drop deadlines are made for other partial term courses. To find out specific deadlines for partial term courses, contact the Registrar's Student Scheduling Office, 10 Enrollment Services Center, 294-2331.

R-Credit Courses (required courses)
Processing a scheduling change for a required course is usually considered administrative. There is no fee for administrative schedule changes. Administrative drops do not count toward a student's ISU drop limit and do not appear as an X on the permanent record. To make a Period 3 R-credit drop administrative requires approval of the college dean.

Validating Enrollment

To validate their enrollment in each course at the beginning of the semester, students must attend the first or second meeting (first meeting if the class meets only once a week). Students who add a course after the term begins must attend the next class meeting. The instructor has the option to offer a registered place in the course to another student when a registered student fails to attend and has not obtained prior approval of the instructor. Students who do not validate their enrollment must drop the course or they will receive an F grade.

Cancellation/Withdrawal

Students who decide not to attend classes before the date class work begins must cancel their registration to avoid tuition and fees assessment. Students who decide not to attend classes beginning the first day of class or later must withdraw from the university.

Registration Cancellation

A cancellation is processed when a student notifies the Office of the Registrar, prior to the day class work begins, of the decision not to attend classes for the current semester. All courses are removed and no tuition and fees are assessed.

Students may cancel their registration by contacting the Office of the Registrar at 0460 Beardshear Hall, 515-294-1889. Students who call should request the name of the person taking the call and record the name as well as the time and date called.

Withdrawal

Students who decide not to attend classes beginning the first day of class or later, must process a withdrawal form. Per the student's request, the "Request for Withdrawal" form is initiated and submitted by the College to the Office of the Registrar. The student is withdrawn from all courses based on the withdrawal date on the form, and tuition and fees are adjusted, if appropriate according to established policies approved by the Board of Regents, State of Iowa. See www.iastate.edu/~registrar/registration/tuition-adj.shtml

Withdrawal procedures must be followed otherwise instructors of the courses involved will assign grades or marks they consider appropriate. Since these grades may be Fs, students are warned that failure to follow the prescribed withdrawal procedures may adversely affect a later application for reentry or transfer to another institution.

Students who are considering withdrawal from the university should immediately consult their academic adviser to discuss reasons for the withdrawal and alternatives.

A request for withdrawal during period 3, (i.e., after the last day to drop a course without extenuating circumstances) will not be approved except for circumstances that are beyond the student's control. The dean of the student's college or his or her designee, must approve such requests. Students should check with their college office to find out who is authorized to grant approvals or exceptions on behalf of the dean.

Students should not expect to withdraw during or after the final examination week. In a situation beyond a student's control, when examinations cannot be completed, arrangements should be made for incompletes rather than withdrawal during final exam week. Students who are on academic probation (P) and withdraw during period 3 will not be permitted to enroll the following term, except under extenuating circumstances.

Withdrawal Procedures

To withdraw from the university, students must do the following:

1. Complete a Request for Withdrawal form, with adviser's signature.
2. Request the approval and obtain the signature of the college in which they are enrolled. (If the request is approved, the withdrawal form will be forwarded to the Office of the Registrar where it will be recorded; the information is then sent to the appropriate offices.)

The effective date of the withdrawal is the date on which it is approved by the college dean, or his or her designee. Students should check with their college office to find out who is authorized to grant approvals or exceptions on behalf of the dean.

If students complete the withdrawal procedure, the courses they are taking will not be included on the permanent record nor counted as part of their drop allowance. Half semester courses completed prior to withdrawal will be included on their permanent record. Incompletes will not be accepted for any courses taken during the term the student withdraws.

Interim or Medical Withdrawal

The University may order involuntary withdrawal of a student if it is determined that the student is suffering from a mental disorder as defined by the current American Psychiatric Association Diagnostic Manual such that the disorder causes, or threatens to cause, the student to engage in behavior which poses a significant danger of causing imminent harm to the student, to others or to substantial property rights, or renders the student unable to engage in basic required activities necessary to obtain an education.

Status of Conduct Proceedings

If the student has been charged with violation of the Uniform Rules of Conduct, but it appears that medical reasons exist for the objectionable behavior, the withdrawal policy may be activated prior to issuance of a determination in the conduct process. If the student is ordered medically withdrawn from the university, such action terminates the pending disciplinary action. If the student is found not to be subject to medical withdrawal under this section, conduct proceedings may be reinstated.

Interim Action

The OJA (Office of Judicial Affairs) Administrator or the Dean of students may order interim medical suspension of a student where there appears to be an imminent threat of harm to self or others. If the student is suspended, within 48 hours of ordering interim medical suspension, the Dean of Students will schedule an interim hearing before the Medical Withdrawal Committee, consisting of the Director of Student Health (or designee), the Director of the Student Counseling Service (or designee), and the Dean of Students. The student and the OJA Administrator will have an opportunity to present information as to whether interim medical suspension should be continued or modified, and whether medical withdrawal should be considered.

The Medical Withdrawal Committee may order the student to be referred for an evaluation by a licensed mental health professional of the university's choosing if there is adequate reason to believe that a basis for medical withdrawal exists. The order of referral must be sent to the student and notify the student of the scheduled evaluation to occur no later than seven days from the date of the referral letter. The University will cover the cost of the evaluation. If a student fails to complete the evaluation, the university may continue interim medical suspension and may order restrictions on campus access until the evaluation is completed and reviewed by the university. The decision to continue interim medical suspension and for referral may be appealed within 48 hours, in writing, to the Vice President for Student Affairs. The student may be assisted by any two individuals of his or her choice in any hearing or appeal.

Involuntary Medical Withdrawal

If the medical evaluation supports medical withdrawal, a hearing will be scheduled before the Dean of Students, the Director of Student Health and a member of the Student Counseling staff. The student will have at least 48 hours to independently review the psychological or psychiatric evaluation prior to the hearing. The student and the OJA Administrator may present arguments for or against involuntary Medical Withdrawal. A written decision shall be rendered by the Medical Withdrawal Committee stating the reasons for its determination. The decision may be appealed, in writing to the Vice President for Student Affairs. A student who has undergone involuntary medical withdrawal must reapply, and may not reenter the university without providing competent medical evidence that the medical condition no longer exists, or is sufficiently under treatment so as to remove any substantial likelihood of reoccurrence of the condition which caused medical withdrawal. The University may require the student, at the student's cost, to undergo a medical evaluation by a licensed mental health professional of the university's choosing. A medical withdrawal is not considered a disciplinary action, though a prior medical withdrawal may be considered in subsequent conduct hearings involving the student.

Tuition and Fees Adjustments for Withdrawals

Tuition and fees adjustments are made for withdrawals according to the schedule for full term courses (appropriate adjustments will be made when partial term courses are involved).

Students may appeal a tuition and fees assessment for withdrawals. Determinations will be made for instances beyond the control of the student. The results will be sent to the student in writing.

Returning/Reentry to the University

U.S. students who have been absent from Iowa State University less than 12 months may be admitted as a returning student. If more than 12 months have elapsed since last enrolled, a U.S. student must apply for reentry to the university. All international students must apply for reentry regardless of the time away from the university.

Returning Students

U.S. undergraduate and non-degree undergraduate students planning to return to Iowa State University after an absence of less than 12 months do not complete a reentry form; however, international undergraduate and non-degree undergraduate students planning to return to Iowa State University after an absence of less than 12 months must complete a reentry form.

Returning U.S. students and graduate students should contact the Office of the Registrar to have their records updated and registration access created. Students should contact their advisers or major professor to select courses and begin the registration process.

Returning students who want to change their curricula should follow the same procedure as in-school students. Students who were dropped from enrollment at Iowa State University must obtain reinstatement by the Academic Standards Committee of the college that initiated the drop. (See below for policies that apply to requests for reinstatement.)

Reentry Students

Undergraduate and nondegree undergraduate (special) students who plan to attend Iowa State University after an absence of twelve months or more must complete a reentry form. Forms are available from www.iastate.edu/~registrar/info/reentry.html.

Students with a bachelor's degree who plan to take supporting graduate level coursework prior to applying for graduate degree admission should request a nondegree graduate admission application.

Students who have previously attended Iowa State University only as nondegree (special) students and who now seek to earn an undergraduate degree should request an undergraduate application.

International students must complete a reentry form. Forms are available from www.iastate.edu/~registrar/info/reentry.html. Financial certification of ability to cover all educational and living expenses will be required.

The reentry form should be completed and returned to the Office of the Registrar, 0460 Beardshear Hall, well in advance of the term of reentry. Students who have attended another college or university since enrollment at Iowa State University must have an official transcript(s) of all course work attempted sent to the Office of Admissions, 100 Enrollment Services Center.

Reentering students must also contact their departmental office/adviser to prepare a class schedule. Reentry must be approved prior to registration.

Iowa State University requests the information on the reentry form for the purpose of making a reentry decision. The university reserves the right not to approve reentry if the student fails to provide the required information.

Reentry Approval Process

Generally, a request to reenter Iowa State University will be approved within the Office of the Registrar. However, the Office of the Registrar will refer the reentry form to the college to which a student plans to return if the student: (a) desires to change curriculum; (b) has a previous Iowa State University cumulative grade point average below 2.00; (c) was dropped from the university for unsatisfactory academic progress or was not otherwise in good standing; or (d) since leaving Iowa State University, has completed additional college study with less than a 2.00 grade point average. See Index, Reinstatement.

Academic Renewal Policy

Students who are returning to Iowa State University to pursue an undergraduate degree after an extended absence may request permission to remove one or more of their complete academic terms from future degree and GPA considerations. See Index, Academic Renewal Policy.

Colleges and Curricula

Undergraduate and Professional Degree Programs

The university is organized into eight colleges, including the Graduate College. Six colleges offer undergraduate degree programs, and the College of Veterinary Medicine offers the Doctor of Veterinary Medicine degree. For a listing of the more than 100 majors offered by the Graduate College, see the summary at the end of the Graduate College section of this publication.

Iowa State University is accredited by the Higher Learning Commission of the North Central Association.

The main undergraduate academic programs of each college are listed below, together with the degrees awarded upon completion. In many cases certain majors, minors, options, or electives allow for increased specialization within the programs. Programs which are administered jointly by two colleges are listed within both colleges.

College of Agriculture and Life Sciences

Agricultural Biochemistry, B.S.
Agricultural Business, B.S.
Agricultural and Life Sciences Education, B.S.
Agricultural Studies, B.S.
Agricultural Systems Technology, B.S.
Agronomy, B.S.
Animal Ecology, B.S.
Animal Science, B.S.
Biology, B.S.
Culinary Science, B.S.
Dairy Science, B.S.
Diet and Exercise, B.S./M.S.
Dietetics, B.S.
Environmental Science, B.S.
Food Science, B.S.
Forestry, B.S.
Genetics, B.S.
Global Resource Systems, B.S.
Horticulture, B.S.
Industrial Technology, B.S.
Insect Science, B.S.
International Agriculture, B.S.
Microbiology, B.S.
Nutritional Science, B.S.
Public Service and Administration in Agriculture, B.S.
Seed Science, B.S.

College of Business

Accounting, B.S.
Finance, B.S.
Business Economics, B.S.
Logistics and Supply Chain Management, B.S.
Management, B.S.
Management Information Systems, B.S.
Marketing, B.S.
Operations and Supply Chain Management, B.S.

College of Design

Architecture, B.Arch.
Art and Design, B.A., B.F.A.
Community and Regional Planning, B.S.
Graphic Design, B.F.A.
Integrated Studio Arts. B.F.A.
Interior Design, B.F.A.
Landscape Architecture, B.L.A.

College of Engineering

Aerospace Engineering, B.S.
Agricultural Engineering, B.S.
Biological Systems Engineering, B.S.
Chemical Engineering, B.S.
Civil Engineering, B.S.
Computer Engineering, B.S.
Construction Engineering, B.S.
Electrical Engineering, B.S.
Industrial Engineering, B.S.
Materials Engineering, B.S.
Mechanical Engineering, B.S.
Software Engineering, B.S.

College of Human Sciences

Apparel Merchandising, Design, and Production, B.S.
Child, Adult, and Family Services, B.S.
Culinary Science, B.S.
Diet and Exercise, B.S./M.S.
Dietetics, B.S.
Early Childhood Education, B.S.
Elementary Education, B.S.
Family and Consumer Sciences Education and Studies, B.S.
Family Finance, Housing, and Policy, B.S.
Food Science, B.S.
Hotel, Restaurant, and Institution Management, B.S.
Kinesiology and Health, B.S.
Nutritional Science, B.S.

College of Liberal Arts and Sciences

Advertising, B.A.
Anthropology, B.A., B.S.
Biochemistry, B.S.
Bioinformatics and Computational Biology B.S.
Biological/Pre-Medical Illustration, B.A.
Biology, B.S.
Biophysics, B.S.
Chemistry, B.A., B.S.
Communication Studies, B.A.
Computer Science, B.S.
Earth Science, B.A., B.S.
Economics, B.S.
English, B.A., B.S.
Environmental Science, B.S.
Environmental Studies, B.A., B.S.
Genetics, B.S.
Geology, B.S.
History, B.A., B.S.
Interdisciplinary Studies, B.A., B.S.
International Studies, B.A., B.S.
Journalism and Mass Communication, B.A., B.S.
Liberal Studies, B.L.S.
Linguistics, B.A.
Mathematics, B.S.
Meteorology, B.S.
Music, B.A., B.Mus.
Performing Arts, B.A.
Philosophy, B.A.
Physics, B.S.
Political Science, B.A.
Psychology, B.A., B.S.
Religious Studies, B.A.
Russian Studies, B.A.
Sociology, B.A., B.S.
Software Engineering, B.S.
Speech Communication, B.A., B.S.
Statistics, B.S.
Technical Communication, B.S.
Women's Studies, B.A., B.S.
World Languages and Cultures B.A.:
- French
- German
- Russian Studies
- Spanish

College of Veterinary Medicine

Veterinary Medicine, D.V.M.

Bachelor's Degree Requirements

To receive a degree, a student must meet the requirements of the curriculum in which the degree is to be awarded. Verification that the student has met those requirements is made by the dean of the college, who also has the authority to waive a requirement under exceptional circumstances.

A cumulative grade point average of at least 2.00 in all work taken at Iowa State University is required for graduation.

A student admitted as a transfer from another college or university is normally required to have a 2.00 cumulative average at the time of entrance. A student may, however, be admitted with a quality-point deficiency, but will be required to earn sufficient quality-points above a 2.00 at Iowa State to offset the quality-point deficiency at the time of entrance.

No more than 65 semester or 97 quarter credits earned at two-year colleges can be applied to a bachelor's degree from Iowa State University. There is no limit to the number of credits that may be transferred from a four-year institution.

A student who takes work at another college or university after having been enrolled at Iowa State must submit transcripts of all work attempted to the Office of Admissions at Iowa State. This work must average a 2.00 or the deficiency of quality points will be assessed against the student. Failure to submit such transcripts will be grounds for dismissal.

In unusual circumstances, the Academic Standards Committees of the respective colleges may review and give further consideration to the records of students who, except for grade-point average, have satisfactorily completed all graduation requirements. If the appropriate college Academic Standards Committee considers that the educational and professional needs of such a student have been satisfactorily met, or can be satisfactorily met by imposing further conditions, the committee may recommend to the dean of the college that the student be graduated or that a supplemental program be accepted in place of the fully unqualified grade point average. The college Academic Standards Committee chairperson reports such exceptional actions to the Faculty Senate Committee on Academic Standards and Admissions.

To qualify for a bachelor's degree, a student must take a minimum of 32 credits in residence at Iowa State University. Also required is that the last 32 credits must be taken in residence, although under special circumstances, with prior written approval of the student's major department, six of the last 32 credits may be transferred and applied toward a degree at Iowa State University.

A student may receive two bachelor's degrees if he or she meets the requirements of each curriculum and earns at least 30 credits beyond the requirements of the curriculum requiring the greater number of credits. Each degree program must be approved by the appropriate department chair or head.

A student fulfilling the requirements of two separate curricula in different colleges may, in certain cases, receive a degree from one of the colleges with double majors crossing college lines. The permission of both deans must be obtained and each degree program must be approved by the appropriate department and dean.

Minors

Requirements for an undergraduate minor are specified by many departments and programs in the university; a record of completion of such requirements appears on a student's transcript. Lists of undergraduate minors offered by each college appear in the college description. Credits used to meet the minor requirements may also be used to satisfy the credit requirement for graduation and to meet credit requirements in courses numbered 300 or above. Some students may have to exceed the graduation credit requirement set by their college in order to meet the requirements of both the minor and the curriculum/major.

All minors require at least 15 credits, including at least 6 credits taken at Iowa State University in courses numbered 300 or above. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement. Courses taken for a minor may not be taken on a pass-not pass basis. Specific requirements and/or restrictions are available from the department or program offering the minor.

Undergraduate Certificates

All undergraduate certificates require at least 20 credits, including at least 12 credits taken at Iowa State University. At least 9 of the credits taken at Iowa State University must be in courses numbered 300 or above. The undergraduate certificate must include at least 9 credits that are not used to meet any other department, college, or university requirement except to satisfy the total credit requirement for graduation and to meet credit requirements in courses numbered 300 or above. Courses taken for an undergraduate certificate may not be taken on a pass-not pass basis. A cumulative grade point average of at least 2.00 is required in courses taken at Iowa State University for an undergraduate certificate. Specific requirements and/or restrictions are available from the department or program offering the undergraduate certificate (see Index).

Communication Proficiency Policy

Basic Principles: The faculty of Iowa State University believe that all educated people should be able to communicate effectively in a variety of settings and media, including electronic. Consequently, Iowa State University graduates are expected to develop competence in three interrelated areas of communication: written, oral, and visual.

This communication competence can best be achieved through the following five principles:

•Communication instruction and practice are distributed over the student's entire undergraduate experience, both in and out of the classroom, from the first year through the senior year.

•Communication instruction and practice are distributed across the curriculum, both in communication courses and in courses in the student's major.

•Active learning and higher-order thinking are fostered through communication.

•Faculty across the university share responsibility for the student's progress in communication practices.

•Both faculty and students engage in ongoing assessment for continuous improvement of the student's communication practices.

Iowa State University's communication curriculum, based on these five principles, seeks to enrich the student's understanding of the various subjects studied as well as prepare the student to communicate successfully in professional, civic, and private life.

Foundation Courses: To ensure that broad communication competence is addressed and developed at the beginning of a university career, all students will earn six credits in the two-course introductory sequence (English 150 and 250), normally taken in the first and second years. Students will focus on writing and critical reading, with complementary instruction in visual, oral, and electronic communication; they will concentrate on civic and cultural themes; and they will enter work in a communication portfolio to document their current level of proficiency.

Upper-Level Curricula: Continuing development of communication skills will be directed by the student's major department. Using the university's basic principles as a guide, each department will specify a set of intended learning outcomes and design communication experiences by which students in the major can achieve the desired level of communication proficiency.

Departments may select from or combine a variety of communication options that best match their faculty, students, and curriculum:

•designated communication-intensive courses that integrate written, oral, and visual communication into a course in the major;

•a sequence of courses within the major that incorporates communication tasks of increasing complexity;

•linked courses—one in communication, one in the major—that integrate readings and assignments;

•advanced composition course(s) appropriate to the student's major and offering instruction in written, oral, and visual communication;

•communication-intensive activities within or beyond course work, such as communication portfolios, discipline- or course- specific student tutoring, community service projects, internships, electronic presentations, informational fairs, juried competitions, entrepreneurial projects, newsletters, Web sites.

Departments will retain the authority for regularly assessing the degree to which their students achieve the specified learning outcomes and for making curricular improvements based on departmental assessment data.

Non-Native Speakers of English: Students admitted to the university whose first language is not English are required to take the English Placement Test before the beginning of their first semester of enrollment as students at Iowa State. This requirement includes freshmen as well as those who have transferred credit from other institutions. The test is administered by the English Department and is offered before the beginning of each semester. Students whose performance on this placement examination is satisfactory will follow the regular university communication proficiency requirements. Students who have deficiencies will enroll in special English classes, as determined by the test results.

Library Study

Independent study and investigation through the use of books, journals, and libraries enable students to grow intellectually and professionally in college and afterward. For this reason, all students receive instruction in the use of the University Library, including practice in how to locate the published literature of their respective fields of study.

U.S. Diversity and International Perspective Requirements

One of Iowa State University's goals is to prepare its students to meet the challenges of responsible citizenship and effective professional roles in a culturally diverse global community. To help achieve this goal, all undergraduate students must fulfill graduation requirements in two areas: U.S. Diversity and International Perspectives. The specific standards used to certify students' fulfillment of these requirements vary from major to major, but all require three credits of course work (or the equivalent in some alternative academic experience) for each of the requirements. In most cases, courses used to meet the U.S. Diversity and International Perspectives requirements can also be used to fulfill general education requirements of the student's college or requirements of the student's major. Students should consult with advisers for details of the requirements in particular majors.

The focus of the U.S. Diversity requirement is the multicultural society of the United States. Courses or alternative academic work used to meet the requirement address significant manifestations of human diversity and provide students with insights that enhance their understanding of diversity among people in the U.S.

Through completion of the U.S. Diversity requirement, students will achieve at least two learning outcomes such as those listed below.

Students will be able to:

- articulate how their personal life experiences and choices fit within the context of the larger mosaic of U.S. society, indicating how they have confronted and critically analyzed their perceptions and assumptions about diversity-related issues.
- analyze and evaluate the contributions of various underrepresented social groups in shaping the history and culture of the U.S.
- analyze individual and institutional forms of discrimination based on factors such as race, ethnicity, gender, religion, sexual orientation, class, etc.
- analyze the perspectives of groups and individuals affected by discrimination
- analyze how cultural diversity and cooperation among social groups affect U.S. society.

The focus of the International Perspectives requirement is the global community. Its objective is to promote students' understanding of cultural diversity and interdependence on a global scale. A period of immersion in a foreign culture is often a particularly effective way of meeting these objectives, so Iowa State University encourages the use of study-abroad experiences as a means of fulfilling the International Perspectives requirement. International students, because they are "studying abroad" from their home country's perspective, are normally deemed to have met the International Perspectives requirement.

Through completion of the International Perspectives requirement, students will achieve at least two learning outcomes such as those listed below.

Students will be able to:

- analyze the accuracy and relevancy of their own worldviews and anticipate how people from other nations may perceive that worldview.
- describe and analyze how cultures and societies around the world are formed, are sustained, and evolve.
- analyze and evaluate the influence of global issues in their own lives.
- describe the values and perspectives of cultures other than their own and discuss how they influence individuals' perceptions of global issues and/or events.
- communicate competently in a second language.

Curriculum Requirements

The curriculum requirements, both in number of credit hours and specific courses, are guidelines for the student and his or her adviser in planning an academic program. The curriculum is subject to change and because of these changes, adjustments may need to be made.

Catalog in Effect

A student may choose to graduate under the catalog in effect at the time of graduation, or one of the two immediately preceding catalogs, provided it covers a period of his or her enrollment. Full requirements of the chosen catalog must be met except that adjustments will be made in instances where courses are no longer available or where programs have been changed.

Special Programs

Honors Program

The Iowa State University Honors Program is designed for students who have demonstrated the ability and motivation to assume more than the usual responsibility for their undergraduate education. The goal of the program is to enable Honors students to gain maximum benefit from their undergraduate education. Students who graduate in the Honors Program receive the Honors designation on their transcripts and on their baccalaureate diplomas.

Special educational opportunities. Students in the Honors Program determine their educational objectives and devise an individualized program of study to meet those objectives. An honors program may include substitutions for required courses, combinations of courses from several departments to form a new major or minor, Honors courses or seminars, independent study and research, and other forms of innovation. Information about Honors courses and seminars for the current academic year can be obtained from the Honors Program Office, 2130 Jischke Honors Building.

Other benefits. Members of the Honors Program have 24-hour access to the Honors building as a quiet place to study, use the computers, and visit with other Honors students. Students also have off-campus opportunities such as attending Honors semesters and Wingspread conferences. Members receive extended loan privileges at the Library, priority scheduling, and the opportunity to apply for research funds.

ISU Students who have a cumulative grade-point average of at least 3.35 become eligible to apply for admission to the Honors Program during their second semester in residence and continue to be eligible for admission as long as they have at least 48 semester credits remaining before graduation. Transfer students with a transfer G.P.A of 3.5 or higher and more than 60 credits remaining are eligible to apply.

College of Agriculture and Life Sciences

Wendy Wintersteen, Dean
Joe Colletti, Senior Associate Dean
David Acker, Associate Dean
Gerald Miller, Associate Dean
www.ag.iastate.edu

Departments of the College

Agricultural Education and Studies
Agricultural and Biosystems Engineering
Agronomy
Animal Science
Biochemistry, Biophysics, and Molecular Biology
Ecology, Evolution, and Organismal Biology
Economics
Entomology
Food Science and Human Nutrition
Genetics, Development and Cell Biology
Horticulture
Natural Resource Ecology and Management
Plant Pathology
Sociology

Students enrolled in the College of Agriculture and Life Sciences are provided a broad-based education that includes coursework in communications; biological, physical, and social sciences; humanities; and technical subject matter.

Upon graduation students find diverse career opportunities because of the well balanced education they have received as undergraduates. Opportunities for graduates include production agriculture, business and industry, public agencies, education, biological and environmental sciences, value-added processing, natural resource management, rural development, animal and human health professions, and graduate studies.

High School Preparation

Requirements for students entering from high school or transferring with less than 24 college credits into the College of Agriculture and Life Sciences include four years of English; three years of mathematics which must include one year each of algebra, geometry, and advanced algebra; three years of science which must include one year each of biology and chemistry, or biology and physics, or chemistry and physics; and two years of social studies. No foreign language is required for admission to the College of Agriculture and Life Sciences.

Majors in the College of Agriculture and Life Sciences

A student has many majors from which to choose. Each major is unique although many courses are common. This is helpful to students in that they may transfer from one major to another before the second year with little loss of credits. Options and areas of specialization further define the majors and required coursework within some majors. In all cases, majors are designed to help students succeed in their chosen professions. Majors in agriculture and life sciences are:

Primary Majors

Agricultural Biochemistry
Agricultural Business
Agricultural and Life Sciences Education
Agricultural Studies
Agricultural Systems Technology
Agronomy
Animal Ecology
Animal Science
Biochemistry
Biology
Culinary Science
Dairy Science
Dietetics
Diet and Exercise
Environmental Science
Food Science
Forestry
Genetics
Global Resource Systems
Horticulture
Industrial Technology
Insect Science
Microbiology
Nutritional Science
Public Service and Administration in Agriculture

Secondary Majors

Environmental Studies
International Agriculture
Seed Science

A secondary major must be taken in conjunction with a primary major.

Minors

Agricultural Biochemistry
Agricultural Education and Studies
Agricultural Systems Technology
Agronomy
Animal Ecology
Animal Science
Biology
Emerging Global Diseases*
Entrepreneurial Studies*
Environmental Science
Environmental Studies
Food Safety*
Food Science
Forestry
Genetics
Horticulture
Industrial Technology
Insect Science
International Agriculture
Meat Science
Microbiology
Nutrition

*The College of Agriculture and Life Sciences participates in these interdepartmental minors.

Certificate

Occupational Safety

See statement on minors in the *Colleges and Curricula* section of this catalog.

Special Programs

Agriculture Exploration

Agriculture Exploration is a starting place for students who wish to pursue careers in the life sciences, food science, natural resources, production agriculture, business, or communications but who are unsure of which majors to choose. Students entering this program will be advised in the Student Services Office until they select their majors.

Preveterinary Medicine

Students in the College of Agriculture and Life Sciences may complete the requirements for admission to the College of Veterinary Medicine by enrolling in any major within the college. Because a solid foundation in the sciences is basic to the program in veterinary medicine, those majors that emphasize the sciences are usually more compatible with preveterinary medicine (see College of Veterinary Medicine section of this catalog for specific admissions requirements).

Students who are undecided about choice of major may enroll in general preveterinary studies (Gen PV). These students will also enroll in an orientation course, which describes the various college majors. A Gen PV student has up to 1.5 semesters to select a major.

Preveterinary medicine students also have an opportunity, with careful planning, to complete the requirements for a bachelor of science degree in an individual curriculum within the College of Agriculture and Life Sciences after admission to the College of Veterinary Medicine. This may be done by completing the prescribed course of study established by an individual major. Students also may meet degree requirements of an individual major through the College of Agriculture and Life Sciences Honors Program. Further details are available from an academic adviser or from members of the College of Agriculture and Life Sciences Honors Committee.

Honors Program

The College of Agriculture and Life Sciences Honors Program provides an opportunity for students of high ability to maximize their educational experience by individualizing their program of study. (See statement on Honors Program in the Colleges and Curricula section of this catalog). For more information, contact the chair of the College of Agriculture and Life Sciences Honors Committee, or a department Honors contact person.

Off-Campus Programs

Coursework leading to a master of science degree in agricultural education, master of agriculture degree in professional agriculture and a master of science degree in agronomy are offered to students who choose to study off-campus; see *Extended and Continuing Education* for further information.

Study Abroad and International Travel Opportunities

Agriculture and life sciences are part of a highly interconnected global system; decisions made in one sector have profound impacts worldwide. It is important for students to develop an understanding and appreciation for the global system and the role that U.S. agriculture plays in providing a safe and predictable food supply for a growing world population. The College of Agriculture and Life Sciences provides study abroad and international internship opportunities in more than 25 countries around the world. For additional information, contact the Office of Global Agriculture Programs in the College of Agriculture and Life Sciences.

Internships and Cooperative Education Programs

Practical work experience can provide a unique learning opportunity that complements academic coursework. This experience is provided through internships or cooperative education programs. For additional information, contact a departmental adviser or internship coordinator.

College of Agriculture and Life Sciences Core Curriculum and Electives

All curricula in the College of Agriculture and Life Sciences lead to a bachelor of science degree. Each major has specific degree requirements for graduation based on department and college student learning outcomes. College of Agriculture and Life Sciences core curriculum requirements for the four areas listed below are established to provide the foundation for successful accomplishment of both departmental and college level learning outcomes.

Students pursuing a primary major in another college and taking a second major in the College of Agriculture and Life Sciences must fulfill the core curriculum requirements of the College of Agriculture and Life Sciences, and all the requirements of the second major. The College of Agriculture and Life Sciences core curriculum follows.

Minimum Credits	Subject Area
9.5	Interpersonal and public communication skills
6	English composition with grades of C or better
3	Speech fundamentals with grades of C or better; 0.5 credit in Lib 160
17	Mathematical, physical, and life sciences 3 credits of mathematics; 3 credits of statistics; 5 credits of physical science (e.g., chemistry, geological and atmospheric sciences, physics); 6 credits of life sciences including Biology 101 or 211, and 3 credits of life sciences from a college-approved list: (http://www.ag.iastate.edu/student/student_services.php)
12	Humanities, social sciences 3 credits of humanities; 3 credits of social sciences; 3 credits of U.S. diversity from an approved list; 3 credits of international perspectives from an approved list.
3	Ethics Requirement met in one of two ways designated by the student's major program of study: 1) 3 credits from a college-approved list; or 2) a course in foundational elements of ethical/critical thinking offered by the Department of Philosophy specifically to meet this requirement for College of Agriculture and Life Sciences majors, and a course designated by the student's major program designated to coordinate with this foundational course. Refer to the College of Agriculture and Life Sciences web site for details of the ethics requirement.

All students graduating with majors within the College of Agriculture and Life Sciences are expected to be proficient in the following college-level outcomes:

Professional, Interpersonal and Cross-cultural Communications
- Speak and write clearly and persuasively.
- Prepare effective visual, oral, written and electronic presentations.
- Effectively read, listen, observe and reflect.

Problem-Solving/Critical Thinking
- Apply a holistic approach to solving complex issue laden problems.
- Apply a rational and objective process to:

  -Distinguish verifiable facts from value claims,

  -Determine the accuracy of statements,

  -Identify assumptions and detect bias,

  -Distinguish relevant from irrelevant information,

  -Prioritize needs.
- Summarize, analyze, and interpret simple research data and policy issues.

Leadership
- Organize, facilitate, and participate effectively in a group, team, or organization.
- Define a problem or opportunity, implement an action planning process, work towards a goal and justify actions taken.

Entrepreneurship
- Demonstrate innovativeness and creativity regardless of context.
- Identify and pursue opportunities that produce value.
- Be persistent in shepherding necessary resources and managing associated risk to facilitate change.

Life-long learning
- Articulate how continued learning after graduation will enrich their lives.
- Identify and participate in new areas for learning beyond the classroom and after graduation.

Ethics
- Define and assess their ethical perspective, moral responsibility, and values.
- Identify and critically evaluate contemporary ethical and moral issues in professional and private life.

Environmental Awareness
- Explain the physical and biological interactions within ecosystems
- Explain how human activities impact the environment and how societies area affected by environmental change.

International/Multi-Cultural Awareness
- U.S. Diversity – Students should achieve two of the following outcomes. They should be able to:

  Articulate how their personal life experiences and choices fit within the context of the larger mosaic of U.S. society, indicating how they have confronted and critically analyzed their perceptions and assumptions about diversity-related issues,

  Analyze and evaluate the contributions of various underrepresented social groups in shaping the history and culture of the U.S.,

  Analyze individual and institutional forms of discrimination based on factors such as race, ethnicity, gender, religion, sexual orientation, class, etc.,

  Analyze the perspectives of groups and individuals affected by discrimination,

  Analyze how cultural diversity and cooperation among social groups affect U.S. society.
- International Perspectives – Students should achieve two of the following outcomes. They should be able to:

  Analyze the accuracy and relevancy of their own worldviews and anticipate how people from other nations may perceive that worldview,

  Describe and analyze how cultures and societies around the world are formed, are sustained, and evolve,

  Analyze and evaluate the influence of global issues in their own lives,

  Describe the values and perspectives of cultures other than their own and discuss how they influence individuals' perceptions of global issues and/or events,

  Communicate competently in a second language.

In addition to the College level learning outcomes, each department within the college has additional discipline-specific outcomes that apply to graduates of that department.

Electives

Students use electives to broaden their education or to strengthen an area of specialization. Electives may be used to meet the requirements for a double major (see statement on double majors in this catalog). Those who wish to change their major, or who decide to graduate with a double major, must be enrolled for the last two semesters in the curriculum in which they expect to graduate. Students in ROTC may apply ROTC credits toward elective requirements.

Advising

Each student in the College of Agriculture and Life Sciences works closely with an academic adviser who is associated with the major in which the student is enrolled.

All entering students are strongly encouraged to participate in the summer orientation program in which they will have the opportunity to meet and work with academic advisers in planning their first semester schedule of classes.

The advisers also assist students in making personal adjustments to university life, offer suggestions on academic and co-curricular choices, and provide information on career choices. Advisers make a special effort to adjust course schedules in accordance with students' interests and capabilities.

A student may wish to prepare for admission to a professional program such as law, medicine, or veterinary medicine while pursuing a bachelor of science degree in the College of Agriculture and Life Sciences. This may be accomplished through several majors; however, it is recommended that the student work closely with an academic adviser.

Each department prepares a guide to help students chart their long-term programs and to specify the exact requirements for graduation. Visit the college web site www.ag.iastate.edu.

Graduate Study

Graduate study in agriculture is conducted through the Graduate College. Details are found in the Graduate College section of this catalog.

Various departments in the College of Agriculture and Life Sciences also participate in the following graduate-level interdepartmental offerings:

Biorenewable Resources and Technology
Ecology and Evolutionary Biology
Environmental Science
Genetics
Immunobiology
Microbiology
Molecular, Cellular, and Developmental Biology
Neuroscience
Nutritional Sciences
Plant Biology
Professional Agriculture (off-campus)
Seed Technology and Business
Sustainable Agriculture
Technology and Social Change (interdepartmental minor)
Toxicology

For details, consult the Graduate College section of this catalog.

Curriculum in Agricultural Biochemistry

Administered by the Department of Biochemistry, Biophysics and Molecular Biology.

Cr.	Degree Requirements
9.5	**Interpersonal and public communication skills** Engl 150, 250; Sp Cm 212; Lib 160
62-63	**Mathematical, physical, and life sciences** Math 165, 166, 265 or 266; Phys 221, 222; Chem 201 (or 177, 178), 177N (or 177L), 210 or 211, 211L, 322L, 324, 325, 331, 331L, 332; Biol 211, 212, 211L or 212L, 313, 314
15	**Humanities, ethics, and social science** 3 cr. in ethics from an approved list; 3 cr. in humanities; 3 cr. in social sciences; 3 cr. in U.S. diversity from an approved list; 3 cr. in international perspectives from an approved list
9	**Agricultural sciences** 9 cr. from an approved list available in the department. Two courses with environmental awareness emphasis will be chosen from an approved list.
11-13	**Agricultural biochemistry** BBMB 101, 102, 201, 404, 405 or 501, 502; 411. Students wishing research experience in agricultural biochemistry are encouraged to enroll in BBMB 499
21.5-22.5	**Electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
5	Advanced General Chemistry—Chem 201
1	Laboratory in General Chemistry— Chem 177N
4	Calculus I—Math 165
0.5	Library Instruction—Lib 160
3	Principles of Biology—Biol 211
1	Principles of Biology Laboratory—Biol 211L
1	Introduction to Biochemical Activities—BBMB 101
Cr.	**Spring**
3	Critical Thinking and Communication—Engl 150
4	Calculus II—Math 166
3	Communications—Sp Cm 212
3	Principles of Biology—Biol 212
1	Principles of Biology Laboratory—Biol 212L
1	Introduction to Biochemistry—BBMB 102

Curriculum in Agricultural Business

Administered by the Department of Economics. Students majoring in Agricultural Business often choose elective coursework leading to minors in the College of Business or in the College of Agriculture and Life Sciences, or emphasizing specific areas within agricultural business such as finance, management, commodity analysis, research, agricultural sales and marketing, environmental economics, farm and ranch operations, international economics, agricultural extension, or government service.

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Lib 160 Engl 150, 250 Engl 302 or Engl 309 or Engl 314 Sp Cm 212 or AgEdS 311
13	**Mathematics** Math 160, Econ 207, or Math 165, Econ 207, or Math 165, 166 Stat 226, 326
4-5	**Physical Sciences** Chem 163-163L or Phys 111
6	**Life and Environmental Sciences** Biol 101 or 211 NREM 120 or Biol 173 or other credits that meet the environmental intensive requirement
15	**Social science, humanities, and ethics** Courses in individual areas below may overlap but the total credits taken must equal 12 or more Ethics International Perspectives U.S. diversity Humanities (if the student has taken a humanities course among the ethics, international perspectives, or U.S. diversity requirements, the humanities requirement may be fulfilled by taking a course in a social science other than economics)
12	**Business** Acct 284, 285 Fin 301 One of the following: Mgmt 310, 370, Mkt 340, MIS 330, OSCM 320, or LSCM 360
6	**Electives in agricultural, food, or natural resources sciences**
26.5	**Economics** Econ 101, 101L, 110, 235, 301,302 or 353 Twelve credits in economics courses selected from an approved departmental list.
32-33	**Free electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
4	Microeconomics—Econ 101, 101L
0.5	Orientation in Agricultural Business—Econ 110
4	Mathematics I — Math 160 or 165
3	Elective in agricultural, food, or natural resource science.
3	Critical Thinking and Communication—Engl 150
0.5	Library Instruction — Lib 160
Cr.	**Spring**
3	Intro. to Agricultural Markets—Econ 235
3-4	Mathematics II—Econ 207 or Math 166
3	Macroeconomics—Econ 102
3	Environmental Biology—Biol 173
3	Agricultural, Food, or Natural Resources Science Course

Curriculum in Agricultural Education

Administered by the Department of Agricultural Education and Studies. Students majoring in Agricultural Education choose between two options: Teacher Certification or Communications.

Teacher Certification Option

Cr.	Degree Requirements
9.5	**Interpersonal and public communication skills** Engl 150, 250, Lib 160, AgEdS 311 (3 cr.)
18-19	**Mathematical, physical, and life sciences** Chem 163, 163L or 177, 177L; Stat 104; Biol 211, 211L; Biol 212, 212L; Math 104 or 150
18	**Humanities, ethics, and social sciences** Psych 230; C I 333 and 406; American history elective (3 cr.); from approved lists: 3 cr. in ethics; 3 cr. in international perspectives
37	**Agricultural sciences and economics** AgEds 488; Agron 114 and 154; An S 101 and 114; Hort 221; Econ 101, 331; NREM 120; 6 credits in agriculture and life sciences; 6 credits in courses 300-level or above to be chosen from technology systems management, animal science, agronomy, agricultural economics, forestry, or horticulture
31.5	**Professional credits** AgEdS 110A, 211A, 310, 401, 402, 416, 417 (14 Cr.); C I 201, 204, Sp Ed 450.
13-14	**Electives**

Communications Option

Cr.	Degree Requirements
9.5	**Interpersonal and public communication skills—** Engl 150, 250, Lib 160, AgEds 311
23-24	**Mathematical, physical, and life sciences—** Chem 163, 163L or 177, 177L; Biol 211, 212; BMBB 221 or Phys 106; life science elective (3 cr.); demonstration of computer proficiency; (3 cr.) Math 104 or 150; Stat 104
18	**Humanities, ethics, and social sciences—** Econ 101 or 102; psychology elective (3 cr.); ethics elective (3 cr.); international perspectives elective (3 cr.); U.S. diversity elective (3 cr.); humanities elective (3 cr.).
32	**Agricultural sciences and economics—** 10 credits in a selected area of agricultural sciences and economics including 6 credits at the 300-400 level; 6 cr. each in two additional areas of agricultural sciences and economics; agricultural sciences and economics electives (10 cr.)
32.5	**Professional communications—** AgEdS 110A, 211, 215, 315, 412 (6 cr.); select 21 cr. from Jl MC 101, 342, 347, Engl 205, 302, 309, 310, 314, 411, 415, 416, Mgmt 310, 370, 371, Sp Cm 110, 212, 312, 323, 327, ComSt 102, 214, 310, 314, 317
12-13	**Electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
0.5	Orientation–AgEdS 110A
3	Critical Thinking and Communication —Engl 150
3	Probability and Matrices—Math 104 or Discrete Mathematics for Business and Social Sciences – Math 150
3	Principles of Micro Economics—Econ 101
3	Principles of Biology I–Biol 211
1	Principles of Biology Laboratory – Biol 211L
2	Survey of the Animal Industry–- An S 114
2	Working with Animals–An S 101L
0.5	Library Instruction—Lib 160
Cr.	**Spring**
3	Statistics—Stat 104
3	Principles of Agronomy—Agron 114
3	Introduction to Instructional Technology—C I 201
3	Introduction to Agricultural Markets–Econ 235
3	Principles of Biology II—Biol 212
1	Principles of Biology Laboratory– Biol 212L

Curriculum in Agricultural Studies

Administered by the Department of Agricultural Education and Studies. Students are encouraged to develop one or more areas of concentration in agricultural sciences and economics.

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Engl 150, 250; written communications elective (3 cr.); speech elective (3 cr.); Lib 160
20	**Mathematical, physical, and life sciences** Chem 163, 163L or 177, 177L; Math 104 or 150; Stat 104; Biol 101 or 211; life science elective (6 cr.)
18	**Humanities, ethics, and social sciences** Econ 101; AgEdS 315; from approved lists: 3 cr. in ethics; 3 cr. in international perspectives; 3 cr. in U.S. diversity; humanities electives (3 cr.)
43.5	**Agricultural sciences and economics** AgEdS 110B, 215, 450; Agron 114, 154, 212; An S 114 and 101, electives (6 cr.); Econ 235, 330; Ent electives (2 cr.); 300-400 level agricultural sciences and economics electives (9 cr.); electives from the College of Agriculture (2cr.).
Other required courses	
3	Acct 284
31	**Electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
0.5	Orientation—AgEdS 110B
2	Survey of the Animal Industry—An S 114
2	Working with Animals—An S 101
3	Introduction to Probability and Matrices—Math 104 or Discrete Mathematics—Math 150
3	Critical Thinking and Communication—Engl 150
3	Social science elective
3	Introductory Biology—Biol 101
0.5	Library Instruction—Lib 160
Cr.	**Spring**
3	Principles of Agronomy—Agron 114
3	Principles of Microeconomics—Econ 101
3	Life science elective
3	Humanities elective
3	Statistics—Stat 104

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the agricultural studies curriculum.

Curriculum in Agricultural Systems Technology

Administered by the Department of Agricultural and Biosystems Engineering. A minor in agricultural systems technology is available; the requirements appear under Technology Systems Management, Courses and Programs.

Students majoring in Agricultural Systems Technology choose between two options: Agricultural and Biosystems Management or Machine Systems.

Agricultural and Biosystems Management Option

Cr.	Degree Requirements
12.5	Interpersonal and public communication skills Engl 150, 250; Sp Cm 212 or AgEdS 311; Engl 302 or 309 or 314; Lib 160
29	Mathematical, physical, and life sciences Math 142 and 160; Stat 104; Chem 163, 163L; Phys 111 and 112; and 6 cr. of life science from department-approved list
15	Humanities, ethics, and social sciences Econ 101; 3 cr. in humanities from college-approved list; 3 cr. in ethics from college-approved list, 3 cr. in International Perspectives from University-approved list; and 3 cr. U.S. Diversity from University approved list.
30	Technology core TSM 110, 111, 115, 116, 201, 210, 270, 301, 310, 363, 397, 399, 401, 415, and 416.
6	Business core Acct 284; Econ 330 or 355 or 336, or Mgmt 370 or 414.
33	Option core TSM 322, 324, 327, 330, 325, 333, 424, and 12 cr. in technical electives from department-approved list.
125.5	Total credits

Machine Systems Option

Cr.	Degree Requirements
12.5	Interpersonal and public communications skills Engl 150, 250; Sp Cm 212 or AgEdS 311; Engl 302 or 309 or 314; Lib 160
29	Mathematical, physical, and life sciences Math 142 and 160; Stat 104; Chem 163, 163L; Phys 111 and 112; and 6 cr. of life science from department-approved list.
15	Humanities, ethics, and social sciences Econ 101; 3 cr. in humanities from college-approved lists; 3 cr. in ethics from college-approved list; 3 cr. in international perspectives from university-approved list; and 3 cr. in U.S. diversity from university-approved list.
30	Technology core TSM 110, 111, 115, 116, 201, 210, 270, 301, 310, 363, 397, 399, 401, 415, and 416.
6	Business core Acct 284; Econ 330 or 355 or 336, or Mgmt 370 or 414.
33	Option core TSM 216, 240, 330, 333, 335, 337, 370, 443, 465, and 5 cr. of technical electives from department-approved list.
125.5	Total credits

Typical Program for the First Year

Cr.	Fall
1	Introduction to Technology—TSM 110
3	Trigonometry and Analytic Geometry—Math 142
3	Critical Thinking and Communication—Engl 150
5	General Chemistry—Chem 163, 163L
3	Life science elective
0.5	Library Instruction—Lib 160
Cr.	**Spring**
1	Experiencing Technology—TSM 111
3	Solving Technology Problems—TSM 115
3	Principles of Microeconomics—Econ 101
4	General Physics—Phys 111
4	Survey of Calculus—Math 160

Curriculum in Agronomy

Students majoring in agronomy study crop, soil, and environmental sciences under one of five options: agroecology; agronomy management and business; plant breeding; research and development; or soil and environmental science. A minimum of 15 credits in agronomy courses must be earned at Iowa State.

Core Requirements

Cr.	Degree Requirements
12.5	Interpersonal and public communication skills Engl 150, 250; Lib 160; Sp Cm 212 or AgEdS 311; Engl 302, or 309, or 314
6-14	Mathematical sciences Math 140 or 150 or 165/166 or 181/182, depending on option; and Stat 104
15-25	Physical sciences Chem 163/163L, or 177/177L and 178/178L; and 231/231L or BBMB 221 or Chem 331/331L and 332/332L; and Phys 106 or 111 or 221 depending on option
11-26	Biological sciences Biol 211, 211L, 212, 212L; other courses by option
15	Humanities, ethics, and social science 3 cr. each in ethics, U.S. diversity, international perspectives, humanities, and social sciences from approved lists
21.5-31.5	Agronomic sciences Agron 105, 110, 114, 154, 206, 210, 310 or 311, 316, 354, 354L, 410 and agricultural issues course.

Options

Agroecology

The Agroecology option provides the scientific foundation for understanding and managing agricultural systems with ecological and environmental perspectives. Students may pursue graduate study or careers in sustainable agriculture. More information is available from an agronomy adviser or www.agron.iastate.edu/academic/undergraduate/agro_ecol.aspx.

Agronomy Management and Business

The Agronomy Management and Business option is designed for those individuals who seek employment as agronomists working in agribusinesses such as cooperatives, seed companies, herbicide and fertilizer dealers, or crop consulting firms. More information is available from an agronomy adviser or www.agron.iastate.edu/academic/undergraduate/mgt_bus.aspx.

Plant Breeding and Biotechnology

The Plant Breeding and Biotechnology option is a science-oriented option recommended for those who would like to work in plant breeding or plant biotechnology. More information is available from an agronomy adviser or www.agron.iastate.edu/academic/undergraduate/plantbreeding.aspx.

Research and Development

The Research and Development is recommended for individuals who plan to work toward a graduate degree, or anyone who would like a strong science orientation in their degree program. More information is available from an agronomy adviser or www.agron.iastate.edu/academic/undergraduate/res_dev.aspx.

Soil and Environmental Quality

The Soil and Environmental Quality option is designed for those individuals interested in careers in environmental science, soil science, or natural resource managment. More information is available from an agronomy adviser or www.agron.iastate.edu/academic/undergraduate/soil_env.sci.aspx.

Typical Program for the First Year

Cr.	Fall
0.5	Orientation in Agronomy—Agron 110
3	Principles of Agronomy—Agron 114
3	Introduction to Meteorology—Agron 206
5	General Chemistry—Chem 163 and 163L
3	Critical Thinking and Communication—Engl 150
Cr.	**Spring**
3	Fundamentals of Soil Science—Agron 154
4	Principles of Biology I and Lab—Biol 211/211L
3	Mathematics or Statistics—Stat 104
0.5	Library Instruction—Lib 160
3	Principles of Microeconomics—Econ 101

Curriculum in Animal Ecology

Cr. Degree Requirements
15.5 Interpersonal and public communication skills
Engl 150 and 250; Sp Cm 212; Lib 160; two additional 3-cr. courses in written or oral communication from an approved list; and communications-intensive requirement
9-10 Mathematical sciences
Math 140 and 142; Stat 101 or 104
13 Physical sciences
Chem 163, 163L or 177, 177L; 231, 231L; Phys 106
20 Biological sciences
A Ecl 312, 365; Biol 211, 211L, 212, 212L; NREM 110, 120, 211
15 Humanities, ethics, and social science
From approved lists: 3 cr. in humanities; 3 cr. in social sciences; 3 cr. in ethics, 3 cr. in U.S. diversity, and 3 cr. in international perspectives; and environmental-intensive and problem-solving intensive requirements
R Practical experience requirement (NREM 104)

Students majoring in Animal Ecology are required to choose one of the following options by the end of their sophomore year: Aquatic Sciences, Fisheries, Interpretation of Natural Resources, Preveterinary and Wildlife Care, or Wildlife.

Options

Cr.
34 Aquatic Sciences
A Ecl 418, 486, 486L; Math 160 or 165, or 181; NREM 407; remaining credits to complete 34 total from approved list
34 Fisheries
A Ecl 321, 440, 441, 486, 486L; Math 160, 165, or 181; remaining credits to complete 34 total from approved list.
33 Interpretation of Natural Resources
A Ecl 366, Biol 366, Ent 370, NREM 303, 330, 430; one course from For 356 or Biol 474; one course from Agron 154, 206, Astro 120, Geol 100, 101, or Geol 108/Env S 108; remaining credits from approved list to equal 33 total.
33 Preveterinary and Wildlife Care
An S 214, NREM 330; one course from An S 336 or Biol 354; one course from Anthr 438, BMS 329, 415 and 416, Biol 155, 335, 351, 352, 434; one course from An S 331, Biol 313, 423, or Gen 320, one course from A Ecl 366, 458, 459 (one of the 400-level courses preferred for pre-vet students); three or more credits from A Ecl 401, 442, 454
An S 319, 493, Micro 201 and 201L, or Biol 353; 3 credits of A Ecl or NREM coursework at 300-level or above; remaining credits to complete 33 total from approved lists.
42 Wildlife
A Ecl 371, 451; Biol 313 or Gen 320, Biol 366; Math 160 or 165, or 181; 6 credits from A Ecl 457, 458, 459; 6 credits from A Ecl 455, NREM 450X, 460, 385/585, 532, FOR 453, Env S 293, 482, C R P 491; 3 credits from A Ecl 454X, 515, 551, Biol 315, 336X, 354, 354L, 471X, Ent 370, EEOB 507, NREM 475X, Anthr 438; 5 credits from Biol 355, 454, 456, 474, For 356, EEOB 564, Agron 317; remaining credits to complete 42 total from approved lists
12.5-22.5 Free electives
128 Total Credits

Typical Program for the First Year

Cr. Fall
4 Principles of Biology—Biol 211, 211L
R Orientation in Natural Resource Ecology and Management—NREM 110
3 Critical Thinking and Communication—Engl 150
3 College Algebra—Math 140
5 General Chemistry—Chem 163, 163L
Cr. Spring
4 Principles of Biology—Biol 212, 212L
3 Introduction to Renewable Resources—NREM 120
3 Statistics—Stat 101 or 104
0.5 Library Instruction—Lib 160
3 Trigonometry and Analytic Geometry—Math 142
3 Elective

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the animal ecology curriculum. The Preveterinary and Wildlife Care option has been designed for this purpose.

Curriculum in Animal Science

Students majoring in animal science will complete the degree requirements listed below. If desired, a student may also choose a specialized option. To earn a degree in Animal Science (AnS) from Iowa State University (ISU) a minimum of 15 credits in AnS must be earned from courses taught in the AnS department at ISU. Students desiring to complete a minor in AnS must complete 17 credits in AnS courses from a list maintained in the department, and a minimum of 9 credits in AnS must be earned from courses taught in the AnS department at ISU.

Cr. Degree Requirements
12.5 Interpersonal and public communication skills
Engl 150, 250, 302 or 309 or 314; Sp Cm 212 or AgEdS 311 or ComSt 214; Lib 160; and communications-intensive requirement*
10 Mathematical and computer sciences
Stat 101 or 104 or 226
Com S 103
Math 140 or 150 or 160 or 165 or 181 (some options may restrict choices)
3 Business elective
Econ 101 or 102 or Acct 284 (some options may restrict choices)
8 Physical sciences
Chem 163 & 163L or Chem 177 and 177L (some options may restrict choices); BBMB 221 or Chem 231 & 231L or Chem 331 & 331L (some options may restrict choices)
8 Biological sciences
Biol 211, 211L; 212, 212L; Biol 313 or Gen 320; Micro 201 & 201L or Micro 302 & 302L
18 Personal development, human relations, and global awareness
a minimum of: 3 credits in humanities; 3 cr. in social sciences; from approved lists : 3 cr. in ethics, 3 cr. in international awareness, 3 credits in U.S. multicultural awareness; and problem solving-intensive requirement;
36 Animal science
An S 101, 110, 114, 211, 214, 214L, 311, 319, 331, 352, 411; three courses from: AnS 216, 223, 224, 225, 226, 229, 235, 270 (some options may restrict choices); one course from: AnS 336, 337, 345, 360, Biol 305, 314, 352, 353, Ent 372, 374, Micro 310, VDPAM 487 (some options may restrict choices); one course from: AnS 415, 423, 424, 425, 426, 429, 434 (some options may restrict choices); one course from AnS 415, 419, 423, 424, 425, 426, 429, 434, 460, FS HN 405, 410, 420, Micro 407 (some options may restrict choices)
26.5 Pre-Veterinary Medicine
Chem 177, 177L, 178, 331, 331L, 332; BBMB 301 or Biol 314; Math 141 or 142 (if trigonometry not taken in high school) Phys 111; one course from AnS 415, 423, 424, 425, 426, 429 or 434; one course from AnS 415, 419, 423, 424, 425, 426, 429, 434, 460, FSHN 405, 410, 420, Micro 407; free electives 13.5
26.5 Livestock Management
Acct 284; AgEdS 451; Econ 101, 330, 331; An S 270; two courses from An S 223, 225, 226, 229, 235; two courses from An S 336, 337, 345, 360; one course from AnS 423, 424, 425, 426, 429, 434; one course from AnS 415, 419, 423, 424, 425, 426, 429, 434, 460, FS HN 405, 410, 420, Micro 407; VDPAM 487; free electives 8.5
26.5 Animal Products
Chem 177 & 177L; two courses from An S 223, 225, 226, 229, 235; An S 270, 360, 460; one course from 423, 425, 426, 429, 434, FS HN 405 or 410; one course from FS HN 420 or Micro 407; free electives 23.5

26.5 Pre-Graduate/Pre-Professional Studies
Chem 177, 177L, 178; Chem 231 & 231L or Chem 331 & 331L; 3 courses from departmental list ; Math 160 or 165 or 181; free electives 14.5

26.5 Companion Animal Management
Acct 284; business or economics electives 9; two courses from: AnS 216, 223, 225, 226, 229, 235, 270; AnS 224, 336, 424; one course from AnS 415, 419, 423, 425, 426, 429, 434, 460, FS HN 405, 410, 420, Micro 407; free electives 17.5

26.5 Equine Management
Acct 284; business or economics electives 9; ; two courses from: AnS 223, 224, 225, 226, 229, 235, 270; AnS 216, 415; 6 cr. equine electives from AnS 115, 217, 306, 316, 417, 475E, BMS 421; one course from AnS 419, 423, 424, 425, 426, 429, 434, 460, FS HN 405, 410, 420, Micro 407; free electives 11.5

Typical Program for the First Year

Cr.	Fall
R	Orientation in Animal Science—An S 110
2	Working with Animals—An S 101
3	Principles of Biology—Biol 211
1	Principles of Biology Lab—Biol 211L
3	Critical Thinking and Communication—Engl 150
0.5	Library Instruction—Lib 160
3	Mathematics—Math 140 or 150 or 160 or 165 or 181
3	Elective
Cr.	Spring
2	Survey of the Animal Industry—An S 114
4	General Chemistry—Chem 177 or 163
1	General Chemistry Lab—Chem 177L or 163L
3	Communications—Sp Cm 212 or AgEdS 311 or ComSt 214
3	Statistics—Stat 101 or 104 or 226
3	Humanities elective

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the animal science curriculum.

Curriculum in Biology

Administered by the Departments of Ecology, Evolution, and Organismal Biology; and Genetics, Development and Cell Biology.

Cr. Degree Requirements*

9.5 Interpersonal and public communication skills
Engl 150, 250; oral communication Sp Cm 212; Lib 160

7 Mathematics
7 credits of Math or Statistics, to include one semester each of Calculus and Statistics.

25 Physical sciences
25 credits selected from an approved list of chemistry, biochemistry and physics. List available on Biology Program web site.

24 Biological sciences core
Biol 110, 111, 211, 211L; 212, 212L, 312, 313, 313L, 314, 314L, 315

20 Advanced biology courses
20 credits in approved biology courses numbered 300 and above from department-approved list; 8 credits must be taken from biology designator; minimum of two laboratory or field courses must be included.

15 Humanities and social science
3 cr. in humanities, social sciences, ethics, international perspectives and U.S. diversity chosen from an approved list. The environmental intensive requirement is met by the core requirement of Biol 312.

17-20 Free electives

120 Total credits

Typical Program for the First Year

Cr.	Fall
0.5	Orientation in Biology— Biol 110
3	Critical Thinking and Communication—Engl 150
5	General Chemistry— Chem 163, 163L; or 177, 177L
4	Mathematics or Statistics—Math 160, 165 or 181; or Stat 101 or 104
4	Principles of Biology—Biol 211, 211L
0.5	Library— Lib 160
Cr.	Spring
0.5	Opportunities in Biology—Biol 111
4	General Chemistry— Chem 164, 164L; or 178, 178L; 164L; or 178, 178L; or approved physical sciences course
4	Mathematics or Statistics—Math 160, 165 or 181; or Stat 101 or 104
4	Principles of Biology—Biol 212, 212L
3-6	Elective

Curriculum in Culinary Science

Administered by the Department of Food Science and Human Nutrition

Cr. Degree Requirements*

9.5 Communications/Library
Engl 150, 250; Sp Cm 212 or ComSt 214; Lib 160

6-7 Mathematical sciences
Math 140, 142, 160, 165, or 181 Stat 101 or 104

9 Physical sciences
Chem 163;163L; 231, 231L

12-13 Biological sciences
BBMB 301; Biol 211, 212; Micro 201 or 302; and Micro 201L or 302L

11-12 Humanities/Social sciences
Econ 101; FS HN 342; 3 credits Humanities; 2-3 credits ENV S 120 or 201

44 Food science and human nutrition
FS HN 101, 104, 110, 167, 203, 214, 265, 311, 314, 403, 405, 406, 411, 412, 420, 480, 491B, 491D

3 Animal science
An S 270

22 Hotel, restaurant institutional management
HRI 233, 333, 340, 380, 380L, 383, 487 and AESHM 474

0-2 Electives

122.5 Total credits

*Additional requirement: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Curriculum in Dairy Science

Students majoring in Dairy Science will complete the courses below for a professional degree or alternatively may complete the specialized option in Pre-Veterinary medicine.

Cr. Degree Requirements

9.5 Interpersonal and public communication skills
Engl 150, 250; Sp Cm 212 or AgEds 311; Lib 160; and communications intensive requirement

9-13 Mathematical and business sciences
TSM 115 or Com S 103 or proficiency exam; Econ 101; Math 150; Stat (3 cr.)

8 Physical sciences
Chem 177, 177L; BBMB 221 or Chem 231 or 331

10-11 Biological sciences
Biol 211, 211L; Biol 313 or Gen 320; Micro 201 and 201L or FS HN 273; and environmental-intensive requirement

15 Personal development, human relations, and global awareness
3 cr. in humanities; 3 cr. in social sciences; from approved lists: 3 cr. in ethics, 3 cr. in international awareness, 3 cr. in U.S. multicultural awareness; and problem solving-intensive requirement

34 Professional dairy science
An S 101, 110, 114, 211, 214, 214L, 235, 311, 319, 331, 337, 352, 411, 434; FSHN 101 or An S 270; minimum of two courses from list maintained in department; a mini-mum of 15 credits in this category must be earned from courses taught in the ISU Animal Science department.

37.5-42.5 Free electives

Specialized Option

22 Pre-Veterinary Medicine
Additonal courses required for entrance to Veterinary Medicine 22; free electives 15.5-20.5

128 Total Credits

Typical Program for the First Year

Cr.	Fall
R	Orientation in Dairy Science—An S 110
2	Survey or the Animal Industry—An S 114
2	Working with Animals—An S 101
3	Principles of Biology—Biol 211
1	Principles of Biology Lab—Biol 211L

3 First-Year Composition—Engl 150
0.5 Library Instruction—Lib 160
3 Mathematics—Math 150
3 Elective

Cr. Spring
3 Technology Problems—TSM 115
4 General Chemistry—Chem 177
1 General Chemistry Lab—Chem 177L
3 First-Year Composition—Engl 250
3 Introduction to Statistics—Stat 104
3 Elective

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the dairy science curriculum.

Curriculum in Diet and Exercise B.S./M.S.

Administered by the Department of Food Science and Human Nutrition and Health and Kinesiology.

Courses included have been approved as meeting the academic requirements of the American Dietetic Association in preparation for admission to dietetic internship programs. There is a $30 fee for a statement of verification of completion of the approved program. Courses also are included to meet the ACSM requirements for certification at the level of Health Fitness Instructor.

Cr. Degree Requirements*
9.5 Interpersonal and public communication skills
Engl 150, 250; Lib 160; Sp Cm 212
38-41 Mathematical, physical, and life sciences
Math 140, 142, 160, 165, or 181; Stat 101, 104, or 226; Chem 163 and 163L or 177, 177L, and 178; 231; 231L; Phys 106 or 111; BBMB 301; Biol 211, 212, 255, 255L, 256, 256L; Micro 201
15 Humanities and social science
select 3 credits from approved humanities course list; select 3 credits from approved Ethics course list (if ethics course selected is not on the humanities list, 3 additional credits of humanities must be taken.); Psych 101, 230
20-22 Diet and Exercise
Kin 252-253 or FS HN 110; Kin 258; FS HN 167, 214, 265, 360; H S 110
41 Diet and exercise
H S 380; Kin 220, 259, 345,358, 462; FS HN 403. 411, 463, 466, NutrS 561;
HRI 380, 380L, 392; Kin 355, 360, 366, or 372
123.5 Total credits

*Additional requirement: Students must fulfill international perspectives, U.S. diversity requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Graduate Program

Cr. Degree Requirements
39-40 Graduate level coursework
FS HN 581; NutrS 501, 561, 562, 564; Kin 501, 505, 551, 558; Kin 699 or NutrS 699A; Stat 401; Kin 550, 570, or NutrS 502.
Additional requirement: FS HN 490C for students in the FSHN Department.

Curriculum in Dietetics

Administered by the Department of Food Science and Human Nutrition.

The student is prepared for admission to dietetic internship programs and other professional experience programs approved/accredited by The American Dietetic Association. Courses included have been approved as meeting the academic requirements of The American Dietetic Association. There is a $30 fee for a statement of verification of completion of the approved program.

Cr. Degree Requirements*
9.5 Communications
Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212
6-7 Mathematical sciences
3 credits Math 140, 142, 160, 165 or 181; Stat 101 or 104
9-12 Physical sciences
Chem 163 and 163L or 177, 177L, and 178; 231; 231L;
20-22 Biological sciences
BBMB 301 or Biol 314; Biol 211, 212, 212L, 255, 255L; 300-level 300-level physiology course (Biol 306 or 335)
11-12 Humanities/Social sciences
3 crs. Humanities course; Env S 120 or 201; FS HN 342; Psych 101
40 Food science and human nutrition
FS HN 110, 167, 203, 214, 261, 340, 360, 361, 362, 403, 411, 461, 463, 464, 466, 480
11 Management
HRI 380, 380L, 391, 392
0-7 Electives
120.5 Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Curriculum in Environmental Science

Cr. Degree Requirements
9.5 Communication
Engl 150, 250; Lib 160; speech elective (3 cr.)
7 Mathematical sciences
One course in statistics and one course in calculus
24 Physical and Life Sciences
24 credits of approved coursework in biology, chemistry, physics, and earth sciences
15 Humanities, ethics, and social science
3 cr. ethics, 3 cr. U.S. diversity, 3 cr. of international perspectives, 3 cr. of humanities, and 3 cr. of social sciences.
29 Environmental Science
EnSci 110, 201, 250, 381, 382, and 15 additional credits of approved EnSci coursework.
35.5 Free electives
120 Total credits

Typical Program for the First Year

Cr. Fall
1 Orientation – EnSci 110
2 Environmental Issues – EnSci 201
3-4 Statistics —Stat 101 or 104
4 Gen Chem —Chem 177
1 Gen Chem Lab —Chem 177L
3 Communication — Engl 150
0.5 Library Instruction —Lib 160

Cr. Spring
3 Princ. Biology—Biol 211
1 Princ. Biology Lab —211L
4 Calculus —Math 160, 165 or 181
3 Gen Chem II — Chem 178
1 Gen Chem II Lab –Chem 178L
3 Humanities or social science choice

Curriculum in Food Science

Administered by the Department of Food Science and Human Nutrition.

Option 1. Food Science and Technology

Cr. Degree Requirements*
12.5 Communications/Library
Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212; TSM 115
11-12 Mathematical Sciences
Math 165 and 166, or 181 and 182; Stat 101 or 104
23 Physical Sciences
Chem 177, 177L, 178, 331, 331L, 332; Phys 111, 112
13 Biological sciences
BBMB 301; Biol 211, 212; Micro 302, 302L
11-12 Humanities/Social Sciences
3 credits Humanities courses; 3 credits Social Sciences courses; FS HN 342; and Env S 120 or 201
44 Food science and human nutrition
FS HN 101, 110, 167, 203, 311, 351, 403, 405, 406, 410, 411, 412, 420, 421, 471, 472, 480
0-2 Electives
120.5 Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Option 2. Food Science and Industry

Cr. Degree Requirements*
15.5 Communication/Library
Engl 150, 250; Lib 160; Jl MC 305, or 220, or 347; Sp Cm 212 or ComSt 214; TSM 115
7-8 Mathematical Sciences
Math 160, 165, or 181; Stat 101 or 104

16 Physical Sciences
Chem 163 and 163L or 177, 177L and 178; 231; 231L; Phys 106
12-13 Biological Sciences
BBMB 301; Biol 211, 212; Micro 201 or 302; Micro 201L or 302L
11-12 Humanities/Social Sciences
Econ 101; FS HN 342; select 3 credits of humanities courses; and Env S 120 or 201.
6 Business
Select 6 credits from Acct 215, 284, 285; Econ 301, 320; Mgmt 310, 370, 371, 414, 472; MIS 330; Mkt 340, 447, 448
44 Food science and human nutrition
FS HN 101, 110, 167, 203, 311, 351, 403, 405, 406, 410, 411, 412, 420, 421, 471, 472, 480
0-5 Electives
120.5 Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Option 3. Consumer Food Science

Cr. Degree Requirements*
21.5 Communications/Library
Engl 150, 250; Jl MC 305 or 220; select 6 cr. from Jl MC 347, Engl 205, 302, 309, 313, or 314; Sp Cm 212 or ComSt 214; Lib 160; TSM 115
6-7 Mathematical sciences
Math 140, 142, 160, 165, or 181; Stat 101 or 104
16 Physical sciences
Chem 163 and 163L or 177, 177L and 178; 231, 231L; Phys 106
12-13 Biological sciences
BBMB 301; Biol 211, 212; Micro 201 or 302; and Micro 201L or 302L
11-12 Humanities/Social sciences
Econ 101; FS HN 342; 3 credits Humanties courses; and Env S 120 or 201
41 Food science and human nutrition
FS HN 101, 110, 167, 203, 214, 265, 311, 403, 405, 406, 411, 412, 420, 471, 480
6 Business
Mkt 340 and 447
0-3 Electives
120.5 Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Concurrent B.S. and M.S. Program:

Well qualified students in Food Science who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both a bachelor of science in Food Science and a master of science degree in Food Science and Technology. For more information, refer to www.fshn.hs.iastate.edu

Curriculum in Forestry

Cr. Degree Requirements
12.5 Interpersonal and public communication skills
Engl 150, 250; 314, or 302 or 309; Lib 160; Sp Cm 212
22 Mathematical, physical, and life sciences
Math 140, 150; Stat 101 or 104; Chem 163, 163L; Biol 211, 211L; Agron 154
15 Humanities, ethics, and social science
3 cr. in humanities; 3 cr. in ethics from approved list; Soc 130 or 134 and 3 cr. in U.S. diversity and 3 cr. in international perspectives
29 Forestry courses
For 201, 202, 203, 204, 205, 206, 302, 451, 454; NREM 110, 120, 211
R Practical experience requirement
NREM 104

Students majoring in forestry are required to choose one of the following options at the end of their sophomore year: forest ecosystem management; sustainable material science and technology; urban and community forestry; natural resource conservation and restoration; or interpretation of natural resources.

Options

Cr.
40 Sustainable Materials Science and Technology
Chem 231, 231L, Econ 101, For 280, 480, 481, 483, 485, 486, 487; Math 151; Mkt 340, Stat 401
35 Forest Ecosystem Management
Biol 212, 212L, For 280, 342, 356, 452; one course from NREM 385, 460; For 453; Math 151 or 181; NREM 301, 345; Pl P 416
37 Urban and Community Forestry
Biol 212, 212L; For 280, 356, 452, 475; Hort 342 or 344; one course from NREM 385,460 or For 453; Math 151 or 181; Pl P 416; Soc 310 or 382; C R P 253 or 270
44 Natural Resource Conservation and Restoration
A Ecl 312; Biol 212, 212L, 204; For 356, 452; one course from NREM 385, 460 or For 453; Math 151 or 181; NREM 301, 330, 390, 407; Pl P 416; 3 credits from approved departmental list
34 Interpretation of Natural Resources
A Ecl 365 and 366; Biol 212, 212L, 366, Ent 370, NREM 303, 330, 430; For 452, one course from (For 453 or NREM 460 or 385); one course from Agron 206, Astro 120, Geol 100, 101, 108; select remaining credits to complete 34 credits from approved departmental list.
5.5-15.5 Free electives
128 Total credits

Typical Program for the First Year

Cr. Fall
3 Critical Thinking and Communication—Engl 150
R Orientation in Natural Resource Ecology and Management—NREM 110
3 College Algebra—Math 140
3 Principles of Biology I—Biol 211
1 Principles of Biology Laboratory I—Biol 211L
3 Introduction to Renewable Resources—NREM 120
3 Social Science—Soc 130 or 134
16

Cr. Spring
3 Foundations of Soil Science—Agron 154
0.5 Library —Lib 160
3 or 4 Statistics—Stat 101 or 104
4 General Chemistry I —Chem 163
1 General Chemistry Lab I—Chem 163L
3 or 4 Wood Properties and Identification—For 280 or U.S. Diversity/International Perspectives
14.5 or 16.5

Curriculum in Genetics

Undergraduate study in genetics is jointly administered by the Department of Biochemistry, Biophysics, and Molecular Biology, the Department of Genetics, Development, and Cell Biology, and the Department of Ecology, Evolution, and Organismal Biology.

Cr. Degree Requirements
12.5 Communications
Engl 150, 250; an advanced English writing course (Engl 302-316); oral communication (AgEdS 311, Sp Cm 212; Lib 160
11 Math
Must include at least one course from both calculus and statistics chosen from Math 160, 165, 166, 181, 182; Stat 101 or 104, 401, 402, 403
3 Computer Studies
Three credits in computer science or computer applications chosen from an approved list. See department for list.
31 Physical sciences
Chem 177, 177L, 178, 178L (or 211), 331, 331L, 332, 332L; BBMB 404 or 420; Chem 211 or 321 or BBMB 405 or 411; Physics 111, 112 or 221, 222
23 Biological sciences
Biol 211, 211L, 212, 212L, 313, 313L, 314, 314L; Micro 302; Biol 315
15 Humanities, ethics, and social sciences
15 credits including at least 3 cr. each in the humanities, social sciences, ethics, international perspectives and U.S. diversity chosen from an approved list.
The environment-intensive and problem solving-intensive college requirements can be satisfied by selection of appropriate courses. See department for lists.

9.5 Genetics
Gen 110, 410, 411, 460 or 462, 491
9 Support electives
Choose 9 credits from approved list. See department for list.
Biol (A Ecl) 312 must be included in the program
Electives
Additional electives sufficient to equal the 128 credits required for graduation.
128 Total credits

Typical Program for the First Year

Cr.	Fall
5	General Chemistry—Chem 177, 177L
3	English—Engl 150
4	Calculus—Math 165 or 181
4	Principles of Biology—Biol 211, 212L
0.5	Orientation and Career Opportunities—Gen 110
0.5	Library Instruction—Lib 160
Cr.	**Spring**
4	General Chemistry—Chem 178, 178L
3	Statistics 101 or 104
4	Calculus—Math 161 or 166 or 182
4	Principles of Biology—Biol 212, 212L

Curriculum in Global Resource Systems

Administered by a supervisory committee in the College of Agriculture and Life Sciences. Students choose a region of the world, either industrialized or developing, to develop an expertise; they choose a language to learn and develop proficiency through the intermediate level; they choose and possess an area of technical expertise by completing a minor or certificate program in the College of Agriculture and Life Sciences; they complete a required internship in an international setting; and they select and complete a senior research project with faculty mentoring.

Cr.	Degree Requirements
12.5	Interpersonal and Public Communications Skills
3	Critical Thinking and Communication—Engl 150
3	Written, Oral, Visual, and Electronic Composition—Engl 250
0.5	Library Instruction—Lib 160
3	Report and Proposal Writing —Engl 309 or
3	Business Communication —Engl 302 or
3	Technical Communication—Engl 314
3	Fundamentals of Public Speaking—Sp Cm 212 or
3	Presentation and Sales Strategies for Agricultural Audiences—AgEds 311

6-8 credits

Cr.	Mathematical Sciences
3-4	Mathematics (Math 140 or higher course number)
3-4	Statistics—101 or 104

15 credits

Cr.	Humanities, Ethics, and Social Science
3	Humanities (from approved list)*
3	Social Sciences—Econ 101 or 102
3	International Perspectives from approved list*
3	U.S. Diversity from approved list
3	Ethics (from approved list

* Requirement embedded within other curriculum requirements

27-35 credits (depending upon language study)

Cr.	Global Competency
12-20	Students will emphasize a region of the globe. World Language proficiency through intermediate levels. Complete 100 and 200 levels of a single college-level world language.
15	Coursework in culture, history, politics and economics in which students emphasize a global region outside the United States, up to 3 credits may be earned through travel courses. Courses in the WLC Language and Cultures for Professions are also eligible.

15 - 18 credits

Cr.	Physical and Life Sciences
5	General Chemistry—Chem 163, 163L; or 177, 177L
4	Principles of Biology—Biol 211, 211L
3	300-level or higher life sciences course

One of the following is required, two are recommended:

3	Environmental Geology—Geol 101
3	Fundamentals of Soil Science—Agron 154 or
3	Soils for Horticulture Scientists—Agron 155
3	Introduction to Meteorology—Agron 206
3	World Climates—Agron 406

22 credits

Cr.	Global Resource Systems
1	Orientation—Globe 110
3	Global Resource Systems (1Cr.)—Globe 201
3	Issues in Global Resource Systems—Globe 211
3	Resource Systems of Industrialized Nations—Globe 301
3	Resource Systems of Developing Nations—Globe 302
3 - 12	Internship Global or United States
3	Senior Research—Globe 401
3	Responses to Global Resource System Challenges—Globe 402

15 -18 credits

Cr.	Technical Concentration

15 -18 credits: Satisfied by any of the 23 minors or a certificate offered in the College of Agriculture and Life Sciences.

14 - 16 credits: Free Electives

128.5 Total Credits

Curriculum in Horticulture

Students majoring in horticulture will select an option in which to specialize before reaching junior standing and will fulfill the requirements described below under Specialization Options.

A horticulture minor is available. The requirements appear under *Horticulture, Courses and Programs*.

Cr.	Degree Requirements
12.5	Interpersonal and Public Communication Skills Engl 150, 250, 302 or 314; Lib 160; Sp Cm 212 or AgEdS 311; and a communications-intensive requirement (see department for procedure)
6-9	Mathematical sciences Math 140 or 150 or 165 or 181; and Stat 101 or 104 or 226 or 401
13	Physical sciences Chem 163, 163L; or 177, 177L; and 231, 231L, or 331, 331L; and one complete course from: Chem 164, 164L; 178, 178L; or Phys 106 or 111. A student must take either (1) Chem 163/163L and 164/164L series and Chem 231/231L series or (2) Chem 177/177L and 178/178L series and Chem 331/331L. A student may take Phys 106 or 111 instead of Chem 164/164L or 178/178L.
18	Biological sciences Biol 211, 211L, 212, 212L select 10 credits from the following group: Agron 260, 316, 317, 354, 354L; Biol 312, 314, 314L, 330, 355, 366, 454, 474; Ent 370, 375, 376; For 416; Pl P 391, 408; Gen 320 or Biol 313, 313L.
15	Humanities, ethics, and social sciences One 3-credit course from an approved list in each of the following areas: humanities,ethics, social science, U. S. diversity, and international perspectives; see department for procedure in meeting problem-solving, environmental-intensive, and communication-intensive requirements.
3	Soil science Agron 154 or 155
30	Horticulture Hort 110, 221, 321, 497; select a minimum of 22 credits from the following group: Hort 233, 240, 280, 282, 283, 322, 330, 332, 338, 341, 342, 351, 351L, 354, 354L, 380, 381, 391, 398, 422, 423, 424, 434, 435, 442, 444, 445, 446, 451, 452, 453, 454, 461, 471, 471L, 475, 480, 481, 484, 490, 491, 493, 495, 496, 497, 511, 551. Transfer students may transfer up to 10 credits of 200- and 300-courses in the horticulture area.
	Specialization Options (A minor in an approved area of study may be substituted for the Specialization Option with permission of student's adviser)
12	Environmental horticulture option: Hort 424 must be among the courses that fulfill the horticulture requirement. Other recommended course is Hort 484. The student must

take Biol 312 and 9 or more credits from the following group: Agron 260, Biol 355, Econ 334, Ent 375, Env S 293, 324, 382, 450, 460, 491; TSM 324, 424.

12 Fruit and vegetable production and management option:
Hort 422, 445, 461, 471 and 471L must be among the courses that fulfill the horticulture requirement. Acct 284; and 9 or more credits from the following group: Acct 215, 285, 316; Com S 103; Econ 230, 334; FS HN 272, 403, 405, 471, 472; Mgmt 310, 313, 370, 371; Mkt 340, 442, 446, 447; TSM 270.

12 Greenhouse production and management option:
Hort 233, 322, 330, 332, 422, 434, 435 and 445 must be among the courses that fulfill the horticulture requirement. Acct 284; and 9 or more credits from the following group: Acct 215, 285, 316; Com S 103; Econ 334; Ent 375; Mgmt 310, 313, 370; Mkt 340, 442, 446, 447.

15 Horticultural communications and public education:
Students in this option must take Engl 314 under Interpersonal and Public Communications Skills and a minimum of 12 credits from the following group: ComSt 102, 214, 317; Engl 220, 303, 305, 313; Jl MC 201, 220, 310, 341, Sp Cm 312, 313.

12 Landscape Design, Installation and Management option:
Hort 240, 280, 330, 341, 342, 351, 380, 381, 444, 446, 480 and 481 must be among the courses that fulfill the horticulture requirement. Up to 3 credits can be used in the biological sciences area. Another recommended course is Hort 445. Acct 284; and 9 or more credits from the following group: Acct 215, 285 316; Mgmt 310, 313, 370, 371; Mkt 340, 343, 442, 447; TSM 324.

12 Nursery crops production and garden center management option:
Hort 240, 322, 330, 341, 342, 351, 442, and 445 must be among the courses that fulfill the horticulture requirement. Acct 284; and 9 or more credits from the following group: Acct 215, 285, 316; Agron 206; Com S 103; Econ 230, 334; EnSci 446 or 461I; Mgmt 310, 313, 370, 371; Mkt 340, 442, 446, 447; TSM 270.

12 Public garden management and administration option:
Hort 233, 240, 282, 322, 330 and 445 must be among the courses that fulfill the horticulture requirement. Other recommended courses are Hort 280, 332, 341, 342, 351, 351L, 380 and 381. The student must select a minimum of 12 credits from the following: Acct 284, 285, 316; Econ 334; Engl 303, 309, 313, 415; EnSci 446 or 461I; Fin 301; JLMC 220; Mgmt 310, 313, 370, 371 471; Sp Cm 312, 313.

12 Science option:
Those who choose the Science Option must take: Biol 330 for part of the biological sciences requirement; Math 165 or 181 for the mathematical sciences requirement; Chem 177, 177L, 178, 178L, 331, 331L, 332, 332L, Phys 111 and 112 for the physical sciences requirement. BBMB 301 or 404, Math 166 or 182; and 5 or more credits from the following group: BBMB 311, 404, 405, 411; Biol 313, 313L, 314, 314L, 315; Chem 211, 211L, 316, 316L, 321L, 322L, 324; Com S 107, 207; Gen 409, 410.

12 Turfgrass management option:
Hort 240, 351, 351L, 445, 451, 452, 453 and 551 must be among the courses that fulfill the horticulture requirement. Other recommended course: Hort 330. Acct 284 and 9 or more credits from the following group: Acct 285, 316; Agron 206, 260, 317, 338, 356, 360, 459; Com S 103; Econ 334; Ent 375; Env S 201, 324; EnSci 446 or 416I; HRI 289; Mgmt 370, 371; Pl P 391; TSM 270, 324, 424; additional business courses may be used with permission of adviser.

14-18 Electives

128.5 Total credits

Typical Program for the First Year

Cr.	Fall
3	Humanities or Free Elective
5	General Chemistry—Chem 163, 163L or 177, 177L
3	First-Year Composition—Engl 150
1	Orientation in Horticulture—Hort 110
0.5	Library Instruction—Lib 160
3	Fundamentals of Algebra for Science and Higher Mathematics—Math 140
2	Home Horticulture—Hort 121
Cr.	**Spring**
3	General Biology—Biol 211
3-4	Principles or Introduction to Statistics—Stat 101, 104
3	Humanities or social science from an approved list
3	Soils for Horticultural Scientists—Agron 155
3	Principles of Horticulture—Hort 221

Curriculum in Industrial Technology

Administered by the Department of Agricultural and Biosystems Engineering.

An undergraduate certificate in occupational safety is available; the requirements appear under Technology Systems Management courses and programs. A minor in Industrial Technology is available; the requirements appear under Technology Systems Management courses and programs.

Students majoring in Industrial Technology choose between two options: Manufacturing or Occupational Safety.

Manufacturing Option

Cr. Degree Requirements

12.5 Interpersonal and public communications skills
Engl 150, 250; Sp Cm 212 or AgEds 311; Engl 302 or 309 or 314; Lib 160

29 Mathematical, physical, and life sciences
Math 142 and 160; Stat 104; Chem 163, 163L; Phys 111 and 112; and 6 cr. of life science from department-approved list

15 Humanities, ethics, and social sciences
Econ 101; 3 cr. in humanities from college-approved list; 3 cr. in ethics from college-approved list; 3 cr. in international perspectives from university-approved list; and 3 cr. in U.S. diversity from university-approved list.

30 Technology core
TSM 110, 111, 115, 116, 201, 210, 270, 301, 310, 363, 397, 399, 401, 415, and 416.

6 Business core
Acct 284; Econ 330 or 355 or 336, or Mgmt 370 or 414.

33 Option core
TSM 216, 240, 337, 340, 370, 440, 443, 444, 445, 465, and 3 cr. of technical electives from department-approved list

125.5 Total credits

Occupational Safety Option

Cr. Degree Requirements

12.5 Interpersonal and public communications skills
Engl 150, 250; Sp Cm 212 or AgEds 311; Engl 302 or 309 or 314; Lib 160

29 Mathematical, physical, and life sciences
Math 142 and 160; Stat 104; Chem 163, 163L; Phys 111 and 112; Biol 155 and 3 cr. of life science from department-approved list.

15 Humanities, ethics, and social sciences
Econ 101; 3 cr. in humanities from college-approved list; 3 cr. in ethics from college-approved list; 3 cr. in international perspectives from university-approved list; and 3 cr. in U.S. diversity from university-approved list.

30 Technology core
TSM 110, 111, 115, 116, 201, 210, 270, 301, 310, 363, 397, 399, 401, 415, and 416

6 Business core
Acct 284; Econ 330 or 355 or 336, or Mgmt 370 or 414.

33 Option core
H S 105; I E 271; TSM 240, 272, 276, 370, 372, 470, 471, 477, and 8 cr. of technical electives from department-approved list.

125.5 Total credits

Typical Program for the First Year

Cr.	Fall
1	Introduction to Technology—TSM 110
3	Trigonometry and Analytic Geometry—Math 142
3	Critical Thinking and Communication—Engl 150
5	General Chemistry—Chem 163, 163L
3	Life science elective
0.5	Library Instruction—Lib 160
Cr.	**Spring**
1	Experiencing Technology—TSM 111
3	Solving Technology Problems—TSM 115
3	Principles of Microeconomics—Econ 101
4	General Physics—Phys 111
4	Survey of Calculus—Math 160

Curriculum in International Agriculture

Administered by an Interdepartmental Committee. International agriculture can be taken only as a secondary major in conjunction with a primary major in the College of Agriculture and Life Sciences. A minor is available to interested students regardless of their major.

Cr.	Degree Requirements
	(Additional prerequisites may be required for some courses.)
12.5	**Interpersonal and public communication skills** Engl 150, 250; Sp Cm 212 or AgEdS 311; Lib 160; electives (3 cr.) select from Engl 302 or 314, or JI MC 205
19	**Mathematics, physical, and life sciences** Math 150, Chem 163, 163L, or Chem 177, 177L, math or physical science electives select from BBMB, Chem, Com S, Math, Phys, or Stat (5 cr.); biological sciences electives select from Biol, Gen, Micro, or PI P (6 cr.) and demonstration of computer proficiency (See primary major department.)
15	**Humanities, ethics, and social sciences** Soc 130 or 134, or Econ 101; 3 cr. in ethics; 3 cr. in U.S. diversity; 3 cr. in international perspectives
15	International Agriculture Internship in International Agriculture or Study Abroad Program or Foreign Language (6cr.)
3	Agron 342 Select courses with international agriculture focus in any major in the College of Agriculture and Life Sciences (6 cr.) (See Supervisory Committee list)
66.5	**Primary major requirements and free electives**
128	**Total credits**

Program for the First Year

Because international agriculture is a secondary major, the courses taken by the student during the first year will vary, depending on the primary major (see typical program for the primary major).

Curriculum in Insect Science

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Engl 150, 250, 314; Sp Cm 212; Lib 160
3	**Mathematical and physical sciences** Stat 104
14	**Life sciences** Biol 211, 211L, 212, 212L, 312; Micro 201, 201L
15	**Humanities, ethics, and social science** Econ 101; 3 cr. in humanities; from approved lists: 3 cr. in ethics; 3 cr. in international perspectives; 3 cr. in U.S. diversity requirement
19	**Entomology** Ent 110, 201, 211, 370, 374, 376; 490E; Ent electives; for students entering entomology with one year or more of college-level biological sciences courses, Ent 201 and 211 are waived, and the group requirement reduced to 16 cr.

Students majoring in Entomology are required to choose one of the following options by the end of their sophomore year; Agricultural and Horticultural Insect Management, or Insect Biology.

Agricultural and Horticultural Insect Management Option

Cr.	Degree Requirements
5	**Mathematics** Math 140, 141
13	**Physical Sciences** Chem 163, 163L, 231, 231L; Phys 106
6	**Biological Sciences** BBMB 301; Biol 330
12	**Agricultural Sciences** Agron 114 or Hort 221; Agron 154 or 155, 317; PI P 408
5	**Entomology** Ent 283, 375
6	**Social Sciences** Acct 215; Econ 235
17.5	**Free electives**

Insect Biology Option

Cr.	Degree Requirements
4	**Mathematics** Math 181
28	**Physical Sciences** Chem 177, 177L, 178, 178L, 211, 211L, 331, 331L, 332; Phys 111, 112
17-18	**Biological Sciences** Biol 313, 313L, 314, 314L, 315; 330 or 335; 364
14.5-15.5	**Free electives**

Typical Program for the First Year

Cr.	Fall
3	Critical Thinking and Communication—Engl 150
3	Principles of Biology—Biol 211
1	Laboratory in Principles of Biology—Biol 211L
4	General Chemistry—Chem 163 or 177
1	Laboratory in General Chemistry—Chem 163L or 177L
4	Fundamentals of Algebra for Science and Higher Mathematics—Math 140 or Calculus and Differential Equations—Math 181
R	Orientation in Entomology—Ent 110
Cr.	**Spring**
3	Introduction to Statistics—Stat 104
4	General Chemistry—Chem 231, 231L, or 178, 178L
4	Principles of Biology—Biol 212, 212L
1	Introduction to Insects—Ent 201
2	Insects and Society—Ent 211
0.5	Library Instruction—Lib 160

Curriculum in Microbiology

www.micro.iastate.edu
Administered by an interdepartmental committee

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Engl 150, 250; Engl 302 or Engl 309 or Engl 314; Sp Cm 212; Lib 160
10-12	**Mathematical sciences** Stat 101 or 104 required; 2 semesters of math with at least one semester of calculus
26-29	**Physical sciences** **Chemistry**—Chem 177, 177L, 178 **Organic Chemistry:** Chem 331, 331L, 332. **Biochemistry**—BBMB 404 and 405 (recommended) or 301 **Physics**: Phys 111, 112.
16	**Biological sciences** Biol 211, 211L, 212, 212L, and 313, 313L, 314, 314L.
15	**Humanities, ethics, and social sciences** Minimum of 3 credits each in courses in humanities and social sciences. Also, 3 credits each in ethics, international perspectives, and U.S. diversity courses selected from approved lists.
28.5	**Microbiology** Required: Micro 110, 302, 310, 320, 430 or 477 or 456, 450, 451. Required labs: Micro 302L, 310L or 475L, 440. A minimum of 9 credits of microbiology courses at a 400-level and above or from departmental approved list with no more than 3 credits from laboratory courses.
15-20	**Electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
4	General Chemistry—Chem 177
1	Laboratory in General Chemistry—Chem 177L
3	First-Year Composition—Engl 150
3	Principles of Biology—Biol 211
1	Laboratory in General Biology—Biol 211L
3	Humanities, ethics, or social science
0.5	Library 160
R	Orientation in Microbiology—Micro 110

Cr. Spring
3 General Chemistry—Chem 178
3 Principles of Biology—Biol 212
1 Laboratory in General Biology—Biol 212L
3 Biology of Microorganisms—Micro 302
1 Microbiology Laboratory—Micro 302L
3 Statistics 101 or 104
3 Humanities, ethics or social science

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the microbiology curriculum.

Curriculum in Nutritional Science

Administered by the Department of Food Science and Human Nutrition.

Cr.	Degree Requirements*
12.5	**Communications/Library** Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212; Engl 314
7-12	**Mathematical sciences** Math 160, 165-166, or 181-182 Calculus (2 semesters recommended); Stat 101 or 104
24	**Physical sciences** Chem 177, 177L, 178, 331, 331L, 332, 332L; Phys 111, 112
26-27	**Biological sciences** Biol 211, 211L, 212, 212L, 313, 314, 255, 255L, 335; Micro 201 or 302; Micro 201L or 302L
11-12	**Humanities/Social sciences*** FS HN 342; select 3 crs. of humanities courses; select 3 crs. of social science courses; and Env S 120 or 201
34-35	**Food science and human nutrition** FS HN 110, 167, 203, 214 or 311, 265, 360, 361, 362, 461, 480, 492; select at least 9 additional credits from FS HN 403, 412, 419 or 519, 463, 464, 466, 490C, 499, 575; NutrS 501, 502, 562, 565
0-2	**Electives**
120.5	**Total credits**

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Concurrent B.S. and M.S. Program:
Well qualified students in Nuritional Science who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both a bachelor of science in Nutritional Science and a master of science degree in Nutritional Sciences. For more information, refer to www.fshn.hs.iastate.edu

Curriculum in Public Service and Administration in Agriculture

Administered by the Department of Sociology.

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Engl 150, 250; Jl MC 205; Sp Cm 212; Lib 160; communication-intensive requirement
18	**Mathematical, physical and life sciences** Math 150; Stat 101; electives in physical sciences (5 cr.); Biol 101; electives in biological sciences (3 cr.) (To fulfill the College's environmental intensive requirement, students are encouraged to choose Environmental Studies 120 or 173 as the elective in the biological sciences; demonstration of computer proficiency) (see Sociology Department for requirements).
12	**Humanities, ethics, and social sciences** Humanities elective (3 cr.); from approved lists: 3 cr. in ethics; 3 cr. in U.S. diversity; 3 credits in international perspectives. The 3-credit College of Agriculture and Life Sciences requirement in the social sciences is included as part of the Public Service and Administration Core as are the environmental-intensive requirement and problem solving-intensive requirement.
46	**Public service and administration core** **Economics**: 101, 102, 344 or Acct 284, 336; AgEds 451 **Political science:** 215, 310, 371, 475, and 3 additional credits of political science courses at the 300-level or above. **Sociology**: 110, 130, 325 or 382, 415, 420 or 380, and 464
9	**Agricultural sciences**
15	**Required area of concentration**
15.5	**Free electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
3	First-Year Composition—Engl 150
3	Introductory Biology—Biol 101
3	Mathematics for Business and Social Sciences I—Math 150
3	Rural Institutions and Organizations—Soc 130
3	Principles of Microeconomics—Econ 101
R	Orientation to Public Service and Administration in Agriculture—Soc 110
Cr.	**Spring**
3	Principles of Macroeconomics—Econ 102
3	American Government: Institutions and Policies—Pol S 215
3	Fundamentals of Speech Communication—Sp Cm 212
6	Agricultural Science
0.5	Library Instruction—Lib 160

Curriculum in Seed Science

Administered by the Departments of Agricultural and Biosystems Engineering, Agronomy, Horticulture, and Plant Pathology. Must be taken as a secondary major in conjunction with a primary major. The seed science program is designed for students with career interests in one or more aspects of the seed industry. Areas of study include: seed production, conditioning, pathology, physiology, quality control, and marketing, as well as seed plant designs.

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Engl 150, 250; Sp Cm 212 or AgEdS 311; Lib 160; Engl 302 or 309 or 314 or Sp Cm 312
38	**Mathematical, physical, and life sciences** Math 140 or 150; Stat 101 or 104; Chem 163, 163L; BBMB 221 or Chem 231, 231L; Phys 106 or 111, or Chem 164, 164L; Biol 211, 211L; Biol 212, 212L; Ent 376; Gen 320 or Biol 313; Agron 317; Pl P 408; and demonstration of computer proficiency (see department of primary major for procedures)
15	**Humanities, ethics, and social science** 3 cr. each of humanities, social sciences, ethics (from an approved list), U.S. diversity (from an approved list), and international perspectives
21	**Agricultural sciences** Agron 114 or Hort 221; Agron 154, 206, 354; Agron or Hort electives (6 cr.); TSM electives (3 cr.)
9	**Economics and business** Econ 101, 235; and one course from the following group: Acct 284; Econ 102, 330, 336; Mgmt 370; Mkt 340
10	**Seed science** Agron 338, 421, 491, and 2 cr. of Agron, Hort, Pl P or TSM electives at the 300-400 level
22.5	**Primary major requirements and free electives**
128	**Total credits**

Typical Program for the First Year

Because seed science is a secondary major, the courses taken by the student during the first year will vary, depending on the primary major (see typical program for the primary major).

College of Business

Labh S. Hira, Dean
Michael R. Crum, Associate Dean
Kay M. Palan, Associate Dean
www.bus.iastate.edu

Departments of the College

Accounting
Finance
Logistics, Operations and Management
Information Systems
Management
Marketing

Objectives of the Curriculum in Business

The instructional objective of the College of Business is to provide a high quality professional education in business. Such an education should provide the student with: (1) an appreciation of the evolution of the profession and an awareness of the ethical, global, technological, economic, political and social forces shaping its future; (2) an understanding of the major functional areas of business with the opportunity for specialization for a career in business; (3) an ability to recognize and appreciate the affect of diversity in the work place; (4) an opportunity for advanced study.

A comprehensive education in business includes a broad foundation in the liberal arts, courses in the major functional areas of business activity, proficiency in analytical methods, and the ability to identify problems and arrive at logical solutions. In addition, a professional education is designed to inspire students to assume business and community leadership.

The curriculum in business is accredited by the International Association for Management Education (AACSB), the national business accrediting agency.

Organization of Curriculum

The undergraduate curriculum in business is divided into two phases: a general education (pre-business) program and a professional program. The pre-business requirements provide a broad foundation in the liberal arts. The professional program includes two parts: (1) the business core which provides a common body of knowledge in all the functional areas in business, and (2) a major area of study. The eight majors offered for the degree bachelor of science (B.S.) are accounting; finance; management; management information systems; marketing; logistics and supply chain management; operations and supply chain management; and business economics. The college also offers a secondary major in international business. Elective courses are part of the curriculum.

Bachelor of Science

The bachelor of science (B.S.) degree offers a high quality professional education in business. It prepares students for professional careers in specialized functions of business and government. Candidates for this degree must satisfy the requirements established by the College of Business and also the requirements for individual majors specified by the departments of the College. All candidates for the B.S. degree are required to complete one of the following majors: accounting; finance; management; management information systems; marketing; logistics and supply chain management; operations and supply chain management; or business economics.

Required High School Preparation

Students entering the pre-business curriculum must present evidence of the following high school preparation:

a. Four (4) years of English/Language Arts, emphasizing writing, speaking, and reading as well as an understanding and appreciation of literature.

b. Three (3) years of mathematics, including one year each of algebra, geometry, and advanced algebra.

c. Three (3) years of science, including one year each of courses from two of the following fields: biology, chemistry, and physics;

d. Two (2) years of social studies.

Admission Standards to Professional Programs

All new entering students are enrolled in the pre-business curriculum. To enter the professional program in the College of Business, students must complete any Engl 101 courses, Engl 150, and the following foundation courses or their approved substitutions: Math 150, Econ 101, Econ 102, Stat 226, Acct 284, and BusAd 101. See Curriculum in Business.

In addition, all students must achieve an Iowa State University cumulative grade point of 2.5 or a grade-point average of 2.5 in the foundation courses. Admission into the professional program is a prerequisite for pre-business students to gain admission into upper-level business classes.

Students who meet the following requirements qualify for early admission to the professional program. First Semester Freshman: ACT score of 30 or higher, or ranked in the top 5% of high school class, or National Merit/Achievement Finalist, or member of the Freshman Honors Program. All other Students: minimum ISU cumulative GPA of 3.35 in at least 12 credits, or full member of the University Honors Program.

If using the foundation courses for admission to the Professional Program, both transfer grades and Iowa State University grades are used to compute the grade point average. If foundation courses initially taken at Iowa State University need to be repeated, they must be repeated at Iowa State University. With the exception of Acct 285 and MIS 330, pre-business students do not have access to business core classes. To facilitate registration, qualified students may be conditionally admitted during the semester in which they complete the admission requirements.

Admission requirements are subject to change. Applications and the current requirements for admission to the College of Business are available on the Web at https://apps.bus.iastate.edu/ProfessionalProgram/ or from the Undergraduate Programs Office in the College of Business.

Academic Standards and Graduation Requirements

Policies for students enrolled in the College of Business may be obtained on the Web at http://www.business.iastate.edu/undergraduate/ or from the Undergraduate Programs Office in the College of Business.

Students are responsible for knowing and adhering to these College of Business policies as well as the university regulations found in this catalog. The following policies are in effect for students graduating from a professional curriculum in business with a B.S. degree under the 2009-2011 catalog:

(1) A minimum of 122 semester credits are required.

(2) At least 50 percent of the required business credits must be earned at Iowa State. All 300 level and higher business credits must be earned at a four-year college.

(3) At least 50% of the 122 credits required for graduation must consist of general education (non-business credits).

(4) A minimum of 12 credits of the last 32 credits earned in residence must be applied to the business core and/or the major.

(5) The major departments reserve the right to determine the appropriate section of the degree program to which transfer credits will be assigned.

(6) Students must achieve Communication proficiency by earning a grade of C or better in two of the three required English courses.

(7) A student must earn a grade of C or higher in a minimum of 30 credits applied to the business core and the major.

(8) A student must earn at least 42 credits of 300 level and higher coursework from a four-year institution.

(9) Business majors may not take business courses Pass-Not Pass (P/NP).

(10) General education courses may not be taken P/NP.

(11) No more than 9 elective credits may be taken P/NP.

Curriculum in Business

The college offers programs of study leading to the degree bachelor of science with a major in accounting; finance; management; management information systems; marketing; logistics and supply chain management; operations and supply chain management; or business economics. The college also offers a secondary major in international business. Total credits required: 122

Pre-business Curriculum

Cr.	
18.5	Foundation Courses
R	BusAd 150[3]
3	BusAd 250
3	Math 150[1, 2]
3	Econ 101
3	Econ 102
3	Stat 226 [2]
3	Acct 284
0.5	BusAd 101
12.5	Communications
3	Engl 150
3	Engl 250
3	Engl 302
3	Sp Cm 212
0.5	Lib 160
7	Supporting courses[1]
0.5	BusAd 201
0.5	BusAd 301
3	Acct 215
3	Math 151[1,2]
24	General Education Requirements
6	Global/International Perspectives[4]
9	Humanities
3	Phil 230
6	Select from approved list
3	Natural science
6	Social science
	U.S. diversity course[5]

1 Acct, Fin, and Bus Econ majors will also take State 326 as part of the supporting courses. Bus Econ majors will take Math 160 instead of 150, and Econ 207 instead of Math 151. See the Undergraduate Programs Office in the College of Business.

2 Students not adequately prepared in mathematics may have to take remedial courses in addition to courses listed above. Remedial mathematics courses may not be used to satisfy credit requirements for graduation in the business curricula.

3 Students without adequate computer background may take Com S 103 to satisfy the computer literacy requirement.

4 Students may satisfy this requirement either by taking six credit hours from the University International Perspectives list, or three credit hours from the International Perspectives list and three credit hours from the College of Business Global Perspectives list. Approved list of courses is available on the web at http://www.business.iastate.edu/undergraduate/ or from the Undergraduate Programs Office in the College of Business.

5 Courses for this requirement may also be used to fulfill other curriculum requirements or electives and therefore credits are not included in the sum needed.

Professional Program

Cr.	
24	Business Core
	Block A
3	Acct 285
3	MIS 330
	Block B
3	Fin 301
3	OSCM 320
	Block C
3	Mgmt 370
3	Mkt 340
3	LSCM 360
	Block D
3	Mgmt 478

Scheduling note for core courses: Block A, B, C may be taken in any order in sequential semesters. Blocks A, B, C must be completed prior to enrollment in Block D, Mgmt 478, in the student's final semester.

18-21	Business Major
Select one:	
18	Accounting
18	Acct 383, 384, 386, 387, 485, 497
21	Finance
6	Fin 310, 320
12	Select from Fin 327, 330, 361, 371, 415, of which six credits must be at the 400 level
3	Select from department-approved list
18	Management
12	Mgmt 371, 377, 414, 471
6	Select from department-approved list
21	Management Information Systems
15	MIS 331, 432, 433, 435, 438
6	Select from department-approved list
18	Marketing
9	Mkt 443, 444, 447
6	Select from Mkt 343, 410, 442
3	Select from department-approved list
18	Logistics and Supply Chain Management
15	LSCM 460, 461, 485, 486, 487
3	Select from department-approved list
18	Operations and Supply Chain Management
15	OSCM 422, 424, 485, 486, 487
3	Select from department-approved list
18	Business Economics
9	Econ 301, 353, 431, 492
9	Select from departmental approved list
9-15	Elective Courses
	Select courses to broaden or complement required courses to meet degree requirement of 122 credits. (See adviser).

CPA Note: See Accounting Curriculum for information on the additional requirements for students who wish to be candidates for the CPA exam.

Sample Four-Year Plan of Study

Cr	Freshman Year
0.5-1	Bus Ad 101/102
R	Bus Ad 150
3	English 150
3	Bus Ad 250
6	Econ 101 and 102
6	Math 150 and 151
4	Computer Science 103 (Placement out via assessment)
0.5	Library 160
3	International Perspectives
3	Humanities
6	Social Science
35.5	

Cr.	Sophomore Year
0.5	Bus Ad 201
0.5	Bus Ad 301
3	Acct 284
6	Acct 285, MIS 330 (Block A)
3	Stat 226
3	Acct 215
3	Speech Communications 212
3	Engl 250
3	International Perspective/Global Perspective
3	U.S. Diversity
3	Philosophy 230
31	

Cr.	Junior Year
6	Fin 301, OSCM 320 (Block B)
9	Mkt 340, LSCM 360, Mgmt 360 (Block C)
6	Major Courses
3	Humanities
6	General Electives
30	

Cr.	Senior Year
3	Mgmt 478 (Block D)
3	English 302
12-15	Major Courses
3	Global Perspective
6	General Electives
30	

Block A
Acct 285
MIS 330

Block B
FIN 301
OSCM 320

Block C
Mkt 340
LSCM 360
Mgmt 370

Block D
Mgmt 478
Block A, Block B, and Block C are prerequisites for Block D

Advising System

The Undergraduate Programs staff, under the leadership of the Director for Undergraduate Programs, facilitates student progress toward graduation while supporting the academic standards of the College of Business and Iowa State University. To accomplish this, the Undergraduate Programs staff provides services for all College of Business students, including academic advising, learning opportunities, and teaching and developmental activities.

Students in the College of Business have advisers located in the Undergraduate Programs Office. The adviser assists students with developing an academic program; accessing pertinent university resources; and meeting their educational objectives.

The college offers an orientation program for entering students. All entering students and family members are encouraged to attend orientation. During orientation the adviser and the student prepare an appropriate schedule and the student registers for courses. Placement assessments may be required in Mathematics and English to assist in placing students in the appropriate level of courses if this cannot be determined by ACT/SAT scores, high school preparation classes or transfer courses.

Honors

Entering freshmen who meet one of the following criteria, and have a minimum English ACT of 24, will be invited to apply for membership in the Freshman Honors Program: earned an ACT composite of 30, or ranked in the top 5% of their high school classes; or selected as a National Merit or National Achievement finalist.

Enrolled students who have completed 12 graded credits at Iowa State University and earned a 3.35 can be admitted as a full member of the Honors Program. To qualify for full membership, students must have declared a major, developed a program of study, and have a minimum of 48 credits remaining before graduation. Special advisers will assist honors students in developing an appropriate program of study.

Internships

Credit and non-credit internships in business may be approved for College of Business students in all majors including pre-business. Credit hours and requirements vary. Arrangements must be made in the college prior to the beginning of the internship. An internship adviser from the Career Services Center will assist students in making these arrangements.

Multiple Majors

Undergraduates pursuing a degree in the College of Business may complete additional majors in the College of Business. Those desiring additional majors outside the college should refer to the catalog section of the appropriate college and department for the additional major requirements. A multiple major in business economics and agricultural business or economics is not permitted. A major in business economics with a minor in economics is not permitted.

Undergraduates with a primary major outside the College of Business who want a second major in business must meet the admission requirements for the professional program as well as complete the following requirements: the business core courses; the major specialization; computer proficiency; Acct 215; and Math 151.

All students pursuing multiple majors or multiple degrees within the College of Business are required to have a minimum of 15 credits of coursework in each additional major that is not used in the other majors.

Students are limited to three business majors/degrees within the College of Business, or a total of three business major/minors within the college. This limit is on business majors/degrees/minors only, and does not apply to multiple majors/degrees/minors taken outside the College of Business.

Students are limited to three business majors/degrees within the College of Business, or a total of three business major/minors within the college. This limit is on business majors/degrees/minors only, and does not apply to multiple majors/degrees/minors taken outside the College of Business.

Curriculum Changes

Iowa State University students who want to change their curriculum to the College of Business must attend a curriculum change meeting. See Changing Curriculum or Major for more details on this process. Students on Academic Probation will not be allowed to change curriculum to the College of Business during enrollment period three. See Making Schedule Changes.

International Business Secondary Major

A student in the College of Business may earn a secondary major in International Business. The requirements for this major include 12 credits in international business courses, one year of the same university-level foreign language (minimum 6 credits) and an approved international experience (minimum 3 months). Students who pursue this secondary major will be required to complete the requirements for a primary major in Business. Fifteen of the 18 credits required for the International Business major may not be used for the primary major.

Minor

The College of Business offers a structured minor in general business to students outside the College. The minor requires a minimum of 15 credits, not including pre-requisite courses. Requirements for the minor are ACCT 284, Acct 285 or ACCT 215 or BUSAD 250 (6 credits), three courses selected from Fin 301, Mgmt 370, MIS 330, Mkt 340, LSCM 360, or OSCM 320 (9 credits). The minor must include at least 6 credits in courses numbered 300 or above taken at Iowa State University. A "C" average or higher is required in all courses used to satisfy the minor requirements. All requirements for the minor must be taken for a grade.

Students with a major in the College of Business may qualify for a minor specialization in one of the college's departments by taking at least 15 credit hours in the minor specialization, nine hours of which may not be used to satisfy any other department, college, or university requirement. The minor must include at least 6 credits in courses numbered 300 or above taken at Iowa State University with a grade of C or higher. Students with declared majors have priority over students with declared minors in courses with space constraints.

Students with a major outside the College of Business are eligible for a general business minor only—not a specialization in a business department.

Students are limited to three business majors/degrees within the College of Business, or a total of three business major/minors within the college. This limit is on business majors/degrees/minors only, and does not apply to multiple majors/degrees/minors taken outside the College of Business

Entrepreneurial Studies Cross-Disciplinary Minor

The College of Business participates in a cross-disciplinary minor in Entrepreneurial Studies. This minor is available to any undergraduate student. Requirements for the minor include Mgmt 310, Mgmt 313 (6 credits), two business-oriented electives from an approved list (6 credits), and an experiential learning component (3 credits). The approved list of courses is available in the Undergraduate Programs Office in the College of Business and on the web at http://www.business.iastate.edu/undergraduate/minors/entrepreneurship.

Non-degree Seeking Students

Students who wish to take courses in the College of Business, but are not seeking an undergraduate degree, should apply to the college as non-degree seeking students. Non-degree seeking students are eligible to take up to 9 credits in 300-level and above business courses without meeting the college's admission requirements.

Upper Division Courses for Students Outside the College

Students from outside the College of Business are eligible to take up to 9 credits of 300-level and above business courses without meeting the college's admission requirements, as long as they meet course prerequisites.

Graduate Study

Four programs are offered at the graduate level: a master of business administration (M.B.A.) program, a master of accounting (M.Acc.), a master of science (M.S.) in business, and a master of science in information systems (M.S.I.S.). These programs are intended to meet distinct sets of educational objectives.

The M.B.A. is the professional management education program for those pursuing careers in business. The purpose of this professional program is to provide professional business education by preparing students to understand the impact of technology on business organizations in a global environment. The M.B.A. program consists of a 48-credit curriculum leading to a non-thesis, non-creative component master of business administration. Students may pursue a specialization in accounting, agribusiness, family financial planning, finance, information systems, international business, supply chain management or marketing.

The master of accounting (M.Acc.) is a 32-hour degree. The program requires 15 hours of graduate accounting courses, at least 9 hours of non-accounting graduate electives, a communications course, and an international course from an approved list. The M.Acc. is appropriate for any student wanting to pursue a variety of accounting careers. Additionally, the program is designed to help interested candidates meet the 150-hour education requirement for CPA certification in Iowa.

The master of science in information systems (M.S.I.S.) is designed to provide students with strong technical skills and a broad background in business needed to effectively develop and manage information systems projects. Using the latest software, students will apply information systems theory and concepts to modern information systems development. Program requirements range from 30-40 credits depending upon the student's background. The M.S.I.S. curriculum includes business foundation courses, information systems core courses and electives, and a research requirement (creative component).

The M.S. program, consisting of 30 minimum credits, is oriented toward further business specialization at the master's level for students with undergraduate degrees or academic backgrounds in business. The program is intended to serve those students who desire specialized study of an area within business. Students in the program must complete a thesis. This program is also a suitable vehicle for students planning to pursue a Ph.D. in business.

Double degree programs are offered with architecture (M.Arch./M.B.A.), community and regional planning (M.B.A./M.C.R.P), informational systems (M.B.A./M.S.I.S), and statistics (M.B.A./M.S.-Statistics). The Department of Logistics, Operations, and Management Information Systems in the College of Business participates in the following graduate level interdepartmental programs: Information Assurance, Human Computer Interaction, Seed Science and Business, and Transportation. The College of Business also offers a business administration minor to students with majors outside the college. A concurrent B.S./M.B.A. is available to eligible engineering undergraduate students majoring in civil engineering, computer engineering, electrical engineering, industrial engineering, and mechanical engineering.

Ph.D in Business and Technology

The College of Business offers graduate work leading to the Doctor of Philosophy degree in business and technology, with one of three specializations—customer management (CM), supply chain management (SCM), or management information technology (MIT). Many departments in the college (Logistics, Operations, Management Information Systems, Marketing and Management), and the departments of Statistics, Economics, Psychology, and Sociology cooperate in providing coursework toward this degree. The program will prepare individuals for academic careers in research, teaching, and public service at institutions of higher learning in the United States and other countries. The PhD program consists of a 44 credit course curriculum followed by 12 credit thesis or dissertation. Students do not need to have an undergraduate degree or master's degree in business in order to qualify for enrollment in the PhD program. However, students without a graduate degree in business will be required to complete 18 credit hours of business foundation courses. For more details or application information see the Business Administration Department listing in this catalog.

College of Design

Mark C. Engelbrecht, Dean
Kate Schwennsen, Associate Dean
Timothy O. Borich, Associate Dean
www.design.iastate.edu

Departments of the College

Architecture
Art and Design
Community and Regional Planning
Landscape Architecture

Objectives of the Curricula in Design

The College of Design is among a small, elite number of comprehensive design schools offering outstanding opportunities for both disciplinary and interdisciplinary education.

The College of Design strives to provide each student with a broad educational background and preparation in a specific environmental design or art discipline. Each program is designed to develop knowledge and appreciation of the physical and cultural environment, to stimulate creative thinking and analysis, and to prepare students for participation in a wide variety of careers.

The college's programs also encompass many opportunities for individualized study and extracurricular activities such as visiting lectures and symposia, workshops, gallery exhibits, practicum and internship programs, field trips, and international study programs.

Graduates of the college are employed in private firms, government, industry, and education, or are self-employed as designers or artists. Opportunities for graduates include careers as architects, landscape architects, community and regional planners, graphic designers, interior designers, studio artists, arts administrators and environmental designers.

Graduate Curricula

The College of Design offers graduate study in the areas shown below. Graduate study is conducted through the Graduate College. Details are found in the Graduate College section of this catalog.

Majors

Architecture
Architectural Studies
Art and Design
Community and Regional Planning
Graphic Design
Integrated Visual Arts
Interior Design
Landscape Architecture
Transportation*

Double Degree Programs

Architecture / Business
Architecture / Community and Regional Planning
Community and Regional Planning / Landscape Architecture
Community and Regional Planning/ Public Administration

Minor

Gerontology*

*The College of Design participates in this interdepartmental graduate program.

Undergraduate Curricula

Majors

Architecture
Art and Design
Community and Regional Planning
Graphic Design
Interior Design
Integrated Studio Arts
Landscape Architecture

Secondary Majors

Environmental Studies*
International Studies*

Minors

Design Studies
Digital Media
Entrepreneurial Studies*
Environmental Studies*
Gerontology*
International Studies*
Technology and Social Change*

*The College of Design participates in these interdepartmental secondary majors and minors.

Organization of Curricula

The undergraduate curricula in design are divided into two phases: a pre-professional Core Design Program and a professional program. The Core Design Program grounds the undergraduate degree programs, provides a rich, rigorous inclusive base for the curricula. It creates shared language, experience, and community for programs, faculty and students and exposes students to all design disciplines, allowing them to make more informed degree choices, apply to multiple programs, and experiment with interdisciplinary work.

For students entering the Core Design Program, the college highly recommends purchase of a digital camera.

The intense, discipline-specific professional curricula that follow the Core focus on developing students' ability and knowledge in their major. Within the major area, students advance creative and professional skills through classroom and studio work, critiques of student projects, discussion with professional practitioners, and field studies.

General education, contained in both the Core and the professional programs, is composed to insure that students receive a well-rounded undergraduate education.

High School Preparation

Courses in fine arts and design that develop visualization and freehand drawing abilities are highly recommended through not required for entrance. Students planning to enroll in an academic program in the College of Design must complete the following high school requirements: 4 years of English, including coursework in composition and literature and up to 1 year of speech and/or journalism, to develop communication skills and critical reading/writing ability; 3 years of mathematics to develop problem solving skills, including 1 year each of algebra, geometry, and advanced algebra; 3 years of science, including at least two of the following: 1 year of biology, 1 year of chemistry, or 1 year of physics; 2 years of social studies, including at least 1 year of U.S. history and 1 semester of U.S. government.

Admission Standards to Enrollment Managed Professional Programs

Admission into the enrollment managed professional programs of Architecture, Community and Regional Planning, Graphic Design, Interior Design, and Landscape Architecture requires a separate application after completing the Core Design Program, depends on available resources, and is subject to review by faculty committee. Applicants are reviewed on the basis of a portfolio of original work, scholarship performance, and a written essay.

Advising

Each student receives personal assistance from an academic advisor within the student's curriculum area. Students enrolled in the college's Core Design Program are advised by professional advisers. Once admitted to professional programs, students are assigned to faculty advisers. Advisers help students develop a program of study, access pertinent university resources as well as provide information on career choice.

The college's career services office works with students to develop their career goals as well as prepare and search for employment.

Honors Program

The College of Design participates in the Honors Program which provides opportunities for outstanding students to individualize their programs of study. See *Index, Honors Program*.

Requirements in the College of Design

All students in the College of Design are expected to meet the following requirements of the college.

Core Design Program

Cr.	Fall/Spring
4	Dsn S 102
4	Dsn S 131
3	Dsn S 183
6	Social Science/Humanities Electives*
6	Math/Science Electives**
6	English 150/250
0.5	Library 160
29.5	**

* General education credits in the Core Design Program may count toward the minimum credits.

** Students applying to Architecture for admission must take Math 142 and Physics 111 in the first year. These two courses total seven credits for a total of 30.5 core credits.

General Education

Minimum Credits.

- 6 **Biological sciences, physical sciences and mathematics**
  Includes courses in the fields of agronomy, astronomy and astrophysics, biology, botany, chemistry, civil engineering, computer science, geology, mathematics, physics, statistics, and zoology.
- 9.5 **Communications**
  Engl 150*, 250*, Lib 160. Includes courses in the fields of English (composition), and speech communication (interpersonal and rhetorical).
- 6 **Humanities**
  Includes courses in the fields of classical studies, English (literature), foreign languages, history, philosophy, religious studies, as well as history/theory/literature courses in dance, music, theater, journalism, African American studies, American Indian studies, environmental studies, Latino/a studies, women's studies, and university studies.
- 6 **Social sciences**
  Includes courses in the fields of African American studies, American Indian studies, anthropology, economics, environmental studies, geography, human development and family studies, Latino/a studies, political science, psychology, sociology, and women's studies.
- 9 **Additional credit hours selected from any of the above areas.**
  Six credits must be at the 300 level or above.
- 9 **Selected from the above areas.**
  Six credits must be at the 300 level or above.
- 36.5 **Minimum credits**

See departmental curricula for specific course requirements within the general education areas.

*To meet requirements for graduation, a minimum grade of C– must be received.

Minor in Design Studies

The undergraduate minor in Design Studies is constructed to facilitate design awareness among interested students and to provide a vehicle for interdisciplinary study within the College of Design. This minor is open to all undergraduate students at Iowa State University.

This minor requires fifteen credits of course work: three credits of history selected form College of Design course offerings and twelve additional credits selected from College of Design course offerings.

At least six of the fifteen credits must be taken at Iowa State University in courses numbered 300 or above. At least nine of the fifteen credits must not be used to meet any other college or university requirements except the credit requirement for graduation.

Students enrolled in the College of Design may not use courses in their major or in the Core Design Program to satisfy this minor.

Minor in Digital Media

Manipulation of digital media has emerged as an essential skill for design inquiry alongside traditional methods of building models and drawing sketches. To familiarize students with the use of digital media in the design process, the College of Design offers an undergraduate Minor in Digital Media. This minor is open to all undergraduate students at Iowa State University.

This minor requires 15 credits, including at least 6 credits taken at Iowa State University in courses numbered 300 or above. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement; and at least 3 credits from the listed courses numbered 200. Courses taken for this minor may not be taken on a pass-not pass basis.

Students enrolled in the College of Design may not use courses in their major or in the Core Design Program to satisfy this minor.

Curriculum in Architecture

The Department offers undergraduate and graduate degree programs:

A 138-credit undergraduate professional program, preceded by a 28-credit preprofessional program, leading to the bachelor of architecture degree.

A 100-credit graduate professional program leading to the Master of Architecture. Applicants holding B.S. or B.A. degrees in Architecture or other affiliated design fields may be given advanced standing in this program. (M.Arch.)

A 30-credit post-professional graduate program leading to the Master of Architecture. (M.Arch. II)

A 30-credit interdisciplinary graduate research program leading to the Master of Science in Architectural Studies. (M.S.A.S.)

For more complete graduate program descriptions see Graduate Study under Architecture in the Courses and Programs section.

In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes three types of degrees: the Bachelor of Architecture, the Master of Architecture, and the Doctor of Architecture. A program may be granted a 6-year, 3-year, or 2-year term of accreditation, depending on the extent of its conformance with established educational standards.

Master's degree programs may consist of a preprofessional undergraduate degree and a professional graduate degree that, when earned sequentially, constitute an accredited professional education. However, the preprofessional degree is not, by itself, recognized as an accredited degree.

Preprofessional Program

First Year

Cr.	Fall/Spring
4	Dsn S 102 (Studio)
0.5	Dsn S 115
3	Dsn S 183 (Cultures)
3	Engl 150
3	Math142
4	Physics 111
6	Social sciences/humanities Electives*
4	Dsn S 131 (Representation)
0.5	Lib 160
28	

Professional Program

Second Year

Cr.	Fall
6	Arch 201 Studio 1
3	Arch 230 Comm.
3	Arch 221 Hist
3	Arch 240 Mat'l/Assemblies 1
3	Engl 250
18	
Cr.	**Spring**
6	Arch 202 Studio 2
3	Arch 222 Hist.
3	Arch 242 Struct. 1
3	Arch 357 Env Forces 1
3	Social Science/Humanity Option*
18	

Third Year

Cr.	Fall
6	Arch 301 Studio 3
3	Arch 271 Env. Theory
3	Arch 344 Struct. 2
3	Arch 458 Env. Control
3	Social Science/Humanity Option*
18	
Cr.	**Spring**
6	Arch 302 Studio 4
3	Arch 346 Struct. 3
3	Arch 448 Mat'l/Assemblies 2
3	SAC Elective*
3	General Elective
18	

Fourth Year

Cr.	Fall
6	Arch 401 Studio 5
3	Arch 482 Prof. Practice
3	University Communication Elective*
3	SAC Elective*
3	General Elective*
18	

Cr.	Spring
6	Arch 402 Studio 6
3	SAC Elective*
3	SAC Elective*
3	Prof. Elective*
15	

Fifth Year

Cr.	Fall
6	Arch 403 Studio 7
3	Professional Elective
3	General Elective
3	General Elective
3	General Elective
18	

Cr.	Spring
6	Arch 404 Studio 8
3	Prof. Elective*
3	General Elective
3	General Elective
15	Electives

*from approved departmental lists

166 Total credits

Curriculum in Art and Design—B.A.

Administered by the Department of Art and Design and leading to a 120.5 credit undergraduate Bachelor of Arts degree including a 29.5 credit pre-professional program (college core).

This curriculum offers two concentrations: Art and Culture, and Art and Design History and Theory. Both concentrations are combined with an applied career minor or approved program.

Consideration for admission into the B.A. curriculum is based upon department resources, GPA earned in the college Core Courses and the freshman year.

Transfer students with studio credits from other programs, colleges and universities must present for department review a portfolio of work done in those courses in order to have the credits apply toward studio requirements. Students are required to present this portfolio upon admission and prior to registration for classes. Arrangements for this process must be made with department advisers.

Cr.	Degree Requirements
36.5	General education
6 min.	Biological and physical sciences and mathematics Select from Astro 120, 150, Biol 101, 173, 211, 212, Bot 111, 265, Chem 160, 163, 163L, Com S 103, 107, Geol 100, 101, Gen 260, Math 104 or 150, 105, 140, 141, 151, Mteor 206, Phys 101, 106, Stat 101, 104 or any higher level course in these disciplines for which these courses are prerequisite
9.5 min.	Communications
6	Engl 150 and 250
3	Select from CmDis 286, ComSt 101, 102, Sp Cm 212
0.5	Lib 160
6 min.	Humanities Select from Af Am 201, 252, Am In 310, Cl St – all courses, Dance 270, 360, Engl 201, 230, 231, 237, 335, 340, 346, 347, 348, 353, 354, 360, 361, 362, 363, 364, 373, 374, 375, 376, 377, 378, 379, 384, 389, WLC 101, 102, 110, 201, 202, 301, 302, Hist—all courses, Music 102, 302, 304, 383, 384, Phil— all courses, Relig— all courses, T C 354, 355, Thtre 106, 110, 252, 465, 466, W S 336, 340, 345, 377, 422
6 min.	Social sciences Select from Anthr 201, 202, 306, Econ 101, 102, Pol S 215, 230, 241, 251, Psych 101, 230, Soc 130 or 134, or any higher level course in these disciplines for which these courses are prerequisite, or select from Am In 210, Env S 201, 223, HD FS 102, 239, 276, 283, 349, 367, 370, 373, 377, 378, 380, 395, Jl MC 101, 205, 320, 453, 474, 476, W S 201, 301, 321, 323, 327, 346, 350, 385, 386, 401
9 min.	Selected from the above areas and/or from CmDis 275, 286, ComSt 101, 102, 214, 310, 311,314, 317, 318, Engl 205, 219, 220, 302, 303, 304, 305, 306, 309, 310, 314, 315, 316, Fin 361, 371, L A 271, Mgmt 370, Mkt 340, Sp Cm 212, 305, 312, 321, 322, 323, 325, 327.Six credits must be at the 300 level or above.
6 min.	General design education
3	Select a history course from Arch, Art H, Dsn S, or L A.
3	Select from Art H 181, 426, 446, or other approved design studies course
11	College of Design Core (4 cr); Dsn S 131 (4 cr); Dsn S 183 (3 cr)
12	Art History
6	Art H 280 & 281 Art History I & II
6	selections 300 level or above
	Art and Culture Concentration
12	Design and Art Options Select from all 200-level courses in Art, ArtIS, graphic design, and interior design, or approved list ofcourses in architecture, landscape architecture, community and regional planning, and textiles and clothing that are open to nonmajors.
30	Applied minor* or approved program of study (at least 6 credits 300 or above courses). See department for specific curriculum sheets with course information.
13	Electives
120.5	Total credits
	History and Theory Concentration
15	Art and Design Options Select 12 credits from Art H 300-400 level courses, graphic deign history. or interior design history courses; 3 credits Art 498 (Museum/Gallery Internship)
30	Applied minor* or approved program of study (at least 6 credits must be world language courses). See department for specific curriculum sheets with course information.
10	Electives
120.5	Total credits

*A second major or minor must be approved by the department offering the program of study. See university guidelines for structuring and declaring a second major and/or minor. Credit hours not applied toward a formal second major or minor must be used in a coherent program approved by the Department of Art and Design. Approval for these 30 credits must be documented in writing following completion of 75 credits and before completion of 100 credits toward the B.A. degree.

Curriculum in Community and Regional Planning

The Department of Community and Regional Planning administers the 129 credit undergraduate program leading to the Bachelor of Science. The curriculum is designed to prepare students to enter the profession of planning ready to work in a variety of professional settings. Students have the opportunity to work with their faculty advisers to define their own areas of interest, which may include a minor.

Consideration for admission into the Community and Regional Planning professional program takes place either through review of the performance in the College of Design's first year CORE design program, or through transfer from another curricula or accredited institution. If applying through the CORE program, admission is based upon a student's cumulative GPA for all courses earned during the first year, portfolio work submitted upon completion of the CORE courses, and an essay submission. In either case, predictors of success in the program include the quality of prior work and interest in the field. Community and Regional Planning emphasizes responsibility and citizenship, writing and analytical ability, and critical thinking. Students entering the CRP professional program from outsidethe College of Design should provide a similar portfolioof their work for evaluation.

Cr.	Degree Requirements
12.5	Communications Engl 150, 250, 309 or 314; Lib 160; Sp Cm 212
9	Humanities
7	Mathematics Stat 101; Math
6	Natural sciences
18	Social sciences Econ 101 or 102; Pol S 215; Soc 134; options
11.5	Design core Dsn S 102; Dsn S 115; Dsn S 131; Dsn S 183
28	Community and Regional Planning Core C R P 253, 272, 274, 332, 383, 391, 432, 492, 494, 498
12	Core Planning Electives — choose 4 from: 416 Urban Design and Practice 417 Urban Revitalization 425 Growth Management 429 International Planning 435 Planning in Small Town 442 Site Development

445 Transportation Policy Planning
451 Introduction to Geographic Information Systems
455 Community Economic Development
481 Regional and State Planning
484 Sustainable Communities
491 Environmental Law and Planning
C E 350 Introduction to Transportation Planning

11 Other Planning and Planning Related Courses
14 General Electives
129 Total credits

Curriculum in Graphic Design

Administered by the Department of Art and Design and leading to a 123.5 credit undergraduate Bachelor of Fine Arts in Graphic Design including a 29.5 credit pre-professional program (the college core).

Consideration for admission into the graphic design is based on department resources; GPA earned in the College Core courses and the freshman year; as well as porfolio, all of which are submitted at the end of the freshman year.

On admission to the program, the faculty strongly recommend the purchase of a laptop computer and software. Specifications for the laptop computer and software are available at www.design.iastate.edu under the "Students" link.

Transfer students with studio credits from other programs, colleges, and universities must present for departmental review a portfolio of work done in those courses in order to have the credits apply toward studio requirements. Students are required to present this portfolio upon admission and prior to registration for classes. Arrangements for this process must be made with department advisers.

Cr.	Degree Requirements
39.5	General education
6	Biological and physical sciences and mathematics Select from Astro, Biol, Bot, Chem, Com S, Geol, Gen, Math, Mteor, Stat, Phys.
9.5	Communications
6	Engl 150 and 250
3	Select from CmDis 286, ComSt 101, 102, Sp Cm 212
0.5	Lib 160
6	Humanities Select from all courses in Af Am, Am In, Cl St, Dance, Engl, WLC, Hist, Music, Phil, Relig, T C, Thtre. Select from W S 336, 340, 345, 422
6	Social sciences Select from all courses in Anthr, Econ, Pol S, Psych, Soc, Am In, Env S, HD FS, JI MC. (all courses except 315, 342,342L, 343L). Select from W S 201, 302, 321, 323, 327, 346, 350, 385, 386, 401.
12	Selected from the above areas and/or from Advrt (all courses except 436) CmDis, Fin, Mgmt, Mkt, Sp Cm. Six credits must be at the 300 level or above.
11	Design Core (4 cr); Dsn S 131 (4 cr); Dsn S 183 (3 cr)
21	General Design Education
6	History of Art I, II, Art H 280, 281
3	Drawing, Art 230
6	Select a history course from ArtGr 388, Arch, Art H, Dsn S, or L A.
6	Studio Options: Select from ArtIS, ArtID, LA, Arch or other approved studio course.
46	Graphic design
3	Design Through Photography ArtIS 229 or ArtIS 227 Graphic Design Studio I and II—ArtGr 270, 271
4	Graphic Technology I and II—ArtGr 275, 276
1	Theories and Principles of Graphic Design—ArtGr 291
1	Graphic Design Internship Seminar—ArtGr 377
6	Graphic Design Studio III and IV—ArtGr 370, 371
3	Graphic Design History/Theory/ Criticism I, ArtGr 387
2	Graphic Design Materials and Processes—ArtGr 372
3	Graphic Design Studio V—ArtGr 470
3	Graphic Design Professional Presentation—ArtGr 482
3	Graphic Design Professional Practices—ArtGr 481
8	Select four 2-credit options from approved program list. One option will be taken with ArtGr 370, 371, 470, 482
3	Select from: Art and Design in Europe—Art 495G Graphic Design Internship—ArtGr 480
6	Electives
123.5	Total credits

Curriculum in Integrated Studio Arts—B.F.A.

Administered by the Department of Art and Design and leading to a 120.5 credit undergraduate Bachelor of Fine Arts in Integrated Studio Arts including a 29.5 credit pre-professional program (the college core).

Consideration for admission into the Integrated Studio Arts program is based upon departmental resources; GPA earned in the College Core courses and in the freshman year; as well as a portfolio, all of which are submitted at the end of the freshman year.

Transfer students with studio credits from other programs, colleges, and universities must present for department review a portfolio of work done in those courses in order to have the credits apply toward studio requirements. Students are required to present this portfolio upon admission and prior to registration for classes. Arrangements for this process must be made with department advisers.

On admission to the program, if the student wishes to pursue studies in digital media and or photography, the faculty strongly recommend the purchase of a laptop computer and software. Specifications for the laptop computer and software are available at www.design.iastate.edu under the "Students" link

Cr.	Degree Requirements
36.5	General education
6 min	Biological and physical sciences and mathematics Select from Astro 120, 150, Biol 101, 173, 211, 212, Bot 111, 265, Chem 160, 163, 163L, Com S 103, 107, Geol 100, 101, Gen 260, Math 104 or 150, 105, 140, 141, 151, Mteor 206, Phys 101, 106, Stat 101, 104, or any higher level course in these disciplines for which these courses are prerequisite
9.5 min.	Communications
6	Engl 150 and 250
3	Select from CmDis 286, ComSt 101, 102, Sp Cm 212
0.5	Lib 160
6 min.	Humanities Select from Af Am 201, 252, Am In 310, Cl St–all courses, Dance 270, 360, Engl 201, 230,231, 237, 335, 340, 346, 347, 348, 353, 354, 360, 361, 362, 363, 364, 373, 374, 375, 376, 377, 378, 379, 384, 389, WLC 101, 102, 110, 201, 202, 301, 302, Hist—all courses, Music 102, 302, 304, 383, 384, 472, Phil—all courses, Relig— all courses, T C 354, 355, Thtre 106, 110, 252, 465, 466, W S 336, 340, 345, 377, 422
6 min.	Social sciences Select from Anthr 201, 202, 306, Econ 101, 102, Pol S 215, 230, 241, 251, Psych 101, 230, Soc 130 or 134, or any higher level course in these disciplines for which these courses are prerequisite, or select from Am In 210, Env S 201, 223, HD FS 102, 239, 276, 283, 349, 367, 370, 373, 377, 378, 380, 395, JI MC 101, 205, 320, 453, 474, 476, W S 201, 301, 321, 323, 327, 346, 350, 385, 386, 401
9 min.	Selected from the above areas and/or from CmDis 275, 286, ComSt 101, 102, 214, 310, 311, 314, 317, 318, Engl 205, 219, 220, 302, 303, 304, 305, 306, 309, 310, 314, 315, 316, Fin 351, 357, Mgmt 370, Mkt 340, Sp Cm 212, 305, 312, 321, 322, 323, 325, 327. Six credits must be at the 300 level or above
11	College of Design Core Dsn S 102 (4 cr); Dsn S 131 (4 cr); Dsn S 183 (3 cr)
30	ISA Core
2	ArtIS 200 Studio Introduction (students must take all sections ArtIS 205, 207, 209, 211)
3	ArtIS 208 Color Studio
3	Art 230 Drawing II
6	Art H 280 and 281 Art History I & II
3	Art IS 310 Sources of Visual Design
24	ISA Concentration Select eight (8) courses from two and three dimensional ArtIS studio offerings (ArtIS 200, 300 and 400 levels). Students will be assigned an adviser who will assist them in developing their studio concentration

plan.

9	Art History Select from 300 level or above courses
3	Professional Practice
2	ArtIS 399 BFA Professional Practice I
1	ArtIS 499 BFA Professional Practice II
10	Electives
120.5	Total credits

Curriculum in Interior Design

Administered by the Department of Art and Design and leading to a 127.5 credit undergraduate Bachelor of Fine Arts in Interior Design including a 29.5 credit pre-professional program (the college core).

Consideration for admission in the Interior Design program is based upon departmental resources; GPA earned in the College Core and the freshman year; as well as a portfolio, all of which are submitted at the end of the freshman year.

A 34 graduate credit program leading to the master of arts, for students planning to undertake professional or design research-orientated pursuits (NOTE: Applicants without a previous undergraduate degree in interior design may be required to complete up to 40 additional credits of deficiency work).

A 60 graduate credit post-professional graduate program leading to the degree master of fine arts.

For more complete graduate program descriptions see Graduate Study under Interior Design in the Courses and Programs section.

Consideration for admission into the undergraduate Interior Design curriculum requires completion of 29.5 credit freshman design core program, including the following courses: Dsn S 102, Dsn S 131, Dsn S 183, 6 credits of Social Science/Humanities, 6 credits of Math/Science, English 150 or 250 and Library 160. Admission is based on department resources and will be determined by a formal review at the end of the freshman foundation year.

Transfer students with studio credits from other programs, colleges, and universities must present for departmental review a portfolio of work done in those courses in order to have the credits apply toward studio requirements. Students are advised to present portfolio upon admission and prior to registration for classes. Arrangements for this process must be made with department advisers.

Cr.	Degree Requirements
36.5	General education total, including:
6	Biological and physical sciences and mathematics Math 104 or 105 or 140 or 150. Select from Astro 120, 150, Biol 111, 173, 211, 212, Bot 111, 265, Chem 160, 163, 163L, Com S 103, 107, Geol 100, 101, Gen 260, Math 104 or 150, 105, 140, 141, 151, Mteor 206, Phys 101, 106; Stat 101, 104 or any higher level course in these disciplines for which these courses are prerequisite
9.5	Communications Engl 150 and 250; Lib 160 Select from CmDis 286; ComSt 101, 102, Sp Cm 212
6	Humanities Select from Af Am 201, 252; Am In 310, Cl St – all courses, Dance 270, 360, Engl 201, 230, 231, 237, 335, 340, 346, 347, 348, 353, 354, 360, 361, 362, 363, 364, 373, 374, 375, 376, 377, 378, 379, 384, 389, WLC 101, 102, 110, 201, 202, 301, 302, Hist—all courses, Music 102, 302, 304, 383, 384, 472, Phil —all courses, Relig – all courses, T C 354, 355, Thtre 106, 110, 252, 465, 466, W S 336, 340, 345, 377, 422
6	Social sciences Select from Anthr 201, 202, 306; Econ 101, 102, Pol S 215, 230, 241, 251, Psych 101, 230, Soc 130 or 134, or any higher level course in these disciplines for which these courses are prerequisite, or select from Am In 210, Env S 201, 223, HD FS 102, 239, 276, 283, 349, 367, 370, 373, 377, 378, 380, 395, Jl MC 101, 205, 320, 453, 474, 476, W S 201, 301, 321, 323, 327, 346, 350, 385, 386, 401
9	Select from the above areas and/or CmDis 275, 286, ComSt 101, 102, 214, 310, 311, 314, 317, 318, Engl 205, 219, 220, 302, 303, 304, 305, 306, 309, 310, 314, 315, 316, Fin 361, 371, Mgmt 370, Mkt 340, Sp Cm 212, 305, 312, 321, 322, 323, 325, 327. Six credits must be at the 300 level or above.
11	Design Core Dsn S 102 (4 cr); Dsn S 131 (4 cr); Dsn S 183 (3 cr)
6	Select 2 history courses from Arch, Art H, Dsn S or LA
61	Interior Design Concentration, including:
2	Fundamentals of Interior Design—ArtID 250
2	Human Factors in Interior Design—ArtID 251
3	Interior Design History/Theory/Criticism I—ArtID 355
3	Interior Design History/Theory/Criticism II—ArtID 356
2	Graphic Communication for Interior Design I—ArtID 261
2	Graphic Communication for Interior Design II—-ArtID 262
2	Graphic Communication for Interior Design III—ArtID 263
4	Interior Design Studio I—ArtID 265
4	Interior Design Studio II—ArtID 267
4	Interior Design Studio III—ArtID 365
4	Interior Design Studio IV—ArtID 367
4	Interior Design Studio V—ArtID 465
4	Interior Design Studio VI—ArtID 467
3	Advanced Studies in Interior Design—ArtID 469
3	Interior Design Systems I: Materials—ArtID 350
3	Interior Design Systems II: Furniture & Millwork—ArtID 351
3	Interior Design Systems III: Lighting—ArtID 352
3	Interior Design Systems IV: Building Assemblies & Support—ArtID 353 Or
3	Materials and Assemblies I-Arch 240
1	Interior Design Internship Seminar—ArtID 360
3	Interior Design Internship—ArtID 460
2	Interior Design Professional Practices—ArtID 461
R	Sophomore Field Study—ArtID 259
R	Junior Field Study—ArtID 359
R	Senior Field Study—ArtID 459
6	Studio/Business Option Select 2 courses from Arch studio, ArtIS studio, or Mgmt/Mkt
3	Electives
128.5	Total credits

Curriculum in Landscape Architecture

The department offers graduate and undergraduate degree programs.

The undergraduate program consists of a five-year curriculum, requiring 149.5 credits, leading to the degree Bachelor of Landscape Architecture. These credits are distributed between a one-year pre-professional program of 29.5 credits and a four-year professional program of 120 credits.

Admission into the professional program depends upon available resources and is subject to the approval of a faculty committee at the completion of the pre-professional program. Applicants are reviewed on the basis of scholastic performance, a portfolio of original work, and a written essay.

The BLA from Iowa State University is an LAAB (Landscape Architectural Accreditation Board)-accredited professional degree program. In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for professional licensure. The LAAB is the sole entity recognized by the Council for Higher Education Accreditation to accredit U.S. first professional degree programs in landscape architecture at the Bachelor's and Master's levels.

The department also offers a 36 credit graduate program leading to the degree Master of Landscape Architecture. For more complete graduate program descriptions, see Graduate Study under Landscape Architecture in the Courses and Programs section.

Core Design Program

Cr.	Fall/Spring
4	Dsn S 102
4	Dsn S 131
3	Dsn S 183
6	Social Science/Humanities Electives
6	Math/Science Electives
6	English 150/250
0.5	Library 160
29.5	Required for professional program application
3	Additional electives recommended

Cr.	Fall second year
6	Landscape Interpretation and Representation—L A 201
3	Native Plants of the Midwest—LA 221
1	Developing Identity as Landscape Architect—LA 241
3	Cultural Landscape Studies—LA 272
3	Investigating Landscape Form, Process and Detail—LA 281
16	

Cr.	Spring second year
6	Site Planning and Design I—L A 202
3	The Social and Behavioral Landscape—L A 274
3	Introduced Plants of the Midwest—LA 222
3	Landscape Architecture History 1800-present—LA 371
3	Soils for Urban Use—Agron 156
18	

Cr.	Fall third year
6	Site Planning and Design II—L A 301
3	Shaping the Land—LA 381
3	Landscape Architecture History: Prehistory to 1800—LA 373
3	Landscape Change and Conservation—LA 465
3	Elective
18	

Cr.	Spring third year
6	Regional Landscape Design—L A 302
1	Contemporary Landscape Architecture—LA 341
3	LA Professional Elective
3	Social Science/Humanities Elective
3	Math 141 or Math 142/Science Elective
16	

Cr.	Fall fourth year
6	Urban Landscape Design—LA 402
2	Landscape Construction—LA 481
3	Social Science/Humanities
3	LA Professional Elective
3	Communication (300 level)
17	

Cr.	Spring fourth year
R	Landscape Architecture Professional Internship, Study Abroad, National Exchange—LA 451A, B, or C

Cr.	Fall fifth year
6	Community Landscape Design—LA 401
4	LA Professional Elective
3	Social Science/Humanities Elective (300 level)
3	Science/Math Elective
16	

Cr.	Spring fifth year
6	Interdisciplinary Design Studio (Dsn S 446), Advanced Landscape Architectural Design (LA 404), or Senior Thesis (LA 405
2	Professional Practice—LA 441
2	Advanced Landscape Construction—LA 482
6	Elective
16	
149.5	Total credits for BLA

College of Engineering

James E. Bernard, Interim Dean
Diane T. Rover, Associate Dean
Balaji Narasimham, Associate Dean
Loren W. Zachary, Assistant Dean
www.engineering.iastate.edu/

Departments of the College

For information on undergraduate options refer to the following curriculum sections, and for graduate specializations or certificate programs, refer to the Courses and Programs section of the catalog.

Aerospace Engineering
Agricultural and Biosystems Engineering
Chemical and Biological Engineering
Civil, Construction and Environmental Engineering
Electrical and Computer Engineering
Industrial and Manufacturing Systems Engineering
Materials Science and Engineering
Mechanical Engineering

Aligning Education in Engineering with the University Mission

The mission of Iowa State University is to create, share, and apply knowledge to make Iowa and the world a better place. Students will become broadly educated, global citizens who are culturally informed, technologically adept, and ready to lead. The College of Engineering echoes this philosophy and emphasizes preparing its graduates to meet the challenges of the 21st century.

Engineering education seeks to develop a capacity for objective analysis, synthesis, and design to obtain a practical solution. The engineering programs at Iowa State University are designed to develop the professional competence of a diverse student body and, by breadth of study, to prepare students to solve the technical problems of society while considering the ethical, social, and economic implications of their work at state, national and global levels.

The focus of each curriculum is to strengthen students' critical thinking, creative abilities, and communication skills. Students in engineering will have the opportunity for interdisciplinary and experiential learning through learning communities, service learning, internships and cooperative education, as well as research, capstone, and study abroad experiences.

The problem-solving skills learned from an engineering education at Iowa State University also provide an excellent launching pad for careers not only in engineering, but also medicine, law, business, and many other fields.

Each program is guided by the criteria developed by ABET, a non-governmental organization of peer reviewers which assures the quality of post secondary engineering education. The outcomes and objectives of the accredited engineering programs can be found in the Courses and Programs section of the catalog.

Registration as a professional engineer, which is granted by each individual state, is required for many types of positions. The professional curricula in engineering at Iowa State University are designed to prepare a graduate for subsequent registration in all states.

Seniors in accredited curricula of the College of Engineering are encouraged to take the Fundamentals of Engineering Examination toward professional registration during their final academic year. Seniors in engineering curricula who have obtained at least 6 semester credits in surveying may take the Fundamentals Examination for professional registration as land surveyors.

Concurrent Graduate/ Undergraduate Programs

Several engineering programs offer the opportunity for well-qualified undergraduate juniors and seniors to pursue a graduate degree in their program while finishing the undergraduate requirements. The programs offering concurrent undergraduate/graduate degrees are: agricultural engineering, civil engineering, computer engineering, electrical engineering, industrial engineering, mechanical engineering, and materials engineering.

Programs offering concurrent bachelor of science/master of business administration degrees are: civil engineering, computer engineering, electrical engineering, industrial engineering and mechanical engineering. For more information, refer to the graduate study sections for each engineering program. Advanced work in engineering is offered in the post-graduate programs. See the Graduate College section of this catalog.

Joint Undergraduate Programs

A bachelor of science degree in software engineering is offered in the College of Engineering and the College of Liberal Arts and Sciences. This program is jointly administered by the Department of Electrical and Computer Engineering and the Department of Computer Science.

Accreditation

Ten curricula in the College of Engineering are accredited by ABET. Two newer curricula will pursue accreditation. Accreditation status is indicated in the Courses and Programs section for each engineering curricula. For more information on accreditation practices contact:

Engineering Accreditation Commission
ABET
111 Market Place, Suite 1050
Baltimore, MD 21202-4012
Phone: 410-347-7700
http://www.abet.org

Organization of Curricula

All curricula in engineering are designed as four-year programs. They are structured in two phases: a basic program and a professional program. The basic program consists primarily of subjects fundamental and common to all branches of engineering and includes chemistry, physics, mathematics, engineering computations, and English. The professional phase of a curriculum includes intensive study in a particular branch of engineering, as well as a continuation of supporting work in mathematics, basic sciences, humanities, and social sciences.

Students should complete the requirements of the basic program before proceeding to a professional program.

Preparation for the Engineering Curricula

In addition to the standard university admission requirements, the college also requires 2 years of a foreign language. Other high school credits particularly important to students wishing to study engineering include: 2 years of algebra, 1 year of geometry, and 1/2 year of trigonometry and 1/2 year of pre-calculus; 1 year each of chemistry, biology, and physics; 3 years of social science, and 4 years of English. See Index for specific admission requirements.

Placement in mathematics, English, and chemistry will generally be based on high school preparation and test scores. Advanced placement is possible for exceptionally well-prepared students. Students who are not adequately prepared may be encouraged or required to take additional preparatory coursework and should expect to spend more than the customary time to complete the engineering program. Any coursework which is preparatory or remedial in nature cannot be used to satisfy credit requirements for graduation in any of the engineering curricula.

Basic Program for Professional Engineering Curricula

The first year program is much the same for all professional curricula in the College of Engineering. Students normally enroll in the majority of the basic program courses during their first year. The basic program is a set of courses common to all engineering curricula. Since students may also begin curriculum designated requirements during their first year, they will want to select a curriculum as soon as possible. This will enable them to receive the bachelor's degree in a minimum time.

Entering undergraduates must demonstrate proficiency in trigonometry based on test scores, or by having transfer credits from a college trigonometry course, or by passing either Math 141 or 142 before enrolling in Math 166 or C E 160.

The Department of English may recommend placement in one or more sections of Engl 101 if the placement test administered to students whose first language is not English indicates a deficiency in reading or writing. Satisfactory completion of the recommended course(s) will be required of students in the College of Engineering.

Basic Program

Cr.	
8	Mathematics 165, 166
6	English 150, 250
4	Chemistry 167 or 177*
3	Engineering 160, Aer E 160, CE 160, Cpr E 185, E E 185, S E 185, or I E 148**
5	Physics 221
R	Engineering 101***
0.5	Library 160
26.5	Total credits

Students without a strong high school chemistry background may opt to take a two course sequence of Chem 155 (3 cr.) and Chem 165 (4 cr.) to meet the Chem 167 (4 cr.) requirement.

English 250 is normally taken in the second year. However, students who advance place into this course may be able to enroll during their first year. Credit for English 150 is earned upon successful completion of English 250. In addition to the basic program courses listed above, curriculum designated courses normally taken the first year of each engineering curricula are listed below.

Curriculum Designated Requirements

Aerospace Engineering—Aer E 160**, Aer E 161 (4 cr.), Aer E 192 (R), GenEd Electives (3 cr)

Agricultural Engineering—Chem 167L (1 cr.), A E 110 (1 cr.), Engr 170 (3 cr.), SSH Elective (3 cr.)

Biological Systems Engineering—Chem 167L (1 cr.), BSE 110 (1 cr.), Engr 170 (3 cr.), SSH Elective (3 cr.)

Chemical Engineering—Chem 177*, 177L (1 cr.), 178 (3 cr.), 178L (1 cr.), SSH Elective (3 cr.)

Civil Engineering—Chem 167L (1 cr.) or Chem 177L (1 cr.)*, C E 105 (1 cr.), C E 160**, C E 170 (2 cr.), C E 111 (3 cr.), SSH Elective (3 cr.)

Computer Engineering—Cpr E 185** (3 cr.), Com S 227 (4 cr.), Cpr E 166 (R cr.), Gen Ed Elective (3 cr.)

Construction Engineering—Con E 121 (1 cr.), 122 (1 cr.), Psychology Elective – Psych 101, 230, or 280 (3 cr.), Engr 170 (3 cr.), SSH Elective (3 cr.)

Electrical Engineering—E E 185** (3 cr.), Com S 207 (3 cr.) or 227 (4 cr.), E E 166 (R cr.), Gen Ed Elective (3 cr.)

Industrial Engineering—I E 101 (R cr.), I E 148** (3 cr.), SSH Elective (6 cr.)

Materials Engineering—Chem 177*, 177L (1 cr.), 178 (3 cr.), 178L (1 cr.), Engr 170 (3 cr.), Gen Ed Elective (3 cr.), (Physics 221 scheduled in sophomore year.)

Mechanical Engineering—Chem 167L (1 cr.), Engr 170 (3 cr.), M E 102 (R cr.), Gen Ed Elective (3 cr.)

Software Engineering— S E 185** (3 cr.), 166 (R cr.), Com S 227 (4 cr.), 228 (3 cr.)

The student's adviser may require or recommend courses in addition to those specified above if the preparation and progress of the student are such that additional courses are necessary or desirable.

*Students planning to enroll in C E[1], Ch E, or Mat E will find Chem 177 to be a better preparation for Chem 178. However, Chem 167 is accepted as a substitute for 177 for those students declaring one of these curricula after having completed 167. The Chem 155-165 sequence is an acceptable substitute for Chem 167.

**Recommended choices by program:

Aer E: Aer E 160 (3 cr.)
C E: C E 160 (3 cr.)
Cpr E: Cpr E 185 (3 cr.)
E E: E E 185 (3 cr.)
I E: I E 148 (3 cr.)
S E: S E 185 (3 cr.)

Credit hours for graduation will be given for any one of Aer E 160, C E 160, Engr 160, I E 148, Cpr E 185, E E 185, or S E 185 without increasing a curriculum's minimum number of credits required for graduation.

***Students enrolled in the joint software engineering degree program will take S E 101.

[1]Students in the general emphasis in C E have two chemistry/physics sequence options. The environmental emphasis requires Option 1.

Option 1—Chem 177, 177L, 178, 178L, and Phys 221.

Option 2—Chem 167, 167L; or Chem 177, 177L; and Phys 221 and 222. Students who opt for Phys 222 rather than Chem 178, 178L will increase the total number of credits required by 1.

Requirement for Entry into Professional Program

Students enrolled in the College of Engineering must satisfy both of the following requirements before enrolling in the professional courses (200-level and above) offered by departments in the Engineering College:

1. Completion of the basic program with a grade point average of 2.00 or better in the basic program courses.
2. A cumulative grade point average of 2.00 or better for all courses taken at Iowa State University.

The following are the only exceptions to this rule:

a. Students who have completed all of their coursework while enrolled in the College of Engineering, but have not met the two basic program requirements, may enroll for not more than two semesters in 200-level or above courses offered by departments in the College of Engineering.

b. Students transferring to the College of Engineering from another college or university, or from a program outside this college, who have not met the two basic program requirements may also enroll for not more than two semesters in 200-level or above courses offered by departments in the College of Engineering. However, they may be granted an additional semester upon review by the college.

c. Iowa State students not pursuing an engineering degree may generally take engineering courses without restrictions provided they meet the prerequisites and space is available.

d. Only the first two semesters of 200-level and above engineering courses, taken at ISU while a student is not enrolled in the College of Engineering, can be applied toward an engineering degree.

Requirement for Graduation

In order to graduate in a professional engineering curriculum, students must have a minimum GPA of 2.00 in a department-designated group of 200-level and above courses known as the Core. These courses will total no fewer than 24 nor more than 48 semester credits.

Engineering Minors

The College of Engineering offers three undergraduate minors which are open only to students in the College of Engineering. These are minors in bioengineering, nondestructive evaluation, and nuclear engineering. These minors must include at least nine credits which are beyond the total used to meet curriculum requirements.

The bioengineering minor is a 15 credit interdisciplinary program that complements a student's major discipline by providing additional insight into the interactions between various engineering disciplines and biological systems. The minor is administered by a supervisory faculty committee. For minor course requirements, refer to Bioengineering in Courses and Programs.

The nondestructive evaluation minor is a 16 credit minor open only to engineering students who have met the basic program requirements and are not on academic warning or probation. The minor is supervised by an interdisciplinary faculty committee. For minor course requirements, refer to Aerospace Engineering in Courses and Programs for minor course requirements.

The nuclear engineering minor is a 15 credit minor which enables engineering students to acquire a basic and fundamental knowledge of nuclear sciences and engineering. Courses are provided at Iowa State University and also through an inter-institutional distance education program offered through the Web by four of the Big 12 Engineering Consortium Schools. For minor course requirements, refer to Nuclear Engineering in *Courses and Programs*.

Minor for Non-Engineers

The College of Engineering also offers an undergraduate minor in engineering studies which is open only to students outside of the College of Engineering.

The engineering studies minor is a 21 credit interdepartmental minor. A student's minor program in engineering studies must include at least nine credits which are beyond the total used to meet minimum degree requirements. The minor is supervised by an interdepartmental faculty committee. Refer to Engineering Studies in Courses and Programs for minor course requirements.

Undergraduate Majors and Minors Outside the College of Engineering

In addition to the engineering degree program, students may earn majors or minors in other colleges of the university. A major or minor program must meet all requirements of the offering department or program and its college and contain credits beyond the requirements for a B.S. degree in engineering. A minimum of 15 additional credits is required for each major area of study and an additional 9 credits for each minor.

Advising System

The purpose of the advising system in the College of Engineering is to work constructively with students in developing their individual academic programs and to maintain close contact with students during their college careers.

The college offers an orientation program during the spring and summer for students planning to enter in the fall, and during the fall for students planning to enter in the spring. All entering students are encouraged to attend an orientation session. Placement assessments given during the orientation program help determine the student's level of achievement and enable the adviser to prepare an appropriate program for the student.

Special Programs

All engineering students are strongly encouraged to participate in either the cooperative education or internship programs. Students who are qualified to participate in the engineering honors program are also urged to do so. These programs are integrated into the professional engineering curricula and may require additional work. However, both these professional and academic programs offer opportunities that will enrich the standard academic experience. Engineering students are also encouraged to take advantage of study abroad opportunities available through the College of Engineering's International Programs Office.

a. Cooperative Education Program. The College of Engineering offers, through its curricula, a cooperative education program. Enrollment in the program allows students to gain practical experience in their career field while attending college. In general, students enrolled in the co-op program will require an additional year to complete curriculum requirements.

   These programs are arranged so that the student alternates academic work with employment periods. The student has the opportunity to assess career paths within her/his chosen curriculum and the employer evaluates the student's potential as a future full-time employee. Both domestic and international co-op programs are available.

   Cooperative education students pay no fees to the university during their work periods and do not receive credit hours for their work experience. Students register for a non-credit cooperative education course (298, 398, or 498) for each work period and are considered full time students while enrolled in these courses. For additional information contact your academic adviser and the Office of Engineering Career Services.

b. Internship Program. Internships are a mechanism by which a student may work full-time for one semester per academic year while maintaining her/his status as a full-time student.

   Internship students pay no fees to the university during their work periods and do not receive credit hours for their work experience. Students who register for the internship course (397) for a fall or spring semester work period or (396) for the summer term are considered to be full time students. For additional information contact your academic adviser and the Office of Engineering Career Services.

c. Honors Program. The College of Engineering participates in the University Honors Program (see Index). The honors program is designed for students with above average ability who wish to individualize their programs of study. For further details consult the chair of the Engineering College Honors Program Committee or your departmental honors program adviser.

d. Engineering International Programs. In a world where the sun never sets, engineers must be prepared to understand other cultures and other ways of doing business. Engineers must expand their exportable skills, language and cross-cultural skills.

   Engineering International Programs (EIP) has formed worldwide partnerships to create opportunities for students to work and study with leading universities in other countries and multinational corporations. With careful planning, students may earn credit in courses that fulfill their degree requirements. To learn more about work and study with leading universities in other countries and multinational corporations, visit the EIP home page at www.eng.iastate.edu/intl-progs/.

e. Engineering Leadership Program. Started in the Fall Semester of 2006, the Engineering Leadership Program (ELP) was developed to address the growing need for leaders trained in technology. Initial funding for the program was provided by 3M Company with additional funding from other corporate and private sources. Students selected into the ELP have opportunities to interface with engineers and company leadership of the donating companies. Mentored by a faculty and a peer mentor, each student receives individual direction and insight on academics, leadership opportunities, career paths and life skills. They are encouraged to develop their individual leadership styles and leadership competencies, while interacting with industry, government, faculty and student leaders. Incoming freshmen may apply the spring prior to their first fall semester at Iowa State University. Current Iowa State students may apply to be upper-level scholars each spring. Visit the ELP website at: http://www.eng.iastate.edu/leadership/ .

Curriculum in Aerospace Engineering

Leading to the degree bachelor of science.

Total credits required: 126.5. See also *Basic Program and Special Programs.*

International Perspectives[1]: 3 cr.
U.S. Diversity[1]: 3 cr.

Communication Proficiency and Library requirements: Engl 150 and Engl 250 with minimum grade of C ; Lib 160. Department approval. (See Basic Program for credit requirements.)

General Education Electives: 15.0 cr[2]
Complete 15 cr. including a series. A series of at least two courses must be taken to fulfill this requirement.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Aer E 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See Basic Program rule.

Math and Physical Science: 13 cr.
Math 265, 4 cr.; Math 267, 4 cr.; Phys 222, 5 cr.

Aerospace Engineering Core: 48 cr.
Aer E 243, 3 cr. and Aer E 243L 0.5 cr.; Aer E 261, 4 cr.; Aer E 311, 3 cr. and Aer E 311L, 0.5 cr.; Aer E 321, 3 cr.; Aer E 331, 3 cr.; Aer E 343, 3 cr. and Aer E 343L, 1 cr.; Aer E 351, 3 cr.; Aer E 355, 3 cr.; Aer E 411, 3 cr.; Aer E 421, 3 cr.; Aer E 361, 3 cr.; Aer E 461, 3 cr.; Aer E 462, 3 cr.; E M 324, 3 cr.; M E 330, 3 cr.

Other Remaining Courses: 24 cr.
E M 274, 3 cr.; E M 345, 3 cr.; Mat E 272, 2 cr.; Aer E 161, 4 cr. Complete 3 cr., from Aer E 412, 3 cr.; Aer E 422, 3 cr.; Aer E 423, 3 cr.; Aer E 426, 3 cr.; Aer E 432, 3 cr.; Aer E 442, 3 cr.; Aer E 446, 3 cr.; Aer E 451, 3 cr. or Aer E 464. Technical Electives, 3 cr. and Career Electives, 6 cr. selected from preceding Aer E list or departmental-approved 300-level or above courses relevant to technical and career areas.

Seminar/Co-op/Internships:
Aer E 192, R cr.; Aer E 291, R cr.; Aer E 292, R cr., Aer E 391, R cr., Aer E 392, R cr., Aer E 491, R, cr. and Aer E 492, R cr.

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also allowed by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4] 2.00 required including transfer courses.

Curriculum in Agricultural Engineering

Administered by the Department of Agricultural and Biosystems Engineering.

Leading to the degree bachelor of science.

Total credits required: 127.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]
U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with a minimum grade of C; Lib 160. (See *Basic Program* for credits.) Complete one course from AgEds 311, Engl 309, Engl 314 or Sp Cm 212.

Social Sciences and Humanities: 12 cr.[2]
Complete 3 cr. from international perspectives and 3 cr. from U.S. diversity university-approved list. Complete additional 6 cr. Social Sciences and Humanities courses.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Engr 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 9 cr.
Chem 167L, 1 cr. or Chem 177L, 1 cr.; Phys 222, 5 cr.; and Stat 305, 3 cr.

Ag Engineering Core: 24 cr.[4]
A E 216, 3 cr.; A E 316, 3 cr.; A E 363, 4 cr.; A E 415, 2 cr.; A E 416, 2 cr.; E M 274, 3 cr.; E M 324, 3 cr.; E M 327, 1 cr.; Math 266, 3 cr.

Other Remaining Courses: 16 cr.
A E 110, 1 cr.; A E 201, 1 cr.; A E 301, 1 cr.; A E 401, 1 cr.; A E 404, 3 cr.; Engr 170, 3 cr.; M E 330, 3 cr. Complete one course (3 cr.) from AgEds 311, Engl 309, Engl 314 or Sp Cm 212.

Select remaining courses from one of the following options:

Agricultural and Environmental Systems Engineering Option: 40 cr.
A E 271, 1 cr. or A E 272, 1 cr.; A E 431, 3 cr.; A E 431, 3 cr.; A E 472, 3 cr.; Biol 211, 3 cr.; C E 332, 3 cr.; C E 372, 4 cr.; E M 378, 3 cr. Complete one course (3 cr.) from A E 340, A E 478, or BSE 480. Complete 3 cr. from Biological and Natural Resource Sciences list.[2]

Power and Machinery Engineering Option: 40 cr.
A E 271, 1 cr. or A E 272, 1 cr.; A E 340, 3 cr.; A E 342, 3 cr.; A E 413, 3 cr.; Agron 154, 3 cr.; Biol 211, 3 cr.; E M 345, 3 cr.; E M 378, 3 cr.; M E 324, 4 cr.; M E 325, 3 cr.; Mat E 272, 2 cr. Complete one course (3 cr.) from A E 431, A E 469, A E 472 or 478, or A E 480. Complete six credits of electives.[2]

Co-op/Internships (Optional)

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See *Basic Program for Professional Engineering Curricula* for accepted substitutions for curriculum designated courses in the Basic Program.

[4] 2.00 required including transfer courses.

Curriculum in Biological Systems Engineering

Administered by the Department of Agricultural and Biosystems Engineering.

Leading to the degree bachelor of science.

Total credits required: 127.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with a minimum grade of C; Lib 160. (See *Basic Program* for credits.) Complete one course from AgEds 311, C E 203, Engl 309, or Sp Cm 212.

Social Sciences and Humanities: 12 cr. [2]
Complete 3 cr. from international perspectives and 3 cr. from U.S. diversity university-approved list. Complete additional 6 cr. Social Sciences and Humanities courses.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 , 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Engr 160, 3 cr.c; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule.)

Biological, Math and Physical Science: 20 cr.
Biol 212, 3 cr.; Chem 167L, 1 cr.; Math 267, 4 cr.; Phys 222, 5 cr.; and Micro 302, 3 cr., Micro 302L, 1 cr., Stat 305, 3 cr.

Biological Systems Engineering Core: 26 cr.[4]
A E 316, 3 cr.; A E 363, 4 cr.; A E 404, 3 cr.; BSE 201, 1 cr.; BSE 216, 3 cr.; BSE 301, 1 cr.; BSE 380, 3 cr.; BSE 401, 1 cr.; BSE 415, 2 cr.; BSE 416, 2 cr.; BSE 480, 3 cr.

Other Remaining Courses: 23 cr.
BSE 110, 1 cr.; Ch E 356, 3 cr.; Ch E 357, 3 cr.; Engr 170, 3 cr.; E M 274, 3 cr.; E M 324, 3 cr.; E M 327, 1 cr.; M E 330, 3 cr. Complete one course (3 cr.) from AgEds 311, C E 203, Engl 309, or Sp Cm 212.

Complete remaining courses from one of the following options:

Biorenewable Resources Engineering Option: 20 cr.
A E 388, 3 cr. BSE 403, 3 cr.; Chem 331, 3 cr.; Chem 331L, 2 cr.; Chem 332, 3 cr. Complete 6 credits for option electives.[2]

Bioenvironmental Engineering Option: 20 cr.
A E 431, 3 cr. C E 326, 3 cr.; Chem 211, 2 cr.; Chem 211L, 2 cr.; Chem 231, 3 cr.; Chem 231L, 1 cr. Complete 3 cr. from A E 436, C E 421, C E 428, or EnSci 381. Complete 3 credits for remaining option elective. [2]

Food Engineering Option: 20 cr.
AE 451, 3 cr.; BSE 469, 3 cr.; Chem 231, 3 cr.; FSHN 311, 4 cr.; FSHN 420, 3 cr.; FSHN 471, 3 cr. Select 1 credit to complete option elective.

Pre-Professional and Pre-Graduate Option: 19-20 cr.
Chem 331, 3 cr.; Chem 331L, 1 cr.; Chem 332, 3 cr.; Chem 332L, 1 cr. Complete 3 credits from A E 406 or BSE 403. Complete 8 to 9 credits for remaining option electives. [2]

Co-op/Internships (Optional)

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4] 2.00 GPA required including transfer courses.

Curriculum in Chemical Engineering

Administered by the Department of Chemical and Biological Engineering

Leading to the degree bachelor of science.

Total credits required: 125.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]
U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250; Lib 160. (See Basic Program for credit requirements.) Complete one course from Engl 309, 3 cr.; Engl 314, 3cr.; or JL MC 347, 3 cr.

Social Sciences and Humanities: 15 cr.
Complete a total of 15 cr. with at least 6 cr. but not more than 9 cr. from the same department.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Engr 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See Basic Program rule.)

Math and Physical Science: 30 cr.
Math 265, 4 cr.; Math 267, 4 cr.; Phys 222, 5 cr.; Chem 167L, 1 cr. or Chem 177L, 1 cr.; Chem 178, 3 cr.; Chem 178L, 1 cr.; Chem 325, 3 cr.; Chem 331, 3 cr.; Chem 332, 3 cr.; BBMB 301, 3 cr.

Chemical Engineering Core: 33 cr.[4]
Ch E 210, 3 cr.; Ch E 302, 1 cr.; Ch E 310, 3 cr.; Ch E 325, 2 cr.; Ch E 356, 3 cr.; Ch E 357, 3 cr.; Ch E 358, 3 cr.; Ch E 381, 3 cr.; Ch E 382, 3 cr.; Ch E 421, 3 cr.; Ch E 426, 2 cr.; Ch E 430, 4 cr.

Other Remaining Courses: 21 cr.
Complete one course from Engl 309, 3 cr.; Engl 314 3 cr. or JL MC 347, 3 cr.
Complete 3 cr. from Chemistry Electives list.[2]
Complete 3 cr. from Statistical Electives list.[2]
Complete 3 cr. from Chemical Engineering

Electives list.[2] Complete 3 cr. from any 300+ level course in engineering.[2] Complete 6 cr. from Professional Electives list.[2]

Biological Engineering Option
The standard Chemical Engineering program may be modified to meet the option requirements for Biological Engineering:

Math and Physical Science – BBMB 404 or Biol 313, 3 cr., may be substituted for BBMB 301 from list above.

Chemical Engineering Core – Replace Ch E 426, 2 cr. with Ch E 427, 2 cr. in required Core.

Other Remaining Courses:
Chemistry Electives, 3 cr. - BBMB 405 (prerequisite 404), BBMB 420 (prerequisite 301), or Biol 314.
Chemical Engineering Electives, 3 cr. – Ch E 415, Ch E 440, Ch E 542 or Ch E 562.
Engineering Electives, 3 cr. – A E 373, A E 480, BRT 501, C E 421, or MSE 580.
Professional Electives, 6 cr. – Ch E 415, Ch E 440, Ch E 542, Ch E 562, or Ch E 490; and one course from 300-level, or above, life sciences (not BBMB 301), 300- or above level course in Chem, FS HN or BBMB.

Co-op/Internships: Optional

[1]These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program.
U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2]Choose from department approved list.

[3]See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4]2.00 required including transfer courses.

Curriculum in Civil Engineering (General)

Administered by the Department of Civil, Construction and Environmental Engineering.

Leading to the degree bachelor of science.

Total credits required: 131.5* See also *Basic Program and Special Programs.*

International Perspectives: 3 cr.[1]
U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with minimum grade of C); Lib 160. (See Basic Program for credit requirements.)

Social Sciences and Humanities: 12 cr.[2]
Complete 12 cr. with 6 cr. at 200-level or above.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; C E 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See Basic Program rule.)

Math and Physical Science: 17 cr. (18 cr.)*
Chem 177L, 1 cr.; Chem 178, 3 cr. and Chem 178L, 1 cr., or Phys 222 5 cr.; Geol 201, 3 cr.; Math 266, 3 cr. Complete 3 cr. Statistics Electives[2]. Complete 3 cr. Numerical Analysis Electives[2].

C E Engineering Core: 30 cr.[4]
E M 274, 3 cr.; E M 324, 3 cr.; E M 345, 3 cr.; E M 378, 3 cr. C E 305, 3 cr.; C E 326, 3 cr.; C E 332, 3 cr.; C E 355, 2 cr.; C E 360, 3 cr.; and C E 372, 4 cr.

Other Remaining Courses: 45 cr.
C E 105, 1 cr.; C E 111, 3 cr.; C E 170, 2 cr.; C E 205, 3 cr.; C E 306, 3 cr.; C E 333, 3 cr.; C E 334, 3 cr.; C E 382, 3 cr.; C E 453, 4 cr.; C E 485, 2 cr.; C E 486, 3 cr.; E M 327, 1 cr.; Sp Cm 212, 3 cr. Complete 11 cr. Engineering Topics Electives.[2]

Seminar/Co-op/Internships: R cr.
C E 403, R. cr.

Co-op/Internship optional.

[1]These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program.
U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2]Choose from department approved list.

[3]See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4]2.00 required including transfer courses.

* Note: Students who opt for Phys 222 rather than Chem 178, 178L will complete 18 cr. here which will increase the total number of credits required by 1.

Curriculum in Civil Engineering with Environmental Option

Administered by the Department of Civil, Construction and Environmental Engineering.

Leading to the degree bachelor of science.

Total credits required: 130.5. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement: Engl 150 and Engl 250 with minimum grade of C); Lib 160. (See Basic Program for credit requirements.)

Social Sciences and Humanities: 12 cr.[2]
Complete 12 cr. with 6 cr. at 200-level or above.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; C E 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 26 cr.
Chem 177L, 1 cr.; Chem 178, 3 cr. and Chem 178L, 1 cr., Biol 173 or 211, 3 cr.; Chem 231, 3 cr., and Chem 231L, 1 cr.; Geol 201, 3 cr.; Math 266, 3 cr.; Micro 201, 2 cr. Complete 3 cr. Statistics Electives[2]. Complete 3 cr. Numerical Analysis Electives[2].

C E/Env Engineering Core: 27 cr.[4]
E M 274, 3 cr.; E M 324, 3 cr.; E M 378, 3 cr.; C E 305, 3 cr.; C E 326, 3 cr.; C E 332, 3 cr.; C E 355, 2 cr.; C E 360, 3 cr.; and C E 372, 4 cr.

Other Remaining Courses: 39 cr.
C E 105, 1 cr.; C E 111, 3 cr.; C E 170, 2 cr.; C E 205, 3 cr.; C E 306, 3 cr.; C E 334, 3 cr.; C E 382, 3 cr.; C E 420, 3 cr.; C E 421, 3 cr.; C E 428, 3 cr.; C E 485, 2 cr.; C E 486, 3 cr.; E M 327, 1 cr.; Sp Cm 212, 3 cr. Complete 3 cr. Engineering Topics Electives.[2]

Seminar/Co-op/Internships: R cr.
C E 403, R. cr.

Co-op/Internship optional.

[1]These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program.
U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2]Choose from department approved list.

[3]See *Basic Program for Professional Engineering Curricula* for accepted substitutions for curriculum designated courses in the Basic Program.

[4]2.00 required including transfer courses.

Curriculum in Computer Engineering

Administered by the Department of Electrical and Computer Engineering.

Leading to the degree bachelor of science.

Total credits required: 126.5 See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement: Engl 150 and Engl 250 with minimum grade of C; Lib 160. (See *Basic Program* for credit requirements.) Engl 314 or Engl 309 with a minimum grade of C.

General Education Electives: 15 cr.[2]
Complete minimum of 6 cr. from Approved General Education Component at 300 or higher level. Complete additional 9 cr. from Approved General Education Component.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Cpr E 185, 3 cr.c; Lib 160, 0.5 cr.; Math 165, 4 cr. (minimum grade of C-) and Math 166, 4 cr. (minimum grade of C-); and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 20 cr.
Com S 227, 4 cr. (minimum grade of C-) and Com S 228, 3 cr. (minimum grade of C-). Math 265, 4 cr.; Math 267, 4 cr.; and Phys 222, 5 cr.

Computer Engineering Core: 33 cr.[4]
Cpr E 281, 4 cr.; Cpr E 288, 4 cr.; Cpr E 308, 4 cr.; Cpr E 310, 3 cr.; Cpr E 381, 4 cr.; Com S 309, 3 cr.; Com S 311, 3 cr.; E E 201, 4 cr.; and E E 230, 4 cr.

Other Remaining Courses: 32 cr.
Cpr E 491, 3 cr. and Cpr E 492, 2 cr. Engl 314, 3 cr. or Engl 309, 3 cr. with a minimum grade of C.
Complete 3 cr. of Computer Science courses, 6 cr. of Computer Engineering, 9 cr. of Technical Electives, and 3 cr. of Electrical Engineering courses.b Stat 330, 3 cr.

Seminar/Co-op/Internships:
Cpr E 166, R cr. Cpr E 294, R cr., Cpr E 394, R cr. and Cpr E 494, R cr.

Co-op or internship is optional.

Outcomes Assessment - Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses.

Transfer Credit Requirements
The degree program must include a minimum of 30 credits at the 300-level or above in professional and technical courses earned at ISU in order to receive a B.S. in computer engineering. These 30 credits must include Cpr E 491. Senior Design Project I and Professionalism, Cpr E 492 Senior Design Project II, and credits in the core professional curriculum and/or in technical electives. The Electrical and Computer Engineering Department requires a grade of C or better for any transfer credit course that is applied to the degree program.

[1]These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass, but are used to meet the general education electives.

[2]Choose from department approved lists.

[3]See *Basic Program for Professional Engineering Curricula* for accepted substitutions for curriculum designated courses in the *Basic Program*.

[4]2.00 required including transfer courses.

Note: International perspectives and U.S. diversity courses are used to meet the general education electives.

Curriculum in Construction Engineering

Administered by the Department of Civil, Construction, and Environmental Engineering.

Leading to the degree bachelor of science.

Total credits required: Building Option –123.5, Heavy Option – 123.5, Electrical – 126.5, Mechanical – 125.5 cr.

See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirements: Engl 150 and Engl 250 with minimum grade of C; Lib 160. (See *Basic Program* for credit requirements.) Business Communication Elective: one course from Engl 302, Engl 309 or Engl 314 with a minimum grade of C.

Social Sciences and Humanities: 12 cr.
Complete one of Psych 101, Psych 230, Psych 250, or Psych 280. Complete either Econ 101 or Econ 102. Complete 3 cr. from international perspectives and 3 cr. from U.S. diversity approved list.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; C E 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 11 cr. (B, H); 12 cr. (E, M).
Stat 105, 3 cr.; Math 266, 3 cr. (B, H); Math 267, 4 cr. (E, M); Phys 222, 5 cr.

Construction Engineering Core: 24 cr. (B, H, E); 25 cr. (M)[4].
E M 274, 3 cr.; E M 324, 3 cr.; Con E 421, 3 cr.; E M 378, 3 cr.; C E 332, 3 cr.; (See options for remaining option Core courses.)

Additional Required Courses: 35 cr. (B, H), 36 cr. (E, M)
Con E 121, 1 cr.; Con E 122, 1 cr.; C E 170,| 2 cr.; C E 111, 3 cr.; Acct. 284, 3 cr.; Con E 221, 4 cr.; Con E 241, 3 cr.; Con E 251, 1 cr. Complete one 3 cr. Law Elective.[2].; Con E 441, 3 cr.; Con E 487, 2 cr. and Con E 488, 3 cr.; Complete one 3 cr. Business Communication Elective from Engl 302, 309, or 314[2]. Complete one course from Math or Stat Elective, 3 cr. (B, H); 4 cr. (E, M)[2]

Select remaining courses from one of the following options:

Building Option:
Remaining Core courses (9 cr.)
C E 360, 3 cr.; Con E 322, 3 cr.; Con E 340, 3 cr.
Remaining option courses – 15 cr.
C E 333, 3 cr.; C E 334, 3 cr.; C E 383, 1 cr.; Con E 352, 3 cr.; Con E 353, 2 cr.; E M 327, 1 cr.; Complete 2 cr. from Engineering Topics Electives.[2]

Heavy Option:
Remaining Core courses (9 cr.)
C E 360, 3 cr.; Con E 322, 3 cr.; and Con E 340, 3 cr.
Remaining option courses – 15 cr.
C E 333, 3 cr.; C E 334, 3 cr.; C E 382, 3 cr.; E M 327, 1 cr. Complete 5 cr. of Engineering Topics Electives[2].

Electrical Option:
Remaining Core courses (9 cr.)
M E 231, 3 cr.; E E 303, 3 cr. and E E 456, 3 cr.
Remaining option courses – 16 cr.
Con E 352, 3 cr.; Con E 353, 2 cr.; E E 201, 4 cr. E E 230, 4 cr. and E E 457, 3 cr.

Mechanical Option:
Remaining Core courses (10 cr.)
M E 231, 3 cr., M E 436, 4 cr., and M E 441, 3 cr.
Remaining option courses – 14 cr.
Con E 352, 3 cr.; Con E 353, 2 cr; E E 442, 2 cr. and E E 448, 2 cr.; M E 442, 3 cr.
Complete 2 cr. of Engineering Topics Electives.

Co-op/Internships - Optional

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See *Basic Program for Professional Engineering Curricula* for accepted substitutions for curriculum designated courses in the *Basic Program*.

[4] 2.00 required including transfer courses

Curriculum in Electrical Engineering

Administered by the Department of Electrical and Computer Engineering.

Leading to the degree bachelor of science.

Total credits required: 126.5 See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement: Engl 150 and Engl 250 with minimum grade of C; Lib 160. (See *Basic Program* for credit requirements.) Engl 314 or Engl 309 with a minimum grade of C.

General Education Electives: 15 cr.[2]
Complete minimum of 6 cr. from Approved General Education Component at 300 or higher level. Complete additional 9 cr. from Approved General Education Component.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; E E 185, 3 cr.c; Lib 160, 0.5 cr.; Math 165, 4 cr. (minimum grade of C-) and Math 166, 4 cr. (minimum grade of C-); and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 16 cr.
Com S 207, 3 cr. or Com S 227, 4 cr. (minimum grade of C-), Math 265, 4 cr.; Math 267, 4 cr.; and Phys 222, 5 cr.

Electrical Engineering Core: 37 cr.[4]
Cpr E 281, 4 cr.; Cpr E 288, 4 cr.; E E 201, 4 cr.; E E 230, 4 cr.;E E 224, 4 cr.; E E 303, 3 cr.; E E 311, 4 cr.; E E 322, 3 cr.; E E 330, 4 cr. or E E 331, 4 cr.; and E E 332, 3 cr.

Other Remaining Courses: 32 cr.
E E 491, 3 cr. and E E 492, 2 cr. Engl 309, 3 cr. or Engl 314, 3 cr. with a minimum grade of C.
I E 305, 3 cr.
Complete one 3 cr. course from Math Electives list.[2]
Complete 12 cr. from EE/Cpr E Technical Elective list including one approved sequence.[2]
Complete 6 additional credits from Math Electives list, EE/Cpr E Technical Elective list and/or non-EE/CprE Electives list.[2]

Seminar/Co-op/Internships:
E E 166, R cr. E E 294, R cr., E E 394, R cr. and E E 494, R cr. Co-op or internship is optional.

Outcomes Assessment - Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses.

Transfer Credit Requirements
The degree program must include a minimum of 30 credits at the 300-level or above in professional and technical courses earned at ISU in order to receive a B.S. in electrical engineering. These 30 credits must include E E 491 Senior Design Project I and Professionalism, E E 492 Senior Design Project II, and credits in the core professional curriculum and/or in technical electives. The Electrical and Computer Engineering Department requires a grade of C or better for any transfer credit course that is applied to the degree program.

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved lists.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4] 2.00 required including transfer courses.

Note: International perspectives and U.S. diversity courses are used to meet the general education electives.

Curriculum in Industrial Engineering

Administered by the Department of Industrial and Manufacturing Systems Engineering.

Leading to the degree bachelor of science.

Total credits required: 120.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirements:
Engl 150 and Engl 250 with minimum grade of C; Lib 160.

Remaining Communication courses: 6 cr.
Engl 314, 3 cr.; Sp Cm 212, 3 cr.

Social Sciences and Humanities: 12 cr.[2]
Six of twelve credits must be from 200-level or above courses. Six credits must be sequential or related courses.

Basic Program: 26.5 cr.[4]
Chem 167, 4 cr.[3]; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements), Engr 101, R cr.; I E 148, 3 cr.[3], Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 17 cr.
Math 265, 4 cr.; Math 267, 4 cr.; Phys 222, 5 cr.; Stat 231, 4 cr.

Industrial Engineering Core: 31 cr.
I E 248, 3 cr.; I E 271, 3 cr.; I E 305, 3 cr.; I E 312, 3 cr.; I E 413, 4 cr., I E 341, 3 cr.; I E 348, 3 cr.; I E 361, 3 cr.; I E 441, 3 cr.; I E 448, 3 cr.

Other Remaining Courses: 28 cr.
Mat E 272, 2 cr.; E M 274, 3 cr.; E E 442, 2 cr.; M E 330, 3 cr.; Focus Electives , 6 cr.[2]; Management Electives, 6 cr.[2]; and Engineering Topic Electives, 6 cr.[2]

Seminar/Co-op/Internships:

I E 101, R cr. Optional co-op/internship courses.

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also allowed by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4] 2.00 required including transfer courses.

Curriculum in Materials Engineering

Administered by the Department of Materials Science and Engineering.

Leading to the degree bachelor of science.

Total credits required: 127.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with minimum grade of C; Lib 160. (See *Basic Program* for credit requirements.) Complete one course from Engl 302, 309, 314 or JL MC 347 with a minimum grade of C.

General Education Electives: 15 cr.
Complete 12 cr. from approved list with a minimum of 6 cr. but no more than 9 cr. from one designator, and a maximum of 9 cr. of 100-level courses[2] . Complete one course from Engl 302, 309, 314 or JL MC 347.[4]

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Engr 160, 3 cr.c; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See Basic Program rule.)

Math and Physical Science 18 cr.
Complete Chem 177L, 1 cr.; Chem 178, 3 cr. and Chem 178L, 1 cr.; Math 265, 4 cr.; Math 267, 4 cr.; and Phys 222, 5 cr.

Materials Engineering Core: 32 cr.[4]
Mat E 201, R cr.; Mat E 214, 3 cr.; Mat E 215, 3 cr.; Mat E 215L, 1 cr.; Mat E 216, 4 cr.; Mat E 311, 3 cr.; Mat E 314, 3 cr.; Mat E 316, 3 cr.; Mat E 317, 3 cr.; Mat E 413, 3 cr., Mat E 414, 3 cr., Mat E 418, 3 cr.

Other Courses: 12 cr.
Engr 170, 3 cr.; E M 274, 3 cr.; E M 324, 3 cr.; Complete 3 cr. from non-remedial courses.

Seminar/Co-op/Internships
Co-op and internships are optional.

Option Requirements: 18 cr.
Students must choose two from the four areas of specialization: ceramic, electronic, metallic and polymeric materials. In lieu of the second specialty from the four listed, a student may propose an individually designed, materials related technical specialty to meet specific career goals. Students must have a 3.00 gpa and a B+ in Mat E 215. Students may learn other requirements and procedures for applying in the Undergraduate Handbook or by speaking with their adviser. The options below meet that expectation by using the following specialization courses:

Ceramic Materials: 321, 322, 425
Electronic Materials: 334, 332, 433
Metallic Materials: 342, 443, 444
Polymeric Materials: 351, 453, 454

Technical Electives: 6 cr.
Complete 6 cr. technical electives from approved departments.[2]

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the *Basic Program*.

[4] 2.00 required including transfer courses.

Note: A Mat E student may take up to 9 credit hours from General Education and free electives on a P/NP basis, except for courses used to meet the diversity and international perspectives requirement. S/F courses (different from P/NP) will be considered for these requirements on a course-by-course basis.

Curriculum in Mechanical Engineering

Leading to the degree bachelor of science.

Total credits required: 128.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with minimum grade of C); Lib 160. (See Basic Program for credit requirements.)

Remaining Communication Courses: 3 cr.
Engl 314, 3 cr.

General Education Electives: 15 cr.
Econ 101, 3 cr. or Econ 102, 3 cr.
Complete 3 additional credits of Social Science Electives.[2]
Complete 6 cr. of Humanities Electives.[2]
Complete 3 additional General Education credits.[2]

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Engr 160, 3 cr.c; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule)

Math and Physical Science: 20 cr.
Engr 170, 3 cr.; Chem 167L, 1 cr. or Chem 177L, 1 cr.; Math 265, 4 cr.; Math 267, 4 cr. or Math 266, 3 cr. with Math 268, 1 cr.; Phys 222, 5 cr.; Stat 305, 3 cr.

Mechanical Engineering Core: 46 cr.[4]
E M 274, 3 cr.; E M 324, 3 cr.; E M 345, 3 cr.; E E 442, 2 cr.; E E 448, 2 cr.; M E 270, 3 cr.; M E 231, 3 cr; M E 324, 4 cr.; M E 325, 3 cr.; M E 332, 3 cr.; M E 335, 4 cr.; M E 370, 3 cr.; M E 421, 4 cr.; M E 436, 4 cr.; Mat E 272, 2 cr.

Other Remaining Courses: 18 cr.
Complete one course from M E 415, 3 cr.; M E 442, 3 cr. or M E 486, 3 cr. Complete 15 cr. Technical Electives.[2]

Seminar/Co-op/Internships:
M E 102, R cr.; M E 202, R cr. Co-op/Internship Optional

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See *Basic Program* for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the *Basic Program*.

[4] 2.00 GPA average required including transfer courses.

Transfer Credit Requirements - The Mechanical Engineering Department requires a grade of a C or better for any transfer credit course that is applied to the degree program. The degree program must include a minimum of 15 credits taken from courses offered through the Mechanical Engineering Department at Iowa State University. Of these 15 credits, three must be from one of the senior capstone design courses. The remaining 12 credits may be from the core curriculum program (if a student is deficient in these courses) or from 400-level ME technical electives. No more than 3 credits of ME 490 (independent study) shall be applied to meet the 12 credit requirement.

Curriculum in Software Engineering

Administered by the Department of Electrical and Computer Engineering and the Department of Computer Science in the College of Liberal Arts and Sciences.

Leading to the degree bachelor of science.

Total credits required: 124.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with minimum grade of C; Lib 160. (See *Basic Program* for credit requirements.) Engl 314 with a minimum grade of C.

General Education Electives: 15 cr.[2]
Complete 6 cr. from Arts and Humanities list, 3 cr. of Social Sciences, and an additional 6 cr. from either Arts and Humanities or Social Sciences lists.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; S E 185, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. (minimum grade of C-) and Math 166, 4 cr. (minimum grade of C-); and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 11 cr.
Com S 227, 4 cr. (minimum grade of C-) and Com S 228, 3 cr. (minimum grade of C-). Math 267, 4 cr.

Software Engineering Core: 31 cr.[4]
Cpr E 281, 4 cr.; Cpr E 288, 4 cr. or Com S 229, 3 cr.; Cpr E 308, 4 cr. or Com S 352, 3 cr.; Com S 309, 3 cr.; Com S 311, 3 cr.; Com S 330, 3 cr. or Cpr E 310, 3 cr.; ComS 363, 3 cr. S E 319, 3 cr.; S E 329, 3 cr. and S E 339, 3 cr.

Other Remaining Courses: 41 cr.
S E 491, 3 cr. and S E 492, 2 cr. Engl 314, 3 cr. with a minimum grade of C. Complete either Econ 101, 3 cr., Econ 102, 3 cr. or I E 305, 3 cr. Sp Cm 212, 3 cr. Stat 330, 3 cr.
Complete 3 cr. from Math Electives list.[2]
Complete 6 cr. from Software Engineering course list. [2]
Complete 3 cr. from Technical Electives list.[2]
Complete 12 cr. from list of Supplementary Electives.[2]

Note: Excess credits from CprE 288 and/or Cpr E 308 may be applied to meet Supplementary Elective credit requirement.

Seminar/Co-op/Internships
S E 166 or Com S 203. Co-op or internship is optional.

Transfer Credit Requirements
The degree program must include a minimum of 30 credits at the 300-level or above in professional and technical courses earned at ISU in order to receive a B.S. in software engineering. These 30 credits must include S E 491 Senior Design Project I and Professionalism, S E 492 Senior Design Project II, and credits in the core professional curriculum and/or in technical electives. The software engineering degree program requires a grade of C or better for any transfer credit course that is applied to the degree program.

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved lists.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

d 2.00 required including transfer courses.

Note: International perspectives and U.S. diversity courses are used to meet the general education electives.

College of Human Sciences

Pamela White, Interim Dean
Carla Peterson, Associate Dean
www.hs.iastate.edu/

Departments of the College

Apparel, Educational Studies, and Hospitality Management

Curriculum and Instruction

Educational Leadership and Policy Studies

Food Science and Human Nutrition

Kinesiology

Human Development and Family Studies

The College of Human Sciences provides an integrative approach to improving the quality of life for individuals, families, schools and communities by linking discovery, science, creativity, and practice; applying the knowledge of learning in all endeavors; and developing leaders for roles in research, education, business and industry, and health and human services.

The College of Human Sciences (CHS) was founded in 2005 and is the newest college on the ISU campus. The college fosters innovative synergies in teaching and research, and in many ways is reinventing how human potential can be enhanced. Members of the College of Human Sciences community strive to improve the quality of people's lives - helping them learn better, live longer, and lead lives that are more productive and fulfilling.

Recommended High School Preparation

Recommended preparation for students entering most departments of the College of Human Sciences should include 4 years of English (including speech) with emphasis in composition and communication skills; 3 years each of mathematics and natural sciences, and at least 2 years of social science and/or humanities. In addition, students interested in Elementary Education or Early Childhood Education are advised to complete three or more years of high school study in one foreign language.

Information for Prospective Students

Each student in the College of Human Sciences works closely with an academic adviser who is associated with the curriculum in which the student is majoring. In some majors, freshmen are advised by a general college adviser. After the freshmen year, these students are assigned an adviser in the department of the chosen curriculum. Advisers assist students in developing academic programs and in adjusting to university life. They also provide information and guidance about career choices. Advisers attempt to adjust each student's schedule of course work in accordance with the student's interests and capabilities.

The college offers a number of orientation sessions during the summer for students planning to enter in the fall. Incoming students are encouraged to attend an orientation session so that academic assessments can be made and appropriate classes may be scheduled for the following term.

Open Option Status

The College of Human Sciences offers an open option for entering students who have not selected a specific area of study. An orientation course helps students explore the opportunities available. Program planning information can be obtained from general college advisers.

Planned Transfer Programs

By careful planning, students may begin their education at another college, then transfer their courses to a curriculum within the College of Human Sciences with maximum efficiency in meeting the degree requirements. The college works closely with community colleges in Iowa and surrounding states to facilitate a transfer to Iowa State University. For more information, call 1-800-522-0683 or visit the College of Human Sciences Student Services.

Families Extension

Students may prepare for a career in the Cooperative Extension Service by enrolling in a curriculum in the College of Human Sciences that provides them with a broad subject matter base for conducting educational programs for families. Advice on choice of courses should be sought from the Family and Consumer Sciences Education and Studies program, the associate dean and director of Iowa State University Extension to Families programs, the director of Iowa State University Extension to Youth and 4-H programs, or the Extension Human Resources office.

Undergraduate Core Curriculum

Graduates of the College of Human Sciences will demonstrate professional and personal competencies in concepts fundamental to the College's mission. These core concepts serve as a unifying focus for students in the College. Competencies will be assessed by designated outcomes in courses within each major in the College. For information on the specific core competencies for particular majors contact the departmental office administering the program.

General Education

Students in the College of Human Sciences are required to complete a program in general education which is integrated with their professional training and extends through the undergraduate curriculum.

The general education program emphasizes intellectual growth and personal development as contrasted with specific career preparation.

The program aims to stimulate a desire for learning and intellectual endeavor, develop understanding and appreciation for the physical and cultural world, encourage independent thinking and analysis, increase competence in all aspects of communication, and create an understanding of individuals as social, psychological, and physical beings.

The student is expected to complete studies in three groups in general education. Areas represented below are not departmental titles. In some cases, courses relating to a given area may be found in several different departments. Credits listed are minimum requirements.

Minimum Group Requirements in the College of Human Sciences

9.5 cr.

I. Communication Skills: English 150, 250; Library 160; and 3 credits in oral communication

9 cr.

II. Biological and physical sciences and mathematical disciplines: at least 3 credits in mathematical disciplines

15 cr.

III. Social sciences and humanities: at least 6 credits in social sciences and at least 6 credits in humanities

Accreditation and Licensure

The following program-specific accreditation/licensure/registrations have been attained by departments within the college:

Department of Apparel, Educational Studies, and Hospitality Management:
Family and Consumer Sciences Education Teacher Licensure Program is licensed by the Iowa Department of Education and the Iowa Board of Educational Examiners.

Hotel, Restaurant, and Institution Management: is accredited by the Accreditation Commission for Programs in Hospitality Administration, the accrediting agency of the International Council on Hotel, Restaurant, and Institutional Education.

Production focus of the Apparel Merchandising, Design, and Production major is endorsed by the American Apparel and Footwear Association.

Department of Food Science and Human Nutrition:
Food Science and Industry and Food Science and Technology curricula are approved by the Institute of Food Technologists. The Dietetics Internship Program and the Didactic Program in Dietetics are accredited by the Commission on Accreditation/Approval for Dietetics Education of The American Dietetic Association, 216 W. Jackson Blvd., Chicago, IL 60606-6995, 312/899-4876.

Department of Kinesiology:
The Athletic Training Option is accredited by the Commission on Accreditation of Athletic Training Education.

Department of Human Development and Family Studies:
The Child Development Laboratory School is accredited by the National Association for the Education of Young Children (NAEYC) Academy for Early Childhood Programs and licensed by the Iowa Department of Human Services.

Teacher Education and Licensure

All students who are recommended by Iowa State University for teacher licensure must meet the requirements of the University Teacher Education Program and be recommended by the CHS Associate Dean for Teacher Education.

Each student will be enrolled in the department in which he or she plans to major and must meet the graduation requirements of that department and the college in which it is located.

For details concerning the professional teacher education requirements and the areas of specialization requirements, see Teacher Education, Courses and Programs.

Majors

For more information about a major, see: 1) the curriculum descriptions in this section of the catalog; 2) the department catalog section under *Courses and Programs;* and 3) department websites.

Apparel Merchandising, Design, and Production—Options: Merchandising; Design; Production—Administered by the Department of Apparel, Educational Studies and Hospitality Management

Child, Adult, and Family Services—Options: Child Programs; Youth Programs; and Adult/Family Programs — Administered by the Department of Human Development and Family Studies

Culinary Science- Administered by the Department of Food Science and Human Nutrition

Dietetics—Administered by the Department of Food Science and Human Nutrition

Early Childhood Education—Administered jointly by the Department of Curriculum and Instruction and the Department of Human Development and Family Studies

Elementary Education—Administered by the Department of Curriculum and Instruction

Family and Consumer Sciences Education and Studies—Options: Communications; Professional Studies; Teacher Licensure—Administered by the Department of Apparel, Educational Studies and Hospitality Management

Family Finance, Housing, and Policy—Administered by the Department of Human Development and Family Studies

Food Science—Options: Consumer Food Science; Food Science and Industry; Food Science and Technology—Administered by the Department of Food Science and Human Nutrition

Kinesiology—Options: Athletic Training; Community and Public Health; Exercise Science; General Studies; Health/Fitness Management; and Physical Education Licensure —Administered by the Department of Kinesiology

Hotel, Restaurant, and Institution Management—Administered by the Department of Apparel, Educational Studies and Hospitality Management

Nutritional Science—Administered by the Department of Food Science and Human Nutrition

Secondary Education—The College of Human Sciences provides secondary education licensure programs in conjunction with subject matter areas, or majors, offered by various departments across the university campus. These subject matter areas include agriculture, biology, chemistry, earth sciences, English, foreign languages, general sciences, health, family and consumer sciences education, mathematics, music, physical science, physics, and social studies. See *Index, Teacher Education*.

Minors

Minors are available to all Iowa State students. Minors consist of at least 15 credits including 6 credits taken at Iowa State University in courses numbered 300 or above. A student may not apply the same course to two different minors. The minor must include 9 credits that are not used to meet any other department, college or university requirement. Minors are available in the following areas:

Apparel Merchandising, Design, and Production

Athletic Coaching

Child, Adult, and Family Services

Dance

Educational Services in Family and Consumer Sciences

Family Finance, Housing, and Policy

Food Safety (interdepartmental minor)

Gerontology (interdisciplinary minor)

Hotel, Restaurant, and Institution Management

Nutrition (two minors: one for non FSHN majors and one for department majors)

See *Index* for minor requirements for specific departments and programs.

International Studies (secondary major only)

Sport and Culture

The International Studies Program is an interdisciplinary program which may be taken only as a second major. Students pursuing a second major in international studies must complete the International Studies Program as described in this catalog (see *Index, International Studies)*.

Double Majors

Students may elect a second major from the departments and program areas listed above, or from a major field offered for the bachelor's degree in another college of the university. Double majors may be prohibited between majors as determined by the appropriate curriculum committees.

The major departments must approve the degree program, and if those majors involve two colleges, both deans must approve. Such programs must fulfill the general education requirements of the college of the primary major. If one major leads to the B.A. degree and the other to the B.S. degree, the degree awarded will be the one offered by the department of the primary major. If the primary major may lead to either a B.A. or a B.S., a student may choose to receive either degree. In this case, the student must satisfy the requirements of each major and of the degree that is chosen for the primary major.

Students with a primary major in another college who wish to take a second major in the College of Human Sciences are required to meet all requirements for the major, including the CHS core, and prerequisite and supporting courses.

Two Bachelor's Degrees

Any degree offered by the College of Human Sciences may be earned together with a degree in this or any other college of the university. For the requirements for two degrees, see *Index, Two Bachelor's Degrees*.

International and Cross Cultural Programs

International experience opportunities are available and encouraged through the College of Human Sciences to broaden international and cross-cultural perspectives. Scholarships and other forms of financial assistance are available which provide partial support for students studying abroad. The College has established programs with a variety of colleges and universities around the world including Glasgow Caledonian University, Glasgow, Scotland; University of Otago, Dunedin, New Zealand; the International College of Hospitality Administration, Brig, Switzerland; the London College of Fashion, London, England; and Paris American Academy, Paris, France. Students also have an opportunity to participate in group study abroad programs to Europe, Africa, Central and South America, and Asia.

Other opportunities may be developed through consultation with the college director of international experiences and the student's adviser; for example, students have acquired internships and studied in such countries as Kenya, Rwanda, Spain, Puerto Rico, Ireland, Guatemala, Switzerland, England, Australia, Germany, and France. Faculty members bring diversity and global perspectives to instruction and research through their work in India, South Korea, Central and South America, Pakistan, Africa, and Europe.

Honors Program

High achieving students, with a grade point average of above 3.35, are invited to apply to the Honors Program. Honors students are encouraged to develop a creative program of study expanding their interests while meeting individual educational objectives. Students in the Honors Program also participate in University Honors Seminars, Honors Courses and complete an honors project. For further information, contact the College Honors Committee or academic adviser. Also see Index, Honors Program.

Dietetics Internship (DI)

This post-baccalaureate program, administered by the Department of Food Science and Human Nutrition, is accredited by the American Dietetic Association (ADA). The purpose of the program is to enable those who meet the academic requirements of the ADA to obtain at least 900 hours of practice supervised by registered dietitians in medical nutrition therapy, community nutrition, and foodservice management to meet ADA performance requirements for entry level dietitians.

Students who satisfactorily complete the DI will be eligible to take the national registration examination administered by the Commission on Dietetic Registration.

Preparation for Graduate Study

Students considering graduate studies should gain background knowledge in basic subjects related to their area of interest. Undergraduate mathematics, statistics, and research methods courses are useful as preparation for advanced study in graduate school. Upon completion of graduate programs, students are qualified for leadership positions in public and private institutions and for teaching, research, and extension positions in colleges and universities.

Graduate Curricula

The College of Human Sciences offers programs leading to the degrees of master of science, master of education, and doctor of philosophy. Graduate study in the College of Human Sciences is conducted through the Graduate College. Details are found in the Graduate College section of this catalog, (www.grad-college.iastate.edu) and on department websites.

Curriculum in Apparel Merchandising, Design, and Production

Administered by the Textiles and Clothing Program. Leading to the degree bachelor of science. **Total credits required: 123** including a minimum of 18 credits in AMDP at Iowa State University for the degree.

The major in apparel merchandising, design, and production provides a broad based program of study with flexibility in creating program options. Courses are required in general education, and textiles and clothing core. To complete the program, a student combines structured clusters of courses to form primary and secondary program options.

A minor in apparel merchandising, design, and production is available; the requirements appear under *Textiles and Clothing, Courses and Programs.*

Cr.	Degree Requirements
9.5	**Communications Skills**
6.5	Engl 150, 250; Lib 160
3	Select from ComSt 214, 218; Sp Cm 212
9-14	**Biological and Physical Sciences and Mathematical Disciplines**
3-4	Mathematics (Math 150 recommended for Merchandising and Production Options)
3-5	Select from natural sciences (including FS HN 167)
4-5	Stat 101 or 104, or 226
9-10	**Social sciences**
6	Econ 101
3	T C 165
3	Select from the Human Sciences list (including T C 362)
9	**Humanities**
3	T C 257, 354, 356 or AESHM 342.
3	Select from Human Sciences approved list, foreign language requirement
3	One history/art history course. Creative Design: Art H required.

Professional courses

25	**Textiles and clothing core:** AESHM 111, 275, 311; TC 131, 204, 210, 231, 245, 372
3-6	T C 470
2-3	TC 380 or TC 381 (if TC 470 is not out of home state)

Primary options

Select one professional option from the following three choices

13	**Design Professional Courses** T C 221, 225, 278, 321
15	**Merchandising Professional Courses**
12	T C 376, 377, 475; Acct 284;
3	Mkt 340 or T C 340
15	**Production and Sourcing Management Professional Courses**
12	T C 221, 305, 331, 496
3	Acct 284

Additional Requirements for a Primary Option

24	**Design**
R	T C 301
9	T C 325, 326, 495
3	Select one: T C 354 or 356
12	Select from T C 257, 305, 340, 354, 356, 362, 377, 404; 415, 431 AESHM 471, 474; Thtre 255; Any Art History, Art Integrated Studio or Design Studies
24	**Technical Design**
R	T C 301
12	T C 305, 325, 415, 431
6	Select two courses from T C 354, 356, 362, 496
6	Select two courses from: Acct 284; I E 408; OSCM 320; T C 340, 404
24	**Product Development**
15	T C 305, 431, 467, 496; Acct 284
3	Select one: Mkt 340, T C 340
6	Select two: T C 376, 377, 404, 415 475; AESHM 474; I E 408
14-16	**Merchandising Option**
8-10	Select three: AESHM 271, 287, 340, 471, 474, 477; T C 467, 496; ADVRT 230; Mgmt 370, 371; Mkt 340*, 410, 446, 448
3	Select one: T C 354, 356, 362, 467
3	Select one: T C 221, 305, 331, 404
12	**Production/Sourcing Management Option**
6	Select two: I E 408; LSCM 360; OSCM 320; Stat 495; AESHM 340*, 404; TSM 310
3	Select one: T C 354, 356, 362, 467
3	Select one: T C 362, 381 or Study Abroad

Secondary options

For Merchandising and Production/Apparel Engineering select a second cluster from the secondary option areas.

9-10	**Business/Entrepreneurship**
9-12	Select three courses from AESHM 287, 474; Acct 215, 285; Econ 355; Fin 301; LSCM 360; Mgmt 310, 313, 370; Mkt 340; MIS 330; OSCM 320
9	**Communications/Publication**
9	Select three: ComSt 214; Engl 302, 303, 309, 313, 314; Jl MC 310, 321, 341, 342; Sp Cm 212; any Art Graphic Design
9	**Consumer Behavior/Marketing**
3	T C 467
3	Select from T C 499; AESHM 340; Advrt 230; Jl MC 205, 220; Mkt 410, 442, 444, 446, 447, 448, 451, 493
9	**History/Museum Studies**
3	T C 257
6	Select two courses from T C 354, 356, 362, 404, 467, 499; Any History; Any Art History; any Anthropology
9	**Human Resource Management**
9	Select three courses from AESHM 287; T C 438, 467, 499; ComSt 214, 218, 310, 314, 317; Mgmt 370, 371; Psych 450; Soc 380; Sp Cm 212
9	**International Trade**
3	T C 362
6-8	One foreign language or 6 credits from T C 381, AESHM 421; Anthr 323, 325, 326, 418; IntSt 120/220, 235; Mgmt 414; Mkt 448; TSC 341
9	**Public Relations/Event Management**
3	Select three: T C 287, 499; AESHM 471; Advrt 230, 301, 334, 424, 434; Jl MC 205, 220, 321; Mkt 410, 447
	Electives Select courses to broaden or complement the options (see adviser).
123	**Total credits**

* If Merchandising primary option, may need to select another course from approved list.

Curriculum in Child, Adult, and Family Services

Administered by the Department of Human Development and Family Studies. Leading to the degree bachelor of science. **Total credits required: 125.**

The child, adult, and family services curriculum, with options in child programs, youth programs, adult/family programs, leads to employment opportunities in the helping professions working with children, adults, and families in a variety of public and private human service agencies and organizations.

A minor in child, adult, and family services is available; the requirements appear under *Human Development and Family Studies, Courses and Programs.*

The following requirements are for the child programs, youth programs, adult/family programs:

Degree Requirements

12.5	Communications and Library
9.5	Engl 150, 250; Lib 160; Sp Cm 212
3	Select from Engl 302, 309, 314
10-11	Natural Sciences and Mathematical Disciplines*
3-4	Select from: Stat 101, Math 104, 105, 140, 142, 150, 165
4	Com S 103
	Select 3 credits from Biology courses
9	Social Sciences
	Select from CHS list of approved social sciences
9	Humanities
	Select from CHS list of approved humanities
2	HD FS Orientation
	HD FS 110
17	Human Development and Family Studies Core: HD FS 102, 269, 449, 491
11	Child, Adult, and Family Services Core: HD FS 218, 367, 395, and 445 or 486
24	Programs Option
	See option lists
31.5-32.5	Electives
125.0	Total credits

U.S. Diversity and International Perspectives Requirement: Students fulfill the U.S. Diversity and International Perspectives Requirement by choosing three credits of coursework from each of the university-approved lists.

Program Options

24	Child Programs: HD FS 220, 221, 240, 344, 349; H S 105; C I 250 Select 3 credits from: HD FS 239, 283, 360, 270, 380, 479
24	Youth Programs: HD FS 226, 227, 270, 276, 349, 479 Select 3 credits from: C I 250, HD FS 360, Psych 436 and Select 3 credits from: HD FS 239, 283, 373, 380
24	Adult/Family Programs: HD FS 270, 276, 349, 377, 479, and 360 or 463 Select 6 credits from: HD FS 239, 283, 341, 373, and 380

Curriculum in Culinary Science

Administered by the Department of Food Science and Human Nutrition

Cr.	Degree Requirements*
9.5	Communications/Library Engl 150, 250; Sp Cm 212 or ComSt 214; Lib 160
6-7	Mathematical sciences Math 140, 142, 160, 165, or 181 Stat 101 or 104
9	Physical sciences Chem 163;163L; 231, 231L
12-13	Biological sciences BBMB 301; Biol 211, 212; Micro 201 or 302; and Micro 201L or 302L
15	Humanities/Social sciences Econ 101; FS HN 342; 6 credits Humanities courses; 3 additional credits Humanities or Social Sciences
44	Food science and human nutrition FS HN 101, 104, 110, 167, 203, 214, 265, 311, 314, 403, 405, 406, 411, 412, 420, 480, 491B, 491D
3	Animal science An S 270
22	Hotel, restaurant institutional management HRI 233, 333, 340, 380, 380L, 383, 487 and AESHM 474
0-2	Electives
122.5	Total credits

*Additional requirement: Students must fulfill international perspectives, U.S. diversity, and ethics requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Curriculum in Diet and Exercise B.S./M.S.

Administered by the Departments of Food Science and Human Nutrition, and Kinesiology

Courses included have been approved as meeting the academic requirements of the American Dietetic Association in preparation for admission to dietetic internship programs. There is a $30 fee for a statement of verification of completion of the approved program. Courses also are included to meet the ACSM requirements for certification at the level of Health Fitness Instructor.

Cr.	Degree Requirements*
9.5	Interpersonal and public communication skills Engl 150, 250; Lib 160; Sp Cm 212
38-41	Mathematical, physical, and life sciences Math 140, 142, 160, 165, or 181; Stat 101, 104, or 226; Chem 163 and 163L or 177, 177L, and 178; 231;231L; Phys 106 or 111; BBMB 301; Biol 211, 212; 255; 255L; 256; 256L; Micro 201
12	Humanities and social science select 3 credits from approved humanities course list; select 3 credits from approved Ethics course list (if ethics course selected is not on the humanities list, 3 additional credits of humanities must be taken.); Psych 101, 230
20-22	Diet and exercise Kin 252-253, or FS HN 110; Kin 258; FS HN 167, 214, 265, 360;
41	Diet and exercise H S 380; Kin 220, 259, 345, 358, 462; FS HN 403. 411, 463, 466; NutrS 561; HRI 380, 380L, 392 Kin 355, 360, 366, or 372
123.5	Total credits

*Additional requirement: Students must fulfill international perspectives, U.S. diversity, and ethics requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Graduate Program

Cr.	Degree Requirements
39-40	Graduate level coursework FS HN 581; NutrS 501, 561, 562, 564; Kin 501, 505, 551, 558; Kin 699 or NutrS 699A; Stat 401; Kin 550, 570, or NutrS 502. Additional requirement: FS HN 490C for students in the FSHN Department.

Curriculum in Dietetics

Administered by the Department of Food Science and Human Nutrition.

The student is prepared for admission to dietetic internship programs and other professional experience programs approved/accredited by The American Dietetic Association. Courses included have been approved as meeting the academic requirements of The American Dietetic Association. There is a $30 fee for a statement of verification of completion of the approved program.

Cr.	Degree Requirements*
9.5	Communications Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212
6-7	Mathematical sciences 3 credits Math 140, 142, 160, 165 or 181; Stat 101 or 104
12	Physical sciences Chem 163 and 163L or 177, 177L, and 178; 231; 231L;
20-22	Biological sciences BBMB 301 or Biol 314; Biol 211, 212, 212L, 255, 255L; 300-level physiology course (BIOL 306 or 335) Micro 201 and 201L
15	Humanities/Social sciences 6 crs. Humanities course; FS HN 342; Psych 101; 3 crs. Humanities or social science list
41	Food science and human nutrition FS HN 110, 167, 203, 214, 265, 340, 360, 361, 362, 403, 411, 461, 463, 464, 466, 480
11	Management HRI 380, 380L, 391, 392
0-6	Electives
120.5	Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Curriculum in Early Childhood Education

The curriculum in early childhood education is planned for students preparing to teach young children and work with their families. This program leads to careers in working with young children who are typically developing and those with special needs from birth through age eight. Graduates in this curriculum may teach in early childhood (preschool and primary) classrooms and home based programs, with emphasis on inclusive services; graduates may be employed by either public or private agencies or schools. This curriculum has been approved by the Iowa Department of Education and meets the requirements for the early childhood education unified teacher license, which permits individuals to teach general and special education for children from birth through age eight. The program is administered jointly by the Departments of Human Development and Family Studies and Curriculum and Instruction.

Students in early childhood education must make application to and be accepted into the teacher education program prior to enrolling in advanced courses. All early childhood students, including those seeking a double major, must meet general education requirements for teacher licensure. Iowa State University is in compliance with the Iowa Department of Education's mandate for a performance based system of teacher training. Following this same type of system, the state of Iowa has developed and implemented a competency system to evaluate the performance of all teachers. A detailed list of the eleven Teacher Education Standards along with other information about the University Teacher Education Program, can be found at www.teacher.hs.iastate.edu/, the teacher education website.

Foreign Language Requirement
Early childhood education majors must satisfy a graduation requirement equivalent to the first year of university-level study in one foreign language (normally, completion of a two-semester sequence in any one foreign language). The requirement may be met by completion of three or more years of high school study in one foreign language.

Students who have completed three or more years of French, German, or Spanish in high school may not receive graded credit for 101-102 in those languages; test-out credit (T credit) may be obtained by passing an appropriate examination or by completing an advanced sequence (200-level or higher) in that language. If these students choose to take 101-102 on a remedial basis, they will be graded S-F.

Degree Requirements
125.5 total semester credits required

- 9.5 Communications and Library
  Engl 150, 250; Lib 160,select 3 credits from Communications

Options

- 9 Natural Sciences and Mathematics
  Math 195, Select 3 credits from physical sciences, Select 3 credits from biological sciences
- 9 Social Sciences*
- 3 Select from American government or American history
- 6 Select from CHS approved list
- 9 Humanities*
  Select from CHS approved list. Must meet Foreign Language Requirement.
- 2 Health, Dance, Physical Education, Safety
  H S 105
- 9 Human Development and Family Studies: HD FS 102, 220, 221
- 2 Orientation
  HD FS 110, HD FS 208
- 15 Professional Education Core:
  C I 201, 204, 250, 332, 406
- 21 Preprimary Inclusive: HD FS 240, 340, 343, 345, 455, 456
- 21-24 Primary Inclusive: C I 245, 268, 377, 433 or 443, 438 or 448, 439 or 449, 468F, 468G, 468I; Sp Ed 355, 368, 455
- 16 Student teaching: Sp Ed 415 and HD FS 417B OR C I 416A and HD FS 417C
- 0-3 Electives

Communication Options
Select 3 credits from: ComSt 102, 218, 317, Sp Cm 212, 312, 313, 322, 327

Physical Sciences Options
Select 3 credits from: Astro 120, 150, Chem 160, 163, 164, Geol 100, 102, LAS 111, Mteor 206, Phys 101, 106

Biological Sciences Options
Select 3 credits from: Biol 101, 173, 155, 211, 211L, 255, 255L, 258, Ent 211

U.S. Diversity and International Perspectives Requirement: Students in Early Childhood Education fulfill the U.S. Diversity and International Perspectives Requirements by choosing three credits of coursework from each of the university-approved lists.

*Refer to departmental curriculum sheet, available from adviser, for specific course requirements.

Curriculum in Elementary Education

The curriculum in elementary education is planned for students preparing to teach in grades kindergarten through six. For additional information, see Index*, Elementary Education*.

Teaching endorsements in areas closely related to elementary education, including a special education endorsement in Instructional Strategist I: Mild/Moderate K-8, are available for elementary education majors. See Teacher Education, Courses and Programs, for information about specific endorsements.

Additional teaching endorsements, available at the graduate level to individuals who hold a valid Iowa teaching license, include the following: K-6 foreign language, reading, special education (Instructional Strategist I: Mild/Moderate K-8; Instructional Strategist I: Mild/Moderate 5-12; and Instructional Strategist II: Behavior Disorders/Learning Disabilities, ages 5-21).

Communication Proficiency
In order to meet graduation requirements, all students must have a C (2.0) or better for each of Engl 150 and Engl 250.

U.S. Diversity and International Perspectives
In order to meet graduation requirements, all students must complete 3 credits of course work in U.S. Diversity and 3 credits in International Perspectives. See department for approved lists of courses.

Foreign Language Requirement
Elementary education majors must satisfy a graduation requirement equivalent to the first year of university-level study in one foreign language (normally, completion of a two-semester sequence in any one foreign language). The requirement may be met by completion of three or more years of high school study in one foreign language.

Students who have completed three or more years of French, German, or Spanish in high school may not receive graded credit for 101-102 in those languages; test-out credit (T credit) may be obtained by passing an appropriate examination or by completing an advanced sequence (200-level or higher) in that language. If these students choose to take 101-102 on a remedial basis, they will be graded S-F. Certification in American Sign Language is recognized by the University and satisfies the foreign language requirement for the curriculum in Elementary Education.

Total credits required: 128.5.

Cr.

- 46.5 General Education*
- 9.5 Communication skills
  Engl 150 (3), 250 (3); Lib 160 (0.5); Select from ComSt 102 (3), 218 (3), 317 (3), Sp Cm 212 (3), 312 (3), 313 (3), 322 (3), 327 (3)
- 9 Social sciences
  HD FS 102 or Psych 230 (3), American history/American government (3), options (3)
- 9 Humanities
  Select 9 credits from department approved list
- 1 Health, dance, kinesiology, safety options (1)
- 9 Mathematics
  Math 195 (3), 196 (3); Select from 104 (3), 105 (3), 140 (3), 142 (3), 160 (3), 165 (4), 180 (3), 297 (3).
- 9 Biological/Physical Sciences
  Biological sciences (3) select from Anthr 202 (3); Biol 101 (3), 173 (3), 211 (3); Biol 202 (2), Biol 155 (3), 155L (2), 255 (3), 258 (3)
  Physical sciences (3) select from Astro 120 (3), 150 (3); Chem 160 (3), 163 (4), 164 (4); Geol 100 (3), 100L (1), 101 (3); Mteor 206 (3); Phys 101 (3), 106 (4)
- 18 Area of specialization
  (Requires at least 24 credits. Nine credits from an area specialization may be used to meet other requirements.)
- 67 Professional education
- 24 Required courses
  C I 201 (3), 204 (3), 245 (2), 268 (1), 332 (3), 406 (3); HD FS 226 (3), 240 (3) or Engl 396 (3), Sp Ed 250 (3)
- 21 Required methods

C I 377 (4), 468A (1), 378 (4), 468B (1), 448 (3), 468C (1), 449 (3), 468D (1), 443 (3)
6 Related Methods
Select from H S 275 (3); ArtEd 211 (3); Music 265 (3); Ex Sp 284 (3)
16 Student teaching
C I 416A (8) or 416D (8), 416B (8) or 416E (8), Sp Ed 416 (special education students only)
R Orientation (required)
First year—115; sophomore—215; transfer—315

*Refer to departmental curriculum sheet, available from adviser, for specific course requirements.

Curriculum in Family and Consumer Sciences Education and Studies

Administered by Apparel, Educational Studies and Hospitality Management. Leading to the degree bachelor of science. Total credits required: 125.5

This curriculum provides a broad-based program of study focusing on preparation for professional careers related to education or community leadership. Courses are required in general education and the College core. Students select one program option.

There are three choices for this curriculum. Option 1, teacher licensure, Option 2, communications, or Option 3, professional studies. In all options, students are prepared with a broad-based understanding of family and consumer sciences.

Option 1, teacher licensure, is designed for students seeking careers as family and consumer sciences educators in a variety of settings such as middle, junior, and senior high schools. With additional credits students may also be approved to teach in specific occupational areas: child care, fashion merchandising, and foodservice. Further information about licensure programs appears under Teacher Education.

Option 2, communications, is designed for students seeking careers emphasizing communication with diverse populations in extension, business, community agencies, community colleges, and youth and adult education programs in a global community.

Option 3, professional studies, is designed to provide students with the opportunity to pursue an individualized program which is planned with their academic advisers. Opportunities to participate in study abroad, internships, and field study build a solid base for work in a global community. Careers include working with diverse population in extension, business, community agencies, community colleges, and youth and adult education programs.

The program offers a minor in family and consumer sciences education; the requirements appear under Family and Consumer Sciences Education and Studies, Courses and Programs.

Cr. Degree Requirements

9.5 Communications and library
6 Engl 150, 250
3 Select from: ComSt 102, 214 218, Sp Cm 212, 312
0.5 Lib 160
9-10 Natural sciences and mathematical disciplines
3 Biol 101 or Biol 155
3-4 Select a course from the mathematical disciplines (Teacher licensure option must select a Math or Stat course and communications option must select Stat 101 or 104)
3 Select additional course in natural science. (Both teacher licensure option and communications option must complete high school chemistry or its equivalent. Teacher licensure must have a physical science course)
9 Social sciences
3 Econ 101
3 Soc 130 or 134
3 HD FS 102
9 Humanities
9 Courses from approved list (Teacher licensure must complete 3 cr. of American history or American government)
14 Family and Consumer Sciences Education and Studies core
AESHM 111, 206, 460
AESHM 311, 379, 421

Option 1: Teacher Licensure
75 Additional Professional Courses
30 FCEdS 214, 280L, 306, 318, 403, 413, 417A, 417B
6 FSHN 111, 167
12 HD FS 239; 276; 283, and 349;
3 Select from HD FS 341, 483, or 488
3 Select from HD FS 220, 221, 226 or FCEdS 223
3 T C Select one course from 121, 131, 165, 204, or 362
15 C I 201, 204, 333, 406, 415, 426
3 Sp Ed 450
125.5 Total Credits

Option 2: Communications
74-75 Additional Professional Courses
14 FCEdS 306, 415, 418A
3 FSHN 167
3 JL MC 305
6 HD FS 239; 283
3 AESHM 287
9 Select from: Engl 302, 309, 313, or 314
3 Sp Cm 312
6 Jl MC Select from 205, 220, 341, 462, 476, or 477
6 Jl MC 342 and 342L
3 Select from Anthr 417, AESHM 342, T C 362, or Phil 340
12 Select from AESHM, FCEdS, FS HN, HD FS, HRI, H S, or T C (At least 6 credits should be 300 level or above)
6-7 Electives
121 Total Credits

Option 3: Professional Studies
74 Additional Professional Courses
6-11 FCEdS 415, 418B
3 HD FS 283
3 HD FS Select from 239, 341, 483, or 488
3 AESHM 474 or Mgmt 310
3 FSHN 167
3 Select from: Anthr 417; AESHM 342, T C 362; Phil 340
6 Select from Engl 302, 309, 313, 314; Jl MC 205; Sp Cm 312
16-21 Select from AESHM, FCEdS, FS HN, HD FS, HRI, H S, or T C (At least 6 credits should be 300 level or above)
14 Select from Natural Sciences, Social Sciences, Humanities, Art and Design
12 Electives
121 Total Credits

Occupational teaching areas available:
Child care: HD FS 220, 221, 340, 343, 445

Fashion merchandising: T C 131, 165, 375, 376, 377, Com S 103

Foodservice: Biol 101, Micro 201 or HRI 233, 333, 380, 380L, 438

Curriculum in Family Finance, Housing, and Policy

Administered by the Department of Human Development and Family Studies. Leading to the degree bachelor of science.

Total credits required: 121.5

The family finance, housing, and policy curriculum prepares students for professional work related to financial and housing resource management and policy analysis. The program focuses on financial resource management, housing services and administration, and family policy issues pertinent to children, adults, and families. Graduates of the program are prepared for employment within the public and private sector as financial counselors and planners, insurance agents, loan officers, mortgage originators, government housing authority administrators, housing advocates, housing planners, real-estate agents, non-profit agency administrators, policy analysts and lobbyists, property managers, and consumer credit and financial aid counselors. Family finance, housing, and policy majors also are prepared to enter graduate programs in family policy and family financial planning.

Learning outcomes are identified for graduates with a degree in family finance, housing, and policy. Students are able to: demonstrate competency in consumer science and their chosen field of emphasis; demonstrate proficiency in interpersonal communication and in working with diverse groups to solve multidisciplinary problems; effectively prepare and deliver information to family finance, housing, and policy professionals as well as to the general public; critically evaluate information and accurately interpret and use research; understand the complexity of issues facing professionals in the field, including ethical, cultural and environmental elements.

A minor in family finance, housing and policy is available; the requirements appear under Human Development and Family Studies, Courses and Programs.

Degree Requirements
121.5 total semester credits required

12.5	Communications and Library Engl 150, 250, Sp Cm 212, Lib 160 Select from Engl 302, 309, 314
10	Natural Sciences and Mathematical Disciplines*
4	Stat 101
3	Select from Computer Science
3	Select from Math, Stat, or natural sciences
9	Social Sciences Econ 101, Soc 134, Select from Anthr, Econ, Pol S, Psych, or Soc
9	Humanities Select from approved College of Human Sciences list
2	HD FS Orientation HD FS 110
20	Human Development and Family Studies Core: HD FS 102, 269, 449, 491, Select 3 credits HD FS from outside of major
20	Family Finance, Housing, and Policy Core: HD FS 239, 270, 283, 341, 395, 489, 489L, 416
15	Family Finance, Housing, and Policy Emphasis: Select from Acct 284, HD FS 360, 380, 378, 463, 483, 488
24	Electives

Courses from Accounting, Architecture, Art, and Design, Community and Regional Planning, Economics, Family and Consumer Sciences Education, Finance, Gerontology, Interior Design, Journalism, Management, Marketing, Political Science, Psychology, and Sociology are suggested.

Curriculum in Food Science

Administered by the Department of Food Science and Human Nutrition.

Option 1. Food Science and Technology

Cr.	Degree Requirements*
12.5	Communications/Library Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212; TSM 115
11-12	Mathematical Sciences Math 165 and 166, or 181 and 182; Stat 101 or 104
23	Physical Sciences Chem 177, 177L, 178, 331, 331L, 332; Phys 111, 112
13	Biological sciences BBMB 301; Biol 211, 212; Micro 302, 302L
15	Humanities/Social Sciences 6 credits Humanities courses; 3 credits Social Sciences courses; FS HN 342; additional 3 credits Humanities or Social Sciences courses
44	Food science and human nutrition FS HN 101, 110, 167, 203, 311, 351, 403, 405, 406, 410, 411, 412, 420, 421, 471, 472, 480
0-2	Electives
120.5	Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Option 2. Food Science and Industry

Cr.	Degree Requirements*
15.5	Communication/Library Engl 150, 250; Lib 160; Jl MC 305, or 220, or 347; Sp Cm 212 or ComSt 214; TSM 115
7-8	Mathematical Sciences Math 160, 165, or 181; Stat 101 or 104
16	Physical Sciences Chem 163 and 163L or 177, 177L and 178; 231; 231L; Phys 106
12-13	Biological Sciences BBMB 301; Biol 211, 212; Micro 201 or 302; Micro 201L or 302L
15	Humanities/Social Sciences Econ 101; FS HN 342; select 6 credits of humanities courses; select 3 additional credits of humanities or social science courses
6	Business Select 6 credits from Acct 215, 284, 285; Econ 301, 320; Mgmt 310, 370, 371, 414, 472; MIS 330; Mkt 340, 447, 448
44	Food science and human nutrition FS HN 101, 110, 167, 203, 311, 351, 403, 405, 406, 410, 411, 412, 420, 421, 471, 472, 480
0-5	Electives
120.5	Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Option 3. Consumer Food Science

Cr.	Degree Requirements*
21.5	Communications/Library Engl 150, 250; Jl MC 305 or 220; select 6 cr. from Jl MC 347, Engl 205, 302, 309, 313, or 314; Sp Cm 212 or ComSt 214; Lib 160; TSM 115
6-7	Mathematical sciences Math 140, 142, 160, 165, or 181
16	Physical sciences Chem 163 and 163L or 177, 177L and 178; 231, 231L; Phys 106
12-13	Biological sciences BBMB 301; Biol 211, 212; Micro 201 or 302; and Micro 201L or 302L
15	Humanities/Social sciences Econ 101; FS HN 342; 6 credits humanties courses; 3 additional credits humanties or social sciences
41	Food science and human nutrition FS HN 101, 110, 167, 203, 214, 265, 311, 403, 405, 406, 411, 412, 420, 471, 480
6	Business Mkt 340 or 447
0-3	Electives
120.5	Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Concurrent B.S. and M.S. Program:
Well qualified students in Food Science who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both a bachelor of science in Food Science and a master of science degree in Food Science and Technology. For more information, refer to www.fshn.hs.iastate.edu

Curriculum in Kinesiology and Health

The curriculum in Kinesiology and Health is designed for students preparing to enter professional areas related to the health, exercise or sport science fields. Students majoring in Kinesiology & Health may select one of six options: 1) Athletic Training, 2) Community and Public Health. 3) Exercise Science, 4) General Studies, 5) Health/Fitness Management, and 6) Physical Education Licensure.

Minors in dance, athletic coaching, and sport and culture are available; the requirements appear under Kinesiology, Courses and Programs.

A major in Performing Arts with a dance emphasis is available; the requirements appear under *Curriculum in Performing Arts in Theatre.*

Communication Proficiency
In order to meet graduation requirements, all students must earn an average of C (2.0) or better in Engl 150 and 250, with neither grade being lower than a C-. Students not meeting this condition must earn a C or better in an advanced writing course (select from Engl 220, 302, 309, or 314).

U.S. Diversity and International Perspectives

In order to meet graduation requirements, all students must complete 3 credits of course work in U.S. Diversity and 3 credits in International Perspectives. See university approved list.

Total credits required: 124 (46 credits in courses numbered 300 or above).

Cr.	
42	General Education
9	Physical and Life Sciences Basic Human Physiology and Anatomy
8	Biol 255, 255L, 256, and 256L
3	Introduction to Human Nutrition—FS HN 167
6	Mathematics and Computer Sciences
2-3	Mathematics/Statistics—select from Math 104, 140, 141, 142, 150, 165 OR Stat 101, 104, 226
3-4	Computer Science choice
9	Social Sciences
6	Humanities
12.5	Communication Skills
6	Freshman Composition—Engl 150, 250

3 Fundamentals of Public Speaking—Sp Cm 212
0.5 Library instruction—Lib 160
3 Business Communication—Engl 302, 314, or Sp Cm 312
17 **Core requirements: (Each course used to meet the Core require ments must be completed with a grade of C- or better.)**
Basic Core
3 Personal and Consumer Health—H S 110
3 Fields and Disciplines in Kinesiology—Kin 252, 253, 254 (required of fresh men only)
2 Concepts of Physical Fitness—Ex Sp 258
Advanced Core
(H S 110, , Kin 252. 253, and 258 should be completed prior to enrollment in the advanced core courses; students must have completed three of these courses with at least one from each sub-discipline; some courses have unique prerequisites which can be taken as part of General Education coursework)

Biological Basis of Physical Activity and Health Promotion
3 Biomechanics - Kin 355
3 Physiology of Exercise—Kin 358
3 Human Diseases—H S 350

Behavioral Basis of Physical Activity and Health Promotion
3 Sociology of Sport and Physical Activity—Kin 360
3 Sport Psychology—Kin 365
OR
Exercise Psychology—Kin 366
3 Motor Control and Learning Across the Lifespan—Kin 372
3 Consumer and Public Health—H S 310

Option 1. Athletic Training

The CAATE accredited athletic training option prepares students for the NATABOC certification examination or for graduate work in athletic training. Admission to the athletic training option is competitive and based on available department resources and will be determined on the basis of grades and other performance factors. Technical standards can be found on the athletic training website. Details are available from the Kinesiology Advising Office or the Athletic Training Education Program.

3 Basic Athletic Training for Athletic Trainers—Kin 222
1 Athletic Training Clinical Practicum—Kin 221, Kin 223
1 Introduction to Taping, Bracing, and Equipment Fitting - Kin 240
3 Evaluation of Athletic Injuries I—Kin 224
1 Athletic Training Clinical Practicum—Kin 225
3 Evaluation of Athletic Injuries II—Kin 226
1 Athletic Training Clinical Practicum—Kin 227
3 Therapeutic Modalities for Athletic Trainers—Kin 323
1 Athletic Training Clinical Practicum—Kin 324
3 Rehabilitation of Athletic Injuries—Kin 326
1 Athletic Training Practicum—Kin 327
3 Organization and Administration of Athletic Training—Kin 425
3 Medical Concerns for the Athletic Trainer—Kin 450
3 Legal Aspects of Sport—Kin 445
4 Principles of Fitness Assessment and Exercise Prescription—Kin 458
R Review of Athletic Training Competencies—Kin 489
2 Instructor's First Aid and CPR—H S 305
4 General Chemistry—Chem 163
1 Laboratory in General Chemistry—Chem 163L
4 Physics 106 or 111
3 Drug Education—H S 215

Elective to equal 124 total credits

The following courses are required; they can be taken as part of the General Education requirements:

3-5 Statistics—Stat 101, 104, 226
2-3 Mathematics—select from Math 140, 141, 142, 150, 165

The following six courses must also be taken; three can fulfill the Advanced Core requirement: Kin 355, 358, 360, 365, 372 and H S 350.

Option 2. Community and Public Health

This option emphasizes health promotion and disease prevention and prepares students for professional involvement in community health agencies which incorporate health services and the educational process. Students will be prepared for employment in state and public health agencies, volunteer health agencies, hospitals (patient education), and industry (health and wellness programs). Graduates are eligible to take the National Certified Health Education Specialist (CHES) exam which recognizes qualified specialists in the diversified field of health education.

2 First Aid and Emergency Care—H S 105
3 Drug Education—H S 215
3 Worksite Health Promotion—H S 380
R Search Strategies for Field Experiences and Employment—H S 385
3 Administration of School Health—H S 390
3 Community Health Program Development—H S 430
2 General Microbiology—Micro 201
1 Intro Micro Lab—Micro 201L
3 Human Sexuality—HD FS 276
3 Aging and the Family—HD FS 377
3 Principles of Accident Prevention—TSM 270
5 General Chemistry with lab—Chem 163 and 163L
4 Principles of Biology with lab—Biol 211 and 211L
3 Principles of Marketing—Mkt 340
3 Principles of Public Relations—Jl MC 220 or Publicity Methods—Jl MC 205
3 Principles of Microeconomics—Econ 101
3-4 Select from Engl 309, Engl 313, HD FS 395, HD FS 449 or Jl MC 342/342L
10-16 Directed Field Experience—H S 485

Electives to equal 124 total credits

The following courses must also be taken. They can fulfill either General Education or Core requirements for the Kinesiology & Health major:

3 Statistics—Stat 101, 104, 226
3 Psych 230 or HD FS 102 (under Social Science choice)

The following three courses must also be taken; they will fulfill the Advanced Core requirement; H S 310, 350 and Kin 366.

Option 3. Exercise Science

The Exercise Science option is designed for students interested in an interdisciplinary approach to the science of human movement. By combining exercise science with another area of study to support an individualized program, this option is suitable for students interested in graduate study or who are preparing for advanced study leading to careers in medicine, physical therapy, or other allied health programs.

R Search Strategies for Field Experience and Employment—Ex Sp 385
6 Two 300-400 level Ex Sp courses
26 Meet the requirements of a specialization area in a related field

Electives to equal 124 total credits
A statistics course and one of Math 140, 141, 142, or 165 must be selected in the General Education requirements.

The following six courses must also be taken; three can fulfill the Advanced Core requirement: Kin 355, 358, 360, 365 or 366, 372 and H S 350.

Option 4. General Studies

The general studies option is provided for students interested in an interdisciplinary approach to the study of human movement. In this option kinesiology is combined with a concentration in another area of study to support an individualized program, such as community sport and recreation, dance, and other sport, exercise, or health related fields. Programs of study must be approved by the undergraduate program coordinator.

R Kin 385
6 Additional credits in 300-400 Kin courses
26 Credits in related areas of study (must be approved by Curriculum Coordinator)
8-12 Internship in Sport and Exercise Science—Kin 485

Electives to equal 124 credits

The following courses must also be taken. They can fulfill the General Education requirements:

2-3 Mathematics—Select from Math 140, 141, 142, 150, 165
3-5 Statistics—select from Stat 101, 104, 226

4 Physics—Physics 106 or 111

The following five courses must also be taken: three can fulfill the Advanced Core requirement: Kin 355, 358, 360, 365, 372.

Option 5. Health/Fitness Management

This option prepares students for careers in the physical fitness/health field. It is designed for those who wish to prepare for professional roles as exercise specialists or program directors in corporate fitness programs, health clubs, cardiac rehabilitation programs, or other public and private agencies providing physical fitness activities.

2 Basic Athletic Training—Kin 220

2 Leadership Techniques for Fitness Programs—Kin 259
3 Management of Health-Fitness Programs and Facilities—Kin 345
3 Worksite Health Promotion—H S 380
R Search Strategies for Field Experiences and Employment—Kin 385
4 Principles of Fitness Assessment and Exercise Prescription—Kin 458
1 Internship in Exercise Leadership —Kin 459
3 Medical Aspects of Exercise—Kin 462
8-16 Internship in Sport and Exercise Science—Kin 485A
3 Principles of Organization and Management—Mgmt 370
3 Principles of Macroeconomics—Econ 101
4 Phys 106 or 111

Electives to equal 124 credits
The following courses are required: they can be taken as part of the General Education requirements:

2-3 Mathematics - select from Math 140, 141, 142, 150, 165
3-5 Statistics - select from Stat 101, 104, 226

The following five courses must also be taken: three can fulfill the Advanced Core requirement: Kin 355, 358, 366, 372 and H S 350.

Option 6. Physical Education Licensure

This option is designed for students seeking a license to teach physical education K-12. Students interested in preparing to coach must earn additional credits in: Kin 220 and 315. Note: when making general education course selections, teacher licensure students must choose C I 201, Psych 230, a natural science and a U.S. history or political science course.

Professional education requirements

3 Foundations of American Education—C I 204
R Senior Seminar—C I 415
3 Multicultural Gender Fair Education—C I 406
8 Supervised Student Teaching in Physical Education in the Secondary School—Kin 417
8 Supervised Student Teaching in Physical Education in the Elementary School—Kin 418

Physical education professional theory

2 Leadership Techniques for Fitness Programs—Kin 259
3 Elementary and Pre-school Movement Education—Kin 312
0.5-1 Directed Field Experience in Elementary School Physical Education—Kin 280
0.5-1 Directed Field Experience in Physical Education—Kin 281
3 Teaching Physical Education—Kin 375
3 Adapted Physical Education—Kin 395
3 Measurment in Physical Education—Kin 471
3 Physical Education Curriculum Design and Program Organization—Kin 475

Physical education professional activity and related courses

2 First Aid and Emergency Care—H S 105
1 Aquatics—Kin 230
1 Tumbling and Gymnastics Skills—Kin 231
1 Fundamentals of Self-defense—Kin 237
1 Fundamentals of Outdoor and Adventure Activities—Kin 238
1 Team Sport - Kin 232 or 233
1 Individual Sport—Kin 235 or 236
2 Dance—Dance 211

Electives to equal 124 total credits
The following course must also be taken. It can fulfill the General Education requirement:

4 Physics 106 or 111

The following five courses must also be taken; three can fulfill the Advanced Core requirement: Kin 355, 358, 360, 365 or 366, and 372.

Curriculum in Hotel, Restaurant, and Institution Management

Administered by the Hotel, Restaurant, and Institution Management Program. Leading to the degree bachelor of science. **Total credits required: 123.5**

The curriculum in Hotel, Restaurant and Institution Management develops students as leaders for the hospitality professions.

Cr. Degree Requirements
9.5 Communications and library
Engl 150, 250; Lib 160; Sp Cm 212
13 Natural sciences and mathematical disciplines
Math 104 or 150; Stat 101; and 6 credits of natural sciences
9 Social sciences
Econ 101; HD FS 102; select 3 credits from psychology or sociology
9 Humanities
AESHM 342 and courses from approved list.
37 Hotel, Restaurant, and Institution Management core
AESHM 287; HRI 101, 193, 233, 315, 333, 352, 380, 380L, 393 or 491, 433, 438,455
13-15 Hotel, Restaurant, and Institution Management electives
Select from AESHM 271, 471, 474, 477; HRI 189, 260, 289, 383, 437, 439, 452, 487
13 Supporting courses
Acct 284, AESHM 111, 311
FS HN 111*, 167*
18-20 Electives
123.5 Total credits

*A student who has not had high school chemistry is required to take Chem 160.
**A student who has not had high school biology is required to take Biol 101.

Curriculum in Nutritional Science

Administered by the Department of Food Science and Human Nutrition.

Cr. Degree Requirements*
12.5 Communications/Library
Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212; Engl 314
7-12 Mathematical sciences
Math 160, 165-166, or 181-182 Calculus (2 semesters recommended); Stat 101 or 104
24 Physical sciences
Chem 177, 177L, 178, 331, 331L, 332, 332L; Phys 111, 112
26-27 Biological sciences
Biol 211, 211L, 212, 212L, 313, 314, 255, 255L, 335; Micro 201 or 302; Micro 201L or 302L
15 Humanities/Social sciences
FS HN 342; select 6 crs. of humanities courses; select 3 crs. of social science courses; select 3 additional crs. of humanities or social sciences courses
34-35 Food science and human nutrition
FS HN 110, 167, 203, 214 or 311, 265, 360, 361, 362, 461, 480, 492; select at least 9 additional credits from FS HN 403, 412, 419 or 519, 463, 464, 466, 490C 499,
0-2 Electives
120.5 Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Concurrent B.S. and M.S. Program:
Well qualified students in Nuritional Science who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both a bachelor of science in Nutritional Science and a master of science degree in Nutritional Sciences. For more information, refer to www.fshn.hs.iastate.edu

College of Liberal Arts and Sciences

Michael B. Whiteford, Dean
Zora D. Zimmerman, Associate Dean
David J. Oliver, Associate Dean
Dawn Bratsch-Prince, Associate Dean
Ruth W. Swenson, Associate Dean Emerita
www.las.iastate.edu/

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Ecology, Evolution, and Organismal Biology
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Genetics, Development, and Cellular Biology
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Mathematics
Military Science (Army Reserve Officers' Training Corps)
Music
Naval Science
Philosophy and Religious Studies
Physics and Astronomy
Political Science
Psychology
Sociology
Statistics
World Languages and Cultures

The College of Liberal Arts and Sciences is the academic home, the foundation, for many essential learning disciplines. The college provides students with all the components of a modern liberal education. Students may choose to study in various fields of the physical, biological, and social sciences; in mathematical disciplines; in methods and systems of communication; and in the arts and humanities.

Learning and Teaching Mission

The primary mission of the college is to promote learning in all its dimensions by providing the student with ample opportunities to acquire the requisite knowledge, abilities, and skills to succeed in the world beyond the university. Throughout coursework within the major and in general education, students will develop skills in reasoning, analysis, and communication; achieve an understanding of the intellectual, historical, and artistic foundations of culture; and work to strengthen their abilities to interact with people, cultures, and the environment in an ethical and sensitive manner. To achieve these learning goals, the college asks students to acquire depth in learning within disciplines of their own choosing, and to acquire breadth through general education courses and electives.

The Curriculum

A baccalaureate degree in liberal arts and sciences is the end result of a curriculum that connects and integrates study in a major with general education. Requirements for a degree are deliberately flexible. Students select programs of study suited to a variety of interests and goals. Students having academic interests not fully met by a departmental major may also pursue a major offered by one of the college's interdepartmental programs or may apply for an undergraduate major in interdisciplinary studies (See *Index, Cross-Disciplinary Studies, Courses and Programs*). The college participates in the University Honors Program; thus, students with exceptional academic promise can develop unique and challenging programs of study.

The college has three curricula: a curriculum in Liberal Arts and Sciences, leading to the bachelor of arts or the bachelor of science degree; a curriculum in music, leading to the bachelor of music degree; and a curriculum in liberal studies, leading to the bachelor of liberal studies degree.

High School Preparation/ Admission Requirements

Students entering the college are required to present evidence of the following high school preparation:

4 years of English (Typically this preparation includes courses in British, American, and world literature in which critical reading and writing skills are emphasized and courses in speech and composition, including at least one senior-level writing course.)

3 years of social studies (Typically such preparation includes two semesters of world history, two semesters of American history, and a semester of American government. Electives can be chosen from areas such as economics, sociology, or psychology.)

2 years of a single world language (Three years or more of a single world language are strongly recommended for students who wish to continue their work in that language. A minimum of three years of a single world language is required to fulfill the world language graduation requirement in the College of Liberal Arts and Sciences.)

3 years of mathematics (Such preparation shall include two semesters of beginning algebra, two semesters of geometry, and two semesters of intermediate algebra. A fourth year of study involving analytic geometry, trigonometry, linear algebra, and/or calculus is strongly recommended for students who will major in mathematical or scientific disciplines.)

3 years of science (At least two years of such preparation shall be chosen from biology, chemistry, and physics.)

Recommended but not required as a condition of admission to the College of Liberal Arts and Sciences is one semester of computer experience. (Such a course should stress problem-solving with computers and should not substitute for courses in mathematics. In schools where computer use is an integral part of most courses, separate instruction in computers is not necessary.)

Students who transfer from another college or university with at least 24 credits of satisfactory coursework may be exempt from most of these requirements. Students who do not meet the requirements listed here may be admitted with a limited number of deficiencies. Contact the college office for further information about resolving these deficiencies.

Transfer Students

To graduate from the College of Liberal Arts and Sciences, a transfer student must complete the general requirements of the college as well as those of the university. Students planning to transfer to Iowa State University for the purpose of enrolling in the College of Liberal Arts and Sciences are advised to contact the college office for information concerning degree program requirements. Prospective transfer students are urged to learn about the academic programs that are of interest to them well before arriving on campus so that pretransfer courses are appropriate to the planned major and transferable toward graduation from ISU. Additional information concerning transfer credit evaluation may be obtained through the Office of Admissions as well as the department in which a student is interested.

A transfer student in the College of Liberal Arts and Sciences may choose to graduate under the catalog in effect at the time of his or her graduation or under one of the two immediately preceding catalogs, provided that it covers the period of his or her enrollment either at Iowa State or any other accredited school. Full requirements of the chosen catalog must be met except that adjustments will be made in instances where courses are no longer available or where programs have been changed. A transfer student is responsible for reviewing his/her transfer credit evaluation with the academic adviser during the first semester of enrollment.

University Requirements

The university requirements for the bachelor's degree, including statements of academic standards, learning goals, the university residence requirement, the Communication proficiency requirement, U.S. diversity and international perspectives requirement, and the library requirement, appear in the Colleges and Curricula portion at the beginning of this catalog.

Curriculum in Liberal Arts and Sciences

To obtain a bachelor's degree from the College of Liberal Arts and Sciences, curriculum in liberal arts and sciences, an undergraduate student must earn a minimum of 120 semester credits including a minimum of 32 semester credits earned in residence at Iowa State University. In addition, the student must meet general education, communication proficiency, library proficiency, world language, and advanced credit requirements, as well as the requirements of a major. Courses taken on a pass/not pass basis may be counted toward the required total of 120 credits, and may be used to meet the advanced credit requirement, if appropriate, but may not be used to satisfy any other graduation requirement. No more than 9 credits of 490 (Independent Study) courses in a single discipline may be counted toward graduation.

General Education

Requirements and Learning Goals

The central importance of a general education is reflected in the learning goals of each of four disciplinary areas. Whereas the courses in a major are designed to develop mastery of a specific field or discipline, courses in general education are designed to establish a strong, intellectual foundation for all specializations. Students earn the minimum credits listed in each of the four general education areas in courses not required by the department of the first major listed on the degree program. Interdisciplinary courses may be used to satisfy requirements in any area for which they have been approved, but a student may not apply the same course to more than one area.

Credit by Examination Program

Individual departments may use CLEP Subject Tests for testout of specific courses. Students in the College of Liberal Arts and Sciences may use CLEP General Test credits as free electives but not toward any of the general education area requirements.

World Language Requirement

The faculty of the College of Liberal Arts and Sciences believes that undergraduate students should acquire elementary practical experience in a second language, should be introduced to the theoretical study of language structure, and should begin to develop an understanding of a second culture through study of that culture's language.

As a means of achieving this objective, a student must satisfy a graduation requirement equivalent to the first year of university-level study in one world language (normally, completion of a two-semester sequence in any one world language). Students who have completed three or more years of high-school world language study are deemed to have completed the LAS World Language Requirement. These students may not enroll in or receive credit for 101 or 102 in those languages; test-out credit may be obtained by passing an appropriate examination or by completing an advanced sequence (200-level or higher) in that language. 101 or 102 may not be taken on a remedial basis.

Students who have completed more than one year but less than three years of high-school world language study may not enroll in 101 in the same language. These students may enroll in either a 102 course in that language, or in the case of Spanish, Span 97. Before enrolling in either Span 97 or a 102 language course, students are advised to take the on-line placement test available at www.language.iastate.edu. Span 97 is designed for students who need additional remedial work in the language at the first-year level (101-102) and are not planning to continue their language study at the second-year 201-202 level. Students who complete Span 97 with a passing grade will have fulfilled the LAS World Language Requirement. Students who have completed Span 97 and wish to pursue further study in Spanish at the 201-202 level may enroll in 102.

Students who have completed more than one year but less than three years of high-school world language study may satisfy the World Language Requirement by (a) passing the exam for credit at the 102 level, (b) receiving a passing grade in a 102 world language course, or (c) receiving a passing grade in a world language course at the 200-level or higher. For more information see *Department of World Languages and Cultures*. (Courses taught in English do not satisfy the World Language Requirement). Iowa State University accepts a record of academic performance in American Sign Language or certification of proficiency in American Sign Language as fulfillment of entrance or graduation requirements in world language for a baccalaureate degree.

Questions about the World Language Requirement and how to meet it should be directed to the Department of World Languages and Cultures. Credits applied toward the World Language Requirement cannot be used to satisfy the general education requirements, but students who have fulfilled the World Language Requirement may apply additional courses in world languages toward the appropriate general education areas. Majors in any world language are deemed to have fulfilled the college World Language Requirement. International students for whom English is a second language may satisfy the World Language Requirement by completion of Engl 150 and 250 at ISU with an average grade of C- or better. See *World Languages and Cultures* for additional information on international students.

Advanced Communication Skills

The continued development of communication skills following the sophomore year is the responsibility of the student's major department. The department promotes this development by adopting measures to certify the writing proficiency of its own majors. Certification occurs upon satisfactory completion of a designated course in which writing is evaluated and is a significant component. This designated course may be be either a course required in the student's program or an advanced writing course offered by the Department of English (e.g., Engl 302, 305, or 314).

General Education Areas

The central importance of a general education is reflected in the learning goals of each of three disciplinary areas. Whereas the courses in a major are designed to develop mastery of a specific field or discipline, courses in general education are designed to establish a strong, intellectual foundation for all specializations. The general education areas with their minimum credit requirements for the College of Liberal Arts and Sciences are:

Arts and Humanities—(Minimum 12 credits). The student should develop an understanding of human cultural heritage and history, and an appreciation of reasoning and the aesthetic value of human creativity.

Natural Sciences and Mathematical Disciplines—(Minimum 11 credits, including 3 in the mathematical disciplines and 8 in the natural sciences). The student should experience science as a rational search for understanding the structure and behavior of the natural world, and should appreciate mathematics as a valuable tool of the sciences and as an intrinsically important way of thinking.

Social Sciences—(Minimum 9 credits). The student should develop an appreciation of the principal methods of studying human behavior and an understanding of the structure and functioning of institutuions.

Because students fulfill, in part, the learning goals of the area of their first major by taking courses in their programs of study, the minimum number of general education credits required in the area of the first major is reduced from that listed above by 3 credits. Students in Liberal Studies or Interdisciplinary Studies majors must complete the minimum requirements in all three areas. The list of majors falling within each area is available from the Office of the Dean, College of Liberal Arts and Sciences, and is posted on the web site of the College of Liberal Arts and Sciences.

Courses from the department of the first major may not be applied to general education requirements. Courses cross-listed with a course in the student's first major may be used to satisfy either major requirements or general education requirements, but may not be used more than once. Interdisciplinary courses may be used to satisfy requirements in any area for which they have been approved, but a student may not apply the same course more than once.

Lists of approved courses are available on the web, from academic advisers or from the Office of the Dean, College of Liberal Arts and Sciences.

Advanced Credit Requirements

To obtain a baccalaureate degree from the College of Liberal Arts and Sciences, curriculum in liberal arts and sciences, a student must earn at least 45 credits at the 300 level or above taken at a four-year college. All such credits, including courses taken on a pass/not pass basis, may be used to meet this requirement.

The major must contain at least 8 credits in courses taken at Iowa State University that are numbered 300 or above and in which the student's grade is C or higher. In addition, the average grade of all courses in the major (those courses listed under major on the degree audit) must be 2.0 or higher. Courses from the department of the first major listed on the degree program may not be counted in the general education areas.

The Major

Students must show they have achieved depth in a specialized area by completing successfully the requirements and learning goals of a major. A major is comprised of 24 to 48 credits in a specific discipline as determined by the faculty. Tracks within a major must have a common 24 credit core. Some courses outside the major discipline may also be required as supporting work for the major. (See Index for page reference to individual department and program requirements.)

The major must contain at least 8 credits in courses taken at Iowa State University that are numbered 300 or above and in which the student's grade is C or higher. In addition, the average grade of all courses in the major (those courses listed under major on the degree audit) must be 2.0 or higher. Courses in the first major listed on the degree program may not be counted in the general education groups.

Courses meeting the requirement of additional majors may be counted in the general education groups. When choosing an additional major, students must confirm that the additional major is allowable (see list under "*Double Majors*").

The major is chosen from the following list, which also indicates the degree(s) offered in the respective majors.

Advertising, B.A.
Anthropology, B.A., B.S.
Biochemistry, B.S.
Bioinformatics and Computational Biology, B.S.
Biological/Pre-Medical Illustration, B.A.
Biology, B.S.
Biophysics, B.S.
Chemistry, B.A., B.S.
Communication Studies, B.A.
Computer Science, B.S.
Earth Science, B.A., B.S.
Economics, B.S.
English, B.A., B.S.
Environmental Science, B.S.
    Environmental Studies (may be taken as a second major with the degree to be determined by the first major)
Genetics, B.S.
Geology, B.S.
History, B.A., B.S.
Interdisciplinary Studies, B.A., B.S.
    International Studies (may be taken as a second major with the degree to be determined by the first major)
Journalism and Mass Communication, B.A., B.S.
Linguistics, B.A.
Mathematics, B.S.
Meteorology, B.S.
Music, B.A., B. Mus.
Performing Arts, B.A.
Philosophy, B.A.
Physics, B.S.
Political Science, B.A.
Psychology, B.A., B.S.
Religious Studies, B.A.
Sociology, B.A., B.S.
Software Engineering, B.S.
Speech Communication, B.A.
Statistics, B.S.
Technical Communication, B.S.
Women's Studies, B.A., B.S.
World Languages and Cultures, B.A.

The major in interdisciplinary studies (B.A., B.S.) is available for undergraduate students who have unique interdisciplinary educational goals. Such a major is designed by the faculty and the student and is approved only when the educational goals cannot be met by a reasonable combination of existing majors, minors, and electives. (See Index, *Interdisciplinary Studies*.)

A curriculum in liberal studies leading to a bachelor of liberal studies degree (B.L.S.) is also available. (See Index, *Liberal Studies*.)

The LAS College offers certificate programs available for students seeking documentation of additional study in specialized academic topics. At present, certificates are available in Latin American Studies and in Community Leadership and Public Service. Information about the specific course requirements in these certificate programs may be found in their respective entries in the Courses and Programs section of this catalog.

Double Majors

Students may elect a second major from the departments and program areas listed above, or from a major field offered for the bachelor's degree in another college of the university. Double majors between the following are not allowed: Chemistry with Biochemistry and Agricultural Biochemistry; Biology with Animal Ecology, Agricultural Biochemistry, Biochemistry, Genetics, and Microbiology.

The major departments must then approve the degree program, and if those majors involve two colleges, both deans must approve. Such programs must fulfill the general education requirements of the college of the primary major. If one major leads to the B.A. degree and the other to the B.S. degree, the degree awarded will be the one offered by the department of the primary major.

If the primary major may lead to either a B.A. or a B.S., a student may choose to receive either degree. In all cases, the student must satisfy the requirements of each major and of the degree that is chosen for the primary major. Students with a primary major in another college who wish to take a second major in the College of Liberal Arts and Sciences are not required to meet the Liberal Arts and Sciences General Education and World Language Requirements.

A student may earn two degrees in the Liberal Arts and Sciences curriculum with two appropriate majors and at least 30 additional credits. Either the B.A. or the B.S. in this curriculum may be earned with the Bachelor of Music. A major in Liberal Arts and Sciences may not be added to a Bachelor of Liberal Studies or a Bachelor of Music degree. Any degree offered by this college may be earned together with a degree with a major in any other college of the university. For the requirements for two degrees, see Index, *Bachelor's Degree Requirements.*

Minor

A minor, which is optional, must consist of at least 15 credits, with at least 6 credits in courses numbered 300 and above taken at ISU with a grade of C or higher. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement. (See Index, *Minors*.)

The following minors are offered by the college of Liberal Arts and Sciences:

Advertising
African American Studies
American Indian Studies
Anthropology
Astronomy
Biochemistry
Biological Illustration
Biology
Chemistry
Chinese Studies
Classical Studies
Communication Studies
Computer Science
Criminal Justice Studies
Economics
Emerging Global Disease
English
Entrepreneurial Studies
Environmental Science
Environmental Studies
French
Genetics
Geology
German
Gerontology
History
International Studies
Journalism and Mass Communication
Latin
Linguistics
Mathematics
Meteorology
Military Studies (Army Reserve Officers' Training Corps)
Music
Music Technology
Performing Arts
Philosophy
Physics
Political Science
Psychology
Religious Studies
Russian Studies
Sociology
Spanish
Speech Communication
Statistics
Technical Communication
Technology and Social Change
Women's Studies

Courses applied toward the general education groups may be used to meet the requirements of a minor. (For restrictions, see *Index, Minors*.)

If a student declares a minor and completes the requirements specified by the offering department/program, the minor will be recorded on the transcript.

Electives

Students will take additional courses, freely elected, sufficient to accumulate a total of 120 credits. These additional courses together with the general education courses may be used to meet the requirements of a minor or of another major, provided that they are taken on a graded basis.

Planning the Program of Study

Careful, comprehensive planning is important for meeting graduation requirements and taking advantage of the resources offered by the university. Each student is encouraged to work with his or her academic adviser in developing a four year plan as soon as possible after declaration of the major. A degree audit listing all completed courses and those remaining to be taken for fulfillment of the degree requirements in the student's chosen major is provided to the student and the adviser each semester. The student should review the audit each semester and consult with the adviser when changes are required. Any changes to the audit must be approved by the academic adviser and by the dean's office. It is essential that the audit be reviewed and updated in a timely fashion in order to avoid delay in the student's graduation.

During the first year, students should meet proficiency requirements in English and in library. They should also make progress toward meeting the general education requirements, a large part of which should be completed by the end of the second year. The third and fourth years should emphasize completion of the major (and minor, if elected) and of general education requirements, and should give the student an opportunity to take electives.

Academic Advising Learning Outcomes

Through their experience with academic advising, students will:

Develop an understanding of the structure, application, and goals of a liberal arts education in relation to their academic development.

Be able to formulate appropriate questions, seek information, and evaluate and apply academic advice.

Know the requirements, policies and protocol of the university, college, and department as they relate to their educational experience.

Understand how degree programs can be enhanced by study and experiences tailored to their intellectual and personal goals.

Be able to identify and utilize university resources effectively to

- Satisfy degree requirements
- Plan programs of study, including selection of appropriate courses and registration
- Discover how interests, skills and goals connect to fields of study and careers
- Link curricular and co-curricular activities
- Research and prepare for advanced study and/or careers

Share responsibility for a mentor-mentee relationship between advisee and adviser.

The Open Option

Many students entering Iowa State University are not ready to declare a major. They want time to become familiar with the academic opportunities that the university offers and to determine the best match between their academic interests and abilities. These students enter Iowa State University as Open Option majors.

The Open Option experience is designed to help students explore majors and careers, become acquainted with the entire university, and make successful adjustments to the academic expectations of Iowa State. Open Option students are assigned academic advisers in the Liberal Arts and Sciences Student Academic Services Office. These advisers help students with academic and career development.

During the first year, an orientation class introduces them to all of the colleges and majors on campus. A career development class in the second semester guides students in selecting a major and career that match their academic and personal goals. Open Option majors also have the opportunity to be members of a learning community with other Open Option students.

Aided by their adviser, Open Option students select courses that allow them to sample their academic interests before committing to a specific university major. Open Option students are encouraged to declare this major by the end of the first year. In addition, students who may have started in a specific field and have discovered it is not meeting their needs may transfer into Open Option for a semester or two while they decide on a new major.

Honors Program

For information on the Honors Program in the College of Liberal Arts and Sciences, see Index*, Liberal Arts and Sciences, Cross-Disciplinary Programs, Honors Program.*

Reserve Officers' Training Corps Programs (ROTC)

The College of Liberal Arts and Sciences also offers students the opportunity to combine their academic programs with ROTC programs in the Military Science (Army), Naval Science, and Air Force Aerospace Studies).

Teacher Licensure

Teaching licenses are issued by the Iowa Board of Educational Examiners. The Recommending Officer for the ISU University Teacher Education Program submits each candidate file after that candidate is determined to be eligible for licensure. Teaching licenses are issued for a specific teaching level, e.g., K-6 or 7-12. A subject area endorsement is listed on the candidate's license. The licensee may have multiple subject area endorsements listed.

Students in the College of Liberal Arts and Sciences who complete the approved licensure program in music education (BM degree with Vocal K-12 option or Instrumental K-12 option) may apply for a teaching license that allows them to teach music in grades K-12. Students who plan to teach in secondary schools (grades 7-12) may qualify for a license by completing an approved licensure program in one of the following LAS majors:

Biology
Chemistry
Earth Science
English
French
German
History
Spanish (Latin & Russian endorsements)
Mathematics
Physics

Students may also add these additional endorsements to their primary license:

English as a Second Language
General Science
Physical Science
Social Studies
Speech Communication

For further information, see *Index, Teacher Education*.

Preprofessional Programs

Students in the College of Liberal Arts and Sciences may participate in preprofessional programs in human health-related fields, law, and theology by taking the courses required for admission to professional schools. Students may enter the college with the designation Premed, Prelaw, or Preprofessional Health Programs. Most will earn a bachelor's degree by choosing a major and meeting the requirements for the major while taking the preprofessional courses.

Others will spend one to three years as students in the college before transferring to a professional school to which they have applied and been accepted. For further information, see *Index, Preprofessional Study.*

Experiential Learning (Internship/Co-op Program)

The Experiential Learning (Internship/Co-op) Program assists students in gaining career-related experience while going to school. Internships/Co-ops provide students with the opportunity to gain specific skills, apply academic knowledge in practical situations, pretest their career choice, earn a salary, and establish a network of professional contacts.

Most internships are full-time and last for a semester or a summer, but a part-time experience is possible. Students wishing to receive academic credit for their internship must make arrangements with a faculty member in their major department. In contrast, co-op students work full-time on an extended basis (work two semesters) or on an alternating basis (work, school, work, etc.) during any semester (fall, spring, summer).

It may take students participating in the Experiential Learning (Internship/Co-op) Program an additional semester or more to complete their academic curriculum requirements. For additional information, contact Business/Liberal Arts and Sciences Career Services.

Curriculum for Bachelor of Music

The Department of Music offers a Bachelor of Music degree (B.Mus.) as well as a Bachelor of Arts degree in music. For information about both degrees, see Music, Courses and Programs.

In order to receive teacher certification in music, students must earn the bachelor of music degree.

Candidates for the bachelor of music will complete the following requirements.

Cr.	
38.5-46.5	General education
47	Music core
31-52.5	Music option

(Students must select one of the following options: music education [vocal or instrumental], performance [voice, piano, organ, string instruments, wind or percussion instrument], or composition.)

Curriculum for Bachelor of Liberal Studies

The LAS College administers a bachelors degree program in Liberal Studies. This degree, the bachelor of liberal studies (B.L.S.), was established by the three Iowa Regent universities to meet the needs of Iowans who want to earn a college degree but whose circumstances present obstacles to completing a traditional on-campus degree program. The B.L.S. is a general studies degree in the liberal arts. There is no traditional major. Instead, students take coursework in three areas of distribution. These areas may be focused in a single discipline or diversified over several disciplines. With the assistance of a B.L.S. adviser, students can structure a program that meets their individual educational, vocational or personal goals.

For specific degree requirements, see Liberal Studies, Courses and Programs.

Curriculum for Software Engineering

A bachelor of science degree in software engineering is jointly administered by the Department of Electrical and Computer Engineering (College of Engineering) and the Department of Computer Science (College of Liberal Arts and Sciences). The program is aimed at creating high-quality software in a systematic, controlled, and efficient manner. The specific objective of the program is to educate students on principles, processes, techniques, and tools for producing, analyzing, specifying, designing and evolving software. A broader objective is to cultivate among students intellectual curiosity, problem solving skills, good learning habits, effective communication skills, leadership, and teamwork.

This interdepartmental program enables students to take a range of Software Engineering courses, as well as elective courses from both Computer Science and Computer Engineering as part of their degree program.

For specific degree requirements, see Software Engineering, Courses and Programs.

College of Veterinary Medicine

John U. Thomson, Dean
Donald D. Draper, Associate Dean for Academic and Student Affairs
Donald L. Reynolds, Associate Dean for Research and Graduate Studies
Eldon Uhlenhopp, Interim Associate Dean for Outreach and Operations

vetmed.iastate.edu/

Departments of the College

Biomedical Sciences
Veterinary Clinical Sciences
Veterinary Diagnostic and Production Animal Medicine
Veterinary Microbiology and Preventive Medicine
Veterinary Pathology

Other units of the college include the Veterinary Teaching Hospital, Veterinary Diagnostic Laboratory, Veterinary Medical Research Institute, Veterinary Education and Technology Services and Office of Curricular and Student Assessment. The college participates in interdisciplinary graduate programs in genetics; molecular, cellular and developmental biology; toxicology; immunobiology; and neuroscience.

Objectives of the Curriculum

The instructional objective of the College of Veterinary Medicine is to enable students to assume vital roles in society as productive health care providers and biomedical scientists. Such an education provides students with general learning, communication, and problem solving abilities; veterinary medical practice and research skills; and professional and ethical values.

The curriculum incorporates basic biomedical and clinical principles, clinical decision making skills, and exceptional clinical experience in small animal medicine and surgery, equine medicine and surgery, food animal medicine and surgery, and production animal medicine. Companion animal medicine and surgery are provided within the regionally recognized referral hospital through the community practice unit and equine field services. The college is located in one of the most intensive livestock producing areas in the United States. Because of this, students engage in extensive food supply veterinary medicine experiences and numerous diagnostic cases.

The professional curriculum is a four-year course of study leading to the doctor of veterinary medicine degree. Each of the first three years of the curriculum consists of two semesters while the fourth year has three semesters. Students are admitted into the professional curriculum after completing a minimum of 60 semester credits of required undergraduate coursework.

A strong and reputable basic science education during the first two years of the professional curriculum prepares veterinary students for a wide range of clinical experience during the last two years of the educational program. Fourth year students may choose to enhance their education by earning clinical elective credits at approved government agencies, research laboratories, veterinary practices and other university hospitals. Outstanding research programs in infectious diseases, food safety, neuroscience, immunoparasitology, evidence-based medicine, and many other areas provide opportunities for qualified students to participate in research.

Concurrent D.V.M./M.S., DVM/Ph.D., D.V.M./M.P.H. programs are available for qualified students who wish to obtain both veterinary and graduate degrees. Students must have a bachelor's degree or a minimum of 128 semester credits in undergraduate and professional curricula in order to participate in the concurrent DVM/graduate degree program. Admission to the concurrent degree program is subject to the approval of the deans of the College of Veterinary Medicine and the Graduate College.

The college is an important recruiting center for employers seeking veterinarians for private practice; industry; educational institutions; international agencies; federal, state and local governments; the armed forces; departments of public health; zoological gardens; and other related fields of professional activity. Graduates are highly sought after and typically have multiple employment offers upon graduation. Career services and an online job board are available for students.

Pre-veterinary Medicine Preparation

Admission Requirements

The College of Veterinary Medicine seeks students with diverse backgrounds and encourages students to enroll in baccalaureate programs in the college of their choice.

Undergraduate students are strongly encouraged to complete a bachelor's degree before applying to the College of Veterinary Medicine. Because veterinarians have varied career options, when deciding on an undergraduate major, the student should consider the area of veterinary medicine which interests them. For example, those who desire a career in clinical practice may wish to pursue a degree in biological science, animal science, agricultural economics, business, social science or humanities. Students with an interest in zoo or wildlife veterinary medicine may want to look at animal ecology, environmental studies or zoology. Future researchers may wish to consider genetics, molecular biology, microbiology, or biochemistry. Students who desire a career in public health (USDA, FDA, etc) or government (legislative/policy) may find benefits in any of the biological sciences or in political science. A degree in education may be valuable to those who envision themselves as educators in a College of Veterinary Medicine. These examples are only suggestions and are but a few of the many possibilities.

For the most current information regarding applications and admission to the College of Veterinary Medicine, please refer to the College web site at www.vetmed.iastate.edu/.

Applicants for admission to the College of Veterinary Medicine must have attended an accredited college or university, have completed 40 semester credits prior to the deadline for filing an application for admission, and have completed 60 semester credits prior to the end of the spring term of the year in which the applicant seeks to be admitted to the College of Veterinary Medicine.

All science requirements should be fulfilled by the time of application or scheduled for completion by the **end of the fall term in which the applicant applies.** However, if necessary, the applicant may complete up to two required science courses during the spring term prior to matriculation.

Any required science courses taken the spring term prior to matriculation requires a grade of B (3.00) or better to fulfill the requirement. Remaining non-science required courses must be completed by the end of spring term prior to matriculation with a grade of C (2.00) or better. Required courses may not be taken during the summer prior to entering the program.

Credits earned must include the following Iowa State semester course offerings or their equivalents:

English Composition One year of composition or writing emphasis courses. May include business or technical writing.

Engl 150, 250, 302, 309, or 314 6 cr.

Oral Communications May include public speaking, interpersonal communication, group or organizational communication or speaking emphasis courses.

Sp Cm 212, 223, or 312 or ComSt 214 or Ag Ed 311 3 cr.

General Chemistry with Laboratory*
One year series for biological science majors with one semester lab.

Chem 177-177L, 178 7 cr.

Organic Chemistry with Laboratory*
One year series with one semester lab.

Chem 331, 331L, 332 7 cr.

Biochemistry*
One semester (no lab required)
BBMB 301 3 cr.

General Physics with Laboratory*
First semester of a two-semester series with lab. Must include mechanics, fluids, heat and thermodynamics, vibrations, waves and sound.
Phys 111 4 cr.

General Biology with Laboratory*
Two semester series with lab each semester. A Bachelor's degree in Biology fulfills this requirement.
Biol 211, 211L, 212, 212L 8 cr.

Genetics *	
Must include Mendelian and molecular genetics.	
Biol 313 or Gen 320	3 cr.
Mammalian Anatomy or Physiology*	
Human anatomy or physiology will also fulfill this requirement (no lab required).	
An S 214, BMS 329, Biol 155, or Biol 255 or Biol 335)	3 cr.
Humanities or Social Sciences	8 cr.
Electives	8 cr.
Total Credits Required	60 cr.

* science requirement

Credits in the previously specified courses will normally be earned on the traditional four-letter grading system with A as the highest grade and D as the lowest passing grade. All required courses must be completed with a grade of C (2.0) or better. It is generally expected that required courses have been completed within the past eight (8) years. AP or CLEP credits must be documented by original scores submitted to the University and MUST meet the University's minimum requirement in the appropriate subject area. CLEP credits may be accepted only for arts, humanities and social sciences. Credits in the preceding specified courses will not be accepted if earned under the pass-not pass grading system or similar options.

Application and Admission

Applicants must apply using the Veterinary Medical College Application Service (VMCAS). The VMCAS application may be found online at the VMCAS website (www.aavmc.org under VMCAS). Those applying through VMCAS also need to complete the ISU Supplementary Application found at the College of Veterinary Medicine website. The deadline for filing the VMCAS application, evaluations and transcripts is October 1. The supplemental application, and processing fee are due to the College of Veterinary Medicine postmarked by October 15.

Any student wishing to use international coursework (including study abroad) to fulfill a preveterinary requirement must provide a transcript from the foreign institution.

A list of courses in progress at the time of submission and/or scheduled for completion by the end of spring term should accompany the supplemental application. Undergraduate college credits must average at least 2.50 on a 4.00 marking system for the application to be accepted. The preceding scholastic requirements are minimum and do not assure admission even though these requirements have been fulfilled.

Admission to the College of Veterinary Medicine is on a competitive and selective basis. Undergraduate GPA, Graduate Record Exam (GRE) general test score (The GRE must be taken prior to October 15 of the year the applicant applies and the scores must be received by October 31.), animal and veterinary experience, essays, recommendations and personal development (leadership, citizenship, etc.) are given consideration in the selection of candidates. An interview will be required for those applying to enter Fall 2008 and later.

Approximately one-half of the positions available are reserved for residents of Iowa. The College of Veterinary Medicine has implemented a Cooperative Program in Veterinary Medicine with the University of Nebraska-Lincoln for Nebraska residents and contracts with the states of North Dakota, South Dakota and New Jersey. A number of positions are also available to residents of other states. A few highly qualified international students may be accepted and are considered in the non-resident/non-contract applicant pool. Consideration is given equally to all applicants without regard to race, color, national origin, gender, religion, disability, or age, political beliefs, or marital or familial status.

For further information on these programs and contracts, please visit the College of Veterinary Medicine at www.vetmed.iastate.edu and click on Admissions.

Curriculum in Veterinary Medicine

Graduation Requirements

To be awarded the degree doctor of veterinary medicine, candidates must have passed all required courses in the curriculum in veterinary medicine, have earned at least 4 elective credits on a graded basis of A, B, C, D while enrolled in the College of Veterinary Medicine, and have at least a 2.0 grade-point average in the veterinary medicine curriculum.

Required Courses in the Professional Program

BBMB 420—Physiological Chemistry
BMS 330—Principles of Morphology I
BMS 331—Principles of Morphology II
BMS 333—Biomedical Sciences I
BMS 334—Biomedical Sciences II
BMS 337—Neurobiology
BMS/VCS 339—Clinical Foundations I
BMS 345—Case Study I
BMS 346—Case Study II
BMS 354—General Pharmacology
BMS 443—Pharmacology and Therapeutics
VCS 311—Veterinarian in Society I
VCS 312—Veterinarian in Society II
VCS 313—Veterinarian in Society III
VCS 314—Veterinarian in Society IV
VCS 315—Veterinarian in Society V
VCS 385—Seminar
VCS 391—Clinical Imaging
VCS 393—Principles of Surgery
VCS 394—Principles of Surgery Lab
VCS 395—Small Animal Surgery
VCS 398—Anesthesiology
VCS 399—Ophthalmology
VCS 436—Small Animal Internal Medicine
VCS/VDPAM 440—Introduction to Clinics
VCS 444—Small Animal Medicine
VCS 445—Equine Medicine
VCS 448—Diagnostic Imaging and Radiobiology
VCS 449—Junior Surgery Laboratory
VCS/VDPAM 450—Disturbances of Reproduction
VDPAM/V PTH 426—Veterinary Toxicology
VDPAM 445—Clinical Medicine
V MPM 378—Case Study IV
V MPM 380—Veterinary Immunology
V MPM 386—Veterinary Microbiology
V MPM 387—Veterinary Virology
V MPM 388—Public Health and the role of the Veterinary Profession
V MPM 437—Infectious Diseases and Preventive Medicine
V PTH 342—Anatomic Pathology I
V PTH 372—Anatomic Pathology II
V PTH 376—Veterinary Parasitology
V PTH 377—Case Study III
V PTH 409—Introduction to Veterinary Cytology and Laboratory Techniques
V PTH 425—Clinical Pathology

Fourth Year

The fourth year of the veterinary medical curriculum is designed to be flexible yet provide a broad based clinical education involving all domestic species of animals. All students participate in rotations that are considered fundamental to any species orientation that the student might choose. In addition, students can participate in rotations focused on small animals, horses, or food animals. Students may obtain clinical elective credits by repeating on-campus rotations or participating in approved off-campus preceptorships at government, private or public agencies; other universities; or private veterinary practices.

Students may choose from the following list of clinical rotations.

Anesthesiology
Beef Production Medicine
Cardiology
CDC Epidemiology
Clinical Microbiology
Clinical Pathology
Community Practice
Dairy Production Medicine
Dermatology
Diagnostic Laboratory
Equine Field Services
Equine Medicine
Equine Surgery
Farrier
Food Animal Medicine and Surgery
Food Supply Field Services
Intensive Care/Emergency Medicine
Necropsy
Neurology
Oncology
Ophthalmology
Orthopedic Surgery
Public Health Laboratory
Radiology
Small Animal Medicine
Small Ruminant Production Medicine
Soft Tissue Surgery
Swine Production Medicine
Theriogenology

Reinstatement

Any student who voluntarily withdraws from the College of Veterinary Medicine or who is dismissed from the College of Veterinary Medicine, after having successfully completed one or more semesters forfeits his/her standing and must make written application for reinstatement to this college a minimum of 60 days prior to the opening of the semester for which they seek to re-enter. Any student who voluntarily withdraws from the College of Veterinary Medicine prior to completion of one semester must re-apply for admission to the college in the general applicant pool.

Graduate College

www.grad-college.iastate.edu/

David K. Holger, Dean
George A. Jackson, Assistant Dean
Carolyn Payne, Assistant Dean

The Graduate College and graduate faculty at Iowa State University are responsible for the quality of graduate education, for administering students' graduate programs, and for promoting research support from various governmental, industrial, and private agencies.

The graduate faculty in various programs handle admission and classification of graduate students, establish requirements for advanced degrees, and have charge of instruction and research at the graduate level. Graduate faculty members also teach graduate courses, serve on program of study (POS) committees, and direct work of master's and doctoral students. All graduate courses offered for major or nonmajor credit are taught by graduate faculty members or graduate lecturers.

Graduate study was offered soon after the university was founded, and the first graduate degree was conferred in 1877. Experimentation and research also started early, first in agriculture and shortly thereafter in home economics, engineering, science, and veterinary medicine. In 1913, the graduate faculty was organized formally and an executive graduate committee was appointed. In 1915, the graduate faculty held its first meeting, and in 1916, it granted the first doctor of philosophy degree.

Graduate education is vital to the quality of university teaching. The creative efforts of graduate faculty members and graduate students result in knowledge necessary to help society solve problems in educational, scientific, technological, and socio-economic areas. The Graduate College encourages educational exchange and contact with undergraduate areas of the university to promote improved teaching on both the undergraduate and graduate levels. A part of this exchange is accomplished by the publication of books and technical articles which are made possible by graduate research.

The degrees master of arts, master of science, and doctor of philosophy are research oriented. In many fields master's degrees are also awarded without a thesis, but a written report of independent study, called a creative component, is generally required. For those individuals interested in advanced study directed toward meeting vocational or professional objectives, the following degrees are offered: master of accounting, master of agriculture, master of architecture, master of arts in teaching, master of business administration, master of community and regional planning, master of education, master of engineering, master of family and consumer sciences, master of fine arts, master of landscape architecture, master of public administration, and the master of school mathematics.

The Graduate College Handbook lists policies and procedures of the Graduate College. It is available at the Graduate College's Web site: www.grad-college.iastate.edu/.

Admission

All degree-seeking graduate students must have graduated with a bachelor's or master's degree from a regionally accredited U.S. institution or from a recognized foreign institution where the requirements for the bachelor's degree or its equivalent are similar to those at ISU. Additionally, each applicant must be accepted at ISU by the major program, the Office of Admissions, and the Graduate College. For information concerning graduate study in a particular academic discipline, prospective students should correspond with the chair of the major program in which they wish to study.

Iowa State University has a shared application process, which means certain items are sent (electronically or in print form) to the Office of Admissions and other items are sent to the graduate program to which the prospective student is applying. Detailed instructions are available at https://www.applyweb.com/apply/isu/. Students are also encouraged to check the Program Requirements Web page on the Graduate College Web site at http://www.grad-college.iastate.edu/programs/APprograms.php for mailing instructions and deadlines for each program.

The nonrefundable application fee is $30 ($70 for international applicants). An electronic application is required to apply to ISU's graduate programs; the form and necessary instructions are available at https://www.applyweb.com/apply/isu/. The application fee is required of all applicants except those who have attended Iowa State as undergraduates, or those applying for admission in the nondegree admission status. Iowa State requires official academic records and statements of all degrees earned from all institutions attended since secondary school. Faxed, scanned, and notarized copies are not considered official. that each previous college or university attended provide official transcripts of grades and credits earned, and request that the institution from which the degree was granted provide a statement of the degree received and the applicant's quartile class rank, if available from the institution.

Many programs have very early application deadlines. For more details, check program deadlines at www.grad-college.iastate.edu/programs/APprograms.php.

Categories of Graduate Admission

An applicant pursuing an advanced degree must be recommended by the program in which he/she will be pursuing an advanced degree and must be approved by the Dean of the Graduate College.There are three admission categories for students who wish to pursue an advanced degree:

Full Admission status may be granted to an applicant who either has achieved a grade point average (GPA) of 3.0 or greater (on a 4.0 scale), or ranks in the upper one-half of his or her undergraduate class.

Provisional admission status may be granted to applicants who meet the requirements for full admission (listed above), but have academic or prerequisite deficiencies to remedy. Transfer from provisional admission to full admission status requires the completion of the graduate English requirement, completion of the coursework prescribed to remedy the background deficiencies with a grade average of B or better, and the written recommendation of the major professor and approval by the Dean of the Graduate College.

Restricted admission status may be granted to an applicant who does not satisfy the formal university requirements for full admission status and/or lacks undergraduate preparation in a field related to the graduate field of study. Restricted admission may also be granted to graduates of non-English-speaking foreign institutions, even if the student meets the university requirements for full admission status. Advancement from restricted to full admission status requires completion of 9 semester credits of graduate level course work as a graduate student with a cumulative grade average of B or better and satisfaction of the Graduate College English requirement. A recommendation is submitted in writing to the Graduate College by the major professor and must be approved by the Dean of the Graduate College.

Graduate Admission Without a Declared Major

Admission without a declared major is a category for graduates of regionally accredited institutions in the United States who do not intend to seek an advanced degree from Iowa State University. Such students usually include:

1. Those who intend to transfer graduate credit earned at Iowa State University to other institutions.
2. Those who intend to use graduate credits earned for professional certification.
3. Those who enroll for personal satisfaction.
4. Those who enroll occasionally in off-campus graduate courses.Students who wish to apply to Iowa State University without a declared major need to contact the Office of Admissions, 100 Enrollment Services Center (1-800-262-3810) for the nondegree application form for students in this category. The application form is also available at the web site at www.admissions.iastate.edu/nondegree/

Applications and schedules for students with an undeclared major are processed directly by the Office of Admissions and the Graduate College office; no program approvals are generally required. (Applications and schedules for students declaring a major require program evaluation and approval.)

A student without a declared major who subsequently seeks full, provisional, or restricted admission must apply to and be accepted by a graduate program and by the Graduate College for degree study. A new application, the application fee (unless the student attended Iowa State University as an undergraduate), and transcripts from all colleges attended are required.

For those students originally admitted to the Graduate College on a nondegree basis, no more than 9 semester hours of graduate credit earned under the nondegree option may be applied if the student later chooses to undertake a graduate degree program. The student's program of study committee will recommend to the Graduate College which courses (if any) taken on a nondegree basis may be included in the degree program.

Graduate Admission of International Students

An applicant who is a graduate of a recognized foreign institution is subject to the same criteria for admission as a graduate from an institution in the United States and may be recommended for the same admission categories described above except that of the nondegree option. International applicants for nondegree status may be considered for admission at the discretion of the Graduate College dean. Application and admission deadlines for international students can be obtained from the Admissions web site at www.admissions.iastate.edu/apply/.

International students are required to show evidence of financial support and to carry adequate health and accident insurance while in residence.

Admission Examinations

Graduate Record Examination. The Graduate Record Examination (GRE) is not a university-wide requirement for all applicants. However, many programs require or recommend submission of GRE scores; individual program statements at www.grad-college.iastate.edu/programs/APprograms.php should be consulted for this information.

English Requirements for Non-native Speakers

Applicants whose native language is not English and who have not earned a bachelor's or master's in a country where the only official language is English are required to submit Test of English as a Foreign Language (TOEFL) scores as part of the admission process. A minimum score of at least 79 on the TOEFL internet-based test or 550 on the paper-based test is required by the Graduate College. International students may also submit IELTS (International English Language Testing System) scores in lieu of the TOEFL. The ISU Graduate College minimum is 6.5. Because many programs require higher TOEFL and/or IELTS scores, applicants should check directly with the program to which they desire admission or browse the Graduate College Web site at www.grad-college.iastate.edu/programs/APprograms.php.

Graduate students whose native language is not English and who did not graduate from a U.S. institution must take an English Placement Test at the beginning of their first semester of enrollment. This test is administered by the Department of English. A student who does not pass this examination is assigned to one or more courses in the English 99 and 101 series. This course work must be completed during the first year of study . (There is a developmental course fee for the English 99 course.). Non-native English speaking ISU graduate students who meet or exceed the TOEFL scores (640 or above on the paper-based test or 105 on the internet-based test) are exempted from taking the Enlish Placement Test. (Self-enrollment in English 099 or 101 courses remains possible.

A graduate student whose native language is not English but did graduate from a U.S. institution, may bring to the Graduate College the "Request for the Graduate College to Approve the Graduate English Requirement for a Student Whose Native Language is NOT English" form, available from the Graduate College or on the Graduate College's Web site at www.grad-college.iastate.edu/forms/forms.html. Two conditions must be met: the student must have received a bachelor's, master's, or Ph.D degree from a U.S. college or university and the language of instruction at that college or university must have been in English.

New teaching assistants whose native language is not English are evaluated for their ability to communicate effectively in English before their assistantship assignments are made. Tests of oral proficiency and teaching skills (SPEAK and TEACH) are given before the beginning of each semester. Department offices have a schedule of SPEAK/TEACH testing dates, or browse the SPEAK/TEACH Web site. Registration for the test is held in 1116 Pearson Hall the day before the test is administered. TAs and faculty with questions about SPEAK/TEACH testing should call 515-294-1958 or 515-294-7996. A prospective teaching assistant who does not pass these tests is required to successfully complete course work and be retested. University Studies 180 is a series of communication courses designed to help new teaching assistants. Students focus upon pronunciation, listening, question-handling, teaching and lecturing skills, and analyze the culture of U.S. university life. Because enrollment is restricted, TAs cannot register for the courses online through AccessPlus. TAs must go to the SPEAK/TEACH Office, 1116 Pearson by the first or second day of classes to obtain permission to enter the course by completing a course add slip.

Graduate Appointments

Graduate assistantships, fellowships, and research grants have been established at Iowa State University to encourage graduate work and to promote research. Such appointments and research opportunities are available through the various departments of instruction and the research centers on campus.

Graduate assistantships, the most common form of graduate student support, are available in three categories: the research assistantship, the teaching assistantship, or the administrative assistantship. A half-time graduate assistantship (20 hours per week) permits the holder to enroll for a maximum of 12 semester credits. Recipients of these assistantships are assessed fees at full Iowa resident rates regardless of the number of credits for which they register. These students may also be eligible for tuition scholarship awards (50% of in-state tuition for most master's students and 100% of in-state tuition for most Ph.D. students and certain terminal masters students). Students who are graduates of a regionally accredited college or university in the United States or of a recognized institution in another country whose requirements for the bachelor's degree are substantially equivalent to those of Iowa State University, who are admitted in the full or provisional admissions status, and who present the requisite undergraduate or graduate preparation, may apply for these appointments.

Students registered on a restricted basis or those placed on academic probation are eligible for assistantship appointment only on a term by term basis but are not normally eligible for a graduate tuition scholarship. Students admitted without a declared major are not eligible for assistantship appointments. Further information may be obtained by writing to the appropriate graduate program.

The satisfactory completion of one appointment, plus satisfactory academic performance, will ordinarily make a student eligible for reappointment. After a period of three years of full time study for the master's degree or five years for the doctorate, the student will not normally be continued on assistantship support (shorter periods may be stipulated by the student's program or department).

Postdoctoral Study

Opportunities are provided for postdoctoral study through the extensive research programs of the university. Inquiries should be directed to the appropriate program, institute, or to the Dean of the Graduate College.

Graduate Study by Staff Members

Any full-time member of the research, instructional, or extension staff at the rank of instructor, research associate, or assistant scientist may carry up to six course credits per semester and three credits per summer session, subject to the approval of the head of the program or section, and provided it does not interfere with other duties. This privilege may be extended to members of the research, instructional, or extension staffs at the rank of assistant professor with approval of the college dean and the Dean of the Graduate College. Staff members at the rank of professor or associate professor cannot become candidates for graduate degrees from ISU.

Registration

Graduate students are encouraged to register for courses on the ISU web site (www.iastate.edu) via AccessPlus. Students who are unable or who choose not to register through this system may use a walk-through registration procedure. Students who do not register by the published deadline for initiation of a schedule through the AccessPlus systems must use the walk-through procedure. For complete information on registration, see the ISU Schedule of Classes or the Registration Web site at www.iastate.edu/~registrar/registration/.

Credit Limits

Registration is limited to a maximum of 15 credits per semester. Schedules for graduate assistants on one-half time appointments are limited to a maximum of 12 credits. For full-time staff members, the limit is 6 credits. (Different credit limits apply during the summer session; see the Graduate College Handbook at www.grad-college.iastate.edu/publications/homepage.html for more details.)

Interim Registration

Registration for special work between semesters and during certain vacation periods cannot exceed one credit for each week that the student is in residence. For more information, consult the Graduate College Handbook.

Distance Education

Iowa State offers many graduate degree and certificate programs off-campus. For a listing of the degree programs, registrations for courses, and more information about distance education, consult the Iowa State University Web site at http://www.distance.iastate.edu/programs/homepage.php.

Other information about graduate requirements is available in the Graduate College Handbook at http://www.grad-college.iastate.edu/publications/gchandbook/homepage.html.

Doctoral Post Prelim (formerly Continuous Registration)

Even when Ph.D. graduate students have completed course work and residency requirements, they are required to register and pay tuition and fees, whether or not university facilities and equipment are used or staff is consulted—either in person or in absentia.

After the preliminary oral examination is passed (with either full or conditional pass) and if university facilities, equipment, and staff time are used, the Ph.D. candidate must register for the appropriate number of credits in the major department or program and pay the appropriate graduate tuition and fees.

After the preliminary oral examination is passed (with either full or conditional pass) and if university facilities, equipment, and staff time are not used, the Ph.D. candidate may register for Gr St 680 (Doctoral Post Prelim Registration) and pay the Doctoral Post Prelim Registration fee.

The Ph.D. candidate must be aware that registration for Gr St 680 is allowed only after the Ph.D. candidate passes the preliminary oral examination; is required only in the fall and spring semesters, and not during the summer term; is not allowed after the completion of the final oral examination; and is not sufficient registration for the term the preliminary or final oral examination is taken; and does not defer student loans.

If students take the final examination during the interim between terms (including the first day of classes), registration can be for the term either before or after the examination is held.

Auditing

Audit registration means taking courses without receiving formal credit. Audit provisions are as follows: Instructors must approve ALL audits; students must register for audits by day 10 of the semester; changes to or from an audit must be made in the first 10 days of the semester; students are assessed tuition and fees as though they were taking the course for credit; and the course DOES NOT count in determining full-time student status.

Audited courses do not appear on the student's permanent record unless the "Request for Audit(s) to Appear on Transcript" form is completed and signed by the student, course instructor, and major professor. Copies of this form, which are available from the Graduate College or from the Graduate College's web site at www.grad-college.iastate.edu/forms/forms.html, must be filed with the Graduate College, 1137 Pearson Hall.

After the fifth class day, if a student changes a regular course to an audit, that course will appear on the student's permanent record as a drop. Audits are not acceptable as registration for loan deferments.

Graduate Courses Taken by Undergraduates

Certain graduate level courses listed in the ISU Catalog may be used in the program of study even though they were taken for graduate credit by the student as an undergraduate at Iowa State University.

The following conditions must be met:

1. The POS committee can request approval from the Dean of the Graduate College that up to nine hours of such credit be applied toward meeting advanced degree requirements (these courses must be clearly marked on the POS).
2. Credits earned in these courses must be in addition to those used to meet requirements for the bachelor's degree and must have grades of B or better.
3. The student must be classified as an undergraduate and not a nondegree undergraduate (credits taken as a nondegree undergraduate student are not allowed).
4. The Graduation Office (10A Enrollment Services Center) should be contacted to determine that the courses were not taken as Graduation Office (10A Enrollment Services Center) indicating that the courses were not taken as a nondegree undergraduate student, were not used toward fulfillment of the undergraduate degree program and were graded B or better.

Undergraduate Admission to Concurrent Graduate Degree Programs

Several programs provide opportunities for well qualified ISU juniors and seniors majoring in those curricula to apply for admission to both a bachelor's and master's degree.

The graduate degree will be awarded only at the same time as, or after, the undergraduate degree is conferred. For a complete listing of the concurrent degree programs, consult the table, "Concurrent Bachelor and Master Programs" in this section.

Students interested in a research career may apply for graduate research assistantships during their last two years of study. Students should contact the programs listed below about applying early in their undergraduate careers. Undergraduate students seeking admission to concurrent graduate degree programs in field other than these, plus any student with an interdepartmental major, must submit a written proposal for an individualized program, co-signed by their advisers, to the Graduate College for review and approval. For more information about the application process and transferring credits, consult the *Graduate College Handbook*.

Veterinary Medicine Students in Concurrent Graduate Degree Programs

Students may be concurrently enrolled in the professional curriculum leading to the D.V.M. degree and in a graduate program leading to the M.S. or Ph.D. degree after completion of 90 semester credits. The graduate program may be in the College of Veterinary Medicine or in another college.

Interested students must complete a graduate application, complete a "Concurrent Enrollment Request" form available in the Graduate College office or on the web site at www.grad-college.iastate.edu/forms/forms.html, submit both forms with appropriate transcripts and letters of recommendation to the Office of Admissions (100 Enrollment Services Center). (Copies of the application forms may be obtained at www.admissions.iastate.edu/apply/index.php.) State on the application that the application is for a concurrent degree program.

Signed approvals on the Graduate Admissions Evaluation form are required from the graduate program, the Dean of the College of Veterinary Medicine, and the Dean of the Graduate College. On admittance, the student receives an admission notification from the Office of Admissions. For more information see the *Graduate College Handbook*.

Graduate Students in Concurrent Undergraduate Programs

Graduate students interested in enrolling in a concurrent undergraduate program should contact the Office of Admissions (100 Enrollment Services Center) to obtain admission information (even if the student has been previously

admitted as an undergraduate). A "Concurrent Enrollment Request" form should be obtained from the Graduate College Web site at www.grad-college.iastate.edu/forms/forms.html and circulated for the appropriate approvals. The student must be formally admitted both as a graduate student and as an undergraduate student. Official enrollment and fee payment will be as a graduate student. Credits transferred from the graduate permanent record to the undergraduate permanent record are no longer available for use on a graduate program of study.

Courses Taken as a Nondegree Undergraduate Student

A person classified as a "nondegree undergraduate" student may not use courses taken under that status in a graduate degree program. A student who has received the baccalaureate degree must register as a graduate student if he/she is to receive graduate credit for courses.

Grading

Grades are the permanent official record of a student's academic performance. Iowa State uses A through F grading for most courses. S, P, and NP grades are given in some courses. The standard four-point scale is used to calculate a grade point average.

Grade Point Average (GPA)

All courses (even if they are undergraduate courses) taken as a graduate student will be calculated into the graduate GPA. The GPA is determined by dividing the number of grade points earned by the total number of ISU cumulative hours. The grade given when an incomplete (I) is resolved is figured into the cumulative grade point average, but not into a particular semester's average. Marks of I, S, P, NP, T, and X are not counted in the grade point average; a mark of F (even if taken S/F) is counted in the grade point average. Creative Component/Research (599 and 699) credits are not used in the calculation of the GPA. In the case of repeated courses, only the grade achieved the last time the course is taken is used in computing the grade point average. (However, grades in courses that are noted as repeatable courses in the catalog, such as certain repeatable seminars, will all be used in calculating the grade point average.)

Grading Research and Creative Component Credits

Creative Component/Research credits may be graded as A, B, C, D, I, S, or F. Plus and minus grades are optional. These credits are not calculated in a student's GPA.

Pass (P)/Not Pass (NP) Course Credit

Pass/Not Pass courses are those that a student, with the approval of the major professor, may take for personal enrichment, but not for satisfying prerequisites or deficiencies in the undergraduate background. P/NP marks may not be used in a POS, nor do P/NP marks contribute to the student's GPA. Full credit for P/NP courses is used in calculating tuition assessment and credit load limitations. For more information, see *the Graduate College Handbook*.

Satisfactory/Fail (S/F) Grading

S/F grading is not the same as P/NP grading. S/F grading is by instructor option; all students in a particular course receive S/F grading. P/NP grading is generally a student option. A P mark is equivalent to at least a D- grade whereas an S mark is equivalent to at least a B grade at the graduate level. No special registration procedures are required for S/F grading. An S mark in a course taken S/F is not counted in the grade point average, but an F mark in a course taken S/F is counted in the grade point average and is equivalent to an F in a regularly graded (A-F) course. No more than 20 percent of the total credits (excluding creative component, thesis or dissertation research) in the program of study may be earned on an S/F basis. S/F grading may be used only for approved courses offered as seminars, symposia, workshops, special topics, and research. Programs must submit requests for S/F grading to the Dean of the Graduate College. The Graduate College Curriculum and Catalog Committee reviews and approves or rejects all S/F courses.

Grievances about Grades

A graduate student who feels that a course grade has been unjustly assigned, and whose attempts to resolve the matter with the instructor have failed, may appeal through the grievance procedures described in the *Graduate College Handbook.*

Concurrent Bachelor and Master Programs

Bachelor's Degree	Bachelor's Major	Master's Degree	Master's Major
B. S.	Accounting	M.Acc.	Accounting
B.S.	Agricultural Biochemistry	M.S.	Biochemistry
B. S.	Agricultural Engineering	M.S.	Agricultural Engineering
B. S.	Animal Science	M.S.	Animal Breeding and Genetics
B. S.	Animal Science	M.S.	Nutritional Sciences
B. S.	Animal Science	M.S.	Meat Science
B. S.	Animal Science	M.S.	Animal Physiology
B. S.	Animal Science	M.S.	Animal Science
B. S.	Biochemistry	M.S.	Biochemistry
B. S.	Biophysics	M.S.	Biophysics
B. S.	Civil Engineering	M.S.	Civil Engineering
B.S.	Civil Engineering	M.B.A.	Business Administration
B. S.	Computer Engineering	M.S.	Computer Engineering
B. S.	Computer Engineering	M.B.A.	Business Administration
B. S.	Diet and Exercise	M.S.	Diet and Exercise
B. S.	Electrical Engineering	M.S.	Electrical Engineering
B. S.	Electrical Engineering	M.B.A.	Business Administration
B.S.	Family Finances, Housing and Policy	M.S.	Human Development and Family Studies
B. S.	Food Science	M.S.	Food Science and Technology
B.S.	Industrial Engineering	M.B.A.	Business Administration
B. S.	Industrial Engineering	M.S.	Industrial Engineering
B. S.	Materials Engineering	M.S.	Materials Science and Engineering
B.S.	Mechanical Engineering	M.B.A.	Business Administration
B.S.	Mechanical Engineering	M.S.	Mechanical Engineering
B. S.	Nutritional Science	M.S.	Nutritional Sciences
B. S.	Psychology	M.S.	Psychology

Concurrent Bachelor and Master Certificates

Bachelor's Degree	Bachelor's Major	Master's Certificate
B.S.	Computer Engineering	Information Assurance
B.S.	Family Finances, Housing and Policy	Family Financial Planning

Probation

If a graduate student does not maintain a cumulative 3.0 grade point average on all course work taken, exclusive of research credit, he or she may be placed on academic probation by the Dean of the Graduate College. Grades earned by graduate students in undergraduate courses are included in the calculation of the grade point average. Academic probation judgments are made on the basis of grades in course work only. New, first-term graduate students who fall below a 3.0 GPA at the end of their first semester will be given a one term grace period to bring their grades back to a 3.0 GPA. These students will receive a warning letter from the Graduate College.

While on academic probation a student will not be admitted to candidacy for a degree and if appointed to a graduate assistantship, the student will not receive a Graduate tuition scholarship unless approval is given by the student's academic college. If a student is to qualify for a tuition scholarship, he/she must be removed from probation by the tenth class day of the term.

To insure that registration does not take place without a review by the program, the Graduate College places a hold on future registrations by a student on probation. Before the student registers for each term, the program must review his or her record and recommend in writing if the Graduate College should permit further registration. Before graduation is approved, the student must complete all courses listed on the program of study with a minimum grade of C and have achieved a 3.0 GPA or greater.

Master's Degrees

General requirements for all master's degrees are as follows:

General Requirements

The Graduate College Handbook outlines the general requirements for completion of a graduate degree at ISU. Faculty in a major field have the responsibility for establishing educational objectives for their graduate program, including specific course requirements and research requirements appropriate to the master's programs in the major. These requirements may place additional responsibilities on the student, the major professor, or the student's program of study (POS) committee beyond those listed in the Graduate College Handbook as deemed appropriate to the goals of the major program.

Faculty and graduate students are active participants in the academic programs of Iowa State University. As active participants, they have a collective impact on the success of those programs and of the university in fulfilling its mission. Each graduate program is encouraged to implement a mechanism for responding to feedback from graduate students as a valuable resource for continuing improvement.

Appointment of the Student's Program of Study (POS) Committee

New graduate students at ISU may be assigned a temporary academic adviser by the major program in the first semester of the student's residence. This faculty member guides the student in selection of a field of study and in development of a graduate program of study until the major professor and POS committee are selected. After the POS committee has been selected, it guides and evaluates the student during the remainder of graduate study.

A master's POS committee consists of at least three members of the graduate faculty. It must include two members, including the major professor, from the major or program. The committee must include member(s) from different fields of emphasis so as to ensure diversity of perspectives. A term member of the graduate faculty may participate in the direction of a student's master's research as a co-major professor if a member of the graduate faculty serves as a co-major professor and jointly accepts responsibility for the direction of a program of study. For more information on duties and makeup of the committee as well as changes to the committee makeup, see the *Graduate College Handbook*.

Program of Study.The student and major professor develop the program of study with the consultation and approval of the POS committee. This agreement between the student and the Graduate College should be submitted as early as possible for approval. It is recommended that the committee be formed and the POS form submitted as early as the second semester of graduate study. In no case can the committee be formed later than the term before the final oral examination.

Residency. There is no on-campus residency requirement for the master's degree.

Credits. Unless otherwise noted, at least 30 credits of acceptable graduate work must be completed in all master's programs. At least 22 graduate credits must be earned from Iowa State University unless noted in the descriptions under "Specific Master's Degrees" in this catalog.

Transfer Credits. At the discretion of the POS committee, and with the approval of the program and the Graduate College, graduate credits earned as a graduate student at another institution or through a distance education program offered by another institution may be transferred if the grade was B or better. Such courses must have been acceptable toward an advanced degree at that institution and must have been taught by individuals having graduate faculty status at the institution. If a student wishes to transfer credits from graduate courses taken at or through another university as an undergraduate student, it is the student's responsibility to provide verification by letter from that institution that these graduate courses were not used to satisfy undergraduate requirements for a degree.

A transcript must accompany the POS in order to transfer credits. The POS committee may ask for other materials, such as a course outline or accreditation of the institution, to evaluate the course. Transfer courses not completed when the POS is submitted must be completed before the term in which the student graduates. A transcript must then be submitted for review and final approval.

Research credits earned at another institution are generally not transferred. In rare circumstances, the transfer of S or P marks may be accepted for research credits only. It is the responsibility of the POS committee to obtain a letter from the responsible faculty member at the other institution stating that research credits recommended for transfer with S or P marks are considered to be worthy of a B grade or better. Audits may be listed on the program of study, but do not carry credit.

Major. A major is an approved area of study leading to a graduate degree. The exact number of credits in a major is not prescribed.

Minor. Students may request a minor in any program approved to grant a graduate degree and in programs approved to offer only a minor. A student may not minor and major in the same field. Requirements for declared minors are determined by the minor program and the faculty member representing the minor field on the student's POS committee.

The minor subject area must be tested at the final oral examination and cannot be placed on the transcript after graduation unless it was approved on the program of study, listed on all examination reports, and recorded on the "Application for Graduation" form (diploma slip). A minor cannot be added to a degree that has already been received.

Department/Program Change.

Transferring from One Major/Program/Department to Another

Students who have been admitted to a graduate program and to the Graduate College may request to transfer at a later date to another department or program. Because graduate students are admitted to particular programs, transfers require the approval of both the receiving program and the Graduate College.

Students seeking transfer to another program or department should first discuss their wishes with the new program DOGE (Director of Graduate Education) to determine requirements and interest by the new program. When a student receives a favorable preliminary response from the new program, he or she should fill out the student portion of the form entitled "Request to Transfer from One/Major/Program/Department to Another" and submit this form to his or her current DOGE. The current DOGE will fill out the Current Program Information adding any comments he or she believes the new program should consider and forward the form to the proposed new program. This form is available from the department, the Graduate College, or the Graduate College web page.

The receiving program will generally give the student the same consideration and employ the same admissions standards that are used for original applications for admission and will expect the same application materials (transcripts, letters of recommendation, test scores, etc). During the process, the new and old programs and the Graduate College are authorized and encouraged to seek and disclose information related to the student's overall fitness for studies in the receiving program. Programs are authorized to inquire into the student's prior conduct at the university, both with the prior department and with the Dean of Students.

Upon departmental action (acceptance or denial), the request to transfer form must be sent to the Graduate College for approval. All parties

will receive a copy of the completed form from the Graduate College.

Students desiring to transfer from a degree-seeking status to a nondegree-seeking status need to fill out the "Request to Transfer from One Major/Program/Department to Non-degree" form and bring it to the Graduate College.

Students desiring to transfer from nondegree-seeking status to a degree-seeking status must be admitted by a program through the regular graduate admission process.

Curriculum Change from Active Graduate to Active Undergraduate Status

Individuals who are in good standing in the Graduate College and who wish to transfer to an undergraduate curriculum must contact the graduate classification officer (1137 Pearson Hall). The classification officer will consult with the student and determine the proper course of action.

Curriculum Change from Inactive Graduate to Active Undergraduate Status

Individuals who were admitted to the Graduate College more than one year previous and who do not have active graduate status but who wish to change their status from inactive graduate to active undergraduate, must follow the same procedures required of reentering undergraduate students and must begin the process by filing a completed "Undergraduate Reentry" form with the Office of the Registrar. When considering reinstatement, the undergraduate college may consider the student's overall fitness for continued studies including information about the student's conduct, employment and education since the student's last enrollment.

Individuals who do not have active graduate status and who first enrolled less than one year previous should first see the classification officer in the Graduate College.

Time Limits. It is expected that work for the master's degree shall be completed within five years. In special circumstances the student's POS committee may recommend that the Dean of the Graduate College extend these degree time limits. Cases in which the student leaves Iowa State during his or her graduate career and later returns are dealt with individually by the student's POS committee and the Graduate College. The inclusion in the student's program of study of course work that is beyond the time limits ("over-age" courses) must be justified by the POS committee in a statement accompanying the submission of the program of study.

Application for Graduation. Students planning to graduate must submit an "Application for Graduation" form (diploma slip) to the Graduate Office by the end of the first week of the semester (fall or spring) in which he/she expects to receive the degree, or by the last day of spring semester when wishing to graduate during summer.

Before submitting this form, a student must have submitted and had approved by the Graduate College a "Recommendation for Committee Appointment" form and a "Program of Study" form. Also the student must have been fully admitted to a program and have met the Graduate English requirement if he/she is a non-native English speaker. Graduation may be delayed if the "Application for Graduation" form filing deadline is not met. If it becomes apparent that a student cannot graduate during the indicated term, he/she should call the Graduate College (515-294-4531) and cancel the previously submitted "Application for Graduation" form. The student must then file a new form for the next planned term of graduation.

Thesis. A master's thesis is a scholarly composition that demonstrates the ability of the author to do independent and creative work. A thesis is required in all fields in which a master's degree is awarded, except where specific provision is made for a nonthesis degree program. A minimum of three research credits is required on every program of study for a thesis master's degree.

Responsibility for writing and editing of the thesis rests with the student, under the supervision of the major professor, and not with the Graduate College. The Graduate College does not permit joint authorship of theses. It is the responsibility of the major professor to supervise the preparation of preliminary and final drafts of the thesis to assure the highest level of quality when the student presents the thesis to the committee for final approval.

Copies of the thesis must be submitted to the members of the POS committee at least two weeks before the final oral examination.

All theses and dissertations will be submitted electronically after the final oral examination is held. Please browse the Graduate College's web site (http://www.grad-college.iastate.edu/thesis/homepage.html) for requirements, revised fees, and other pertinent information.

Shortly after the submission of the "Application for Graduation" form, a one-time, nonrefundable thesis fee is billed by the university accounting system. In addition, a graduation fee will be assessed by the Registrar's Office. This fee is nonrefundable if a student does not cancel his/her graduation by the Graduate College's cancellation deadline.

Creative Component. Most nonthesis students must present substantial evidence of individual accomplishment (e.g., a special report, capstone course, integrated field experience, annotated bibliography, research project, design, or other creative endeavor). A minimum of two credits of such independent work is required on those programs of study for a nonthesis master's degree. Some programs require more credits. (For more information, contact the individual program or consult the Specific Master's Degrees section in this catalog.) The element of creative independent study must be explicitly identified on the program of study. The format of the creative component is determined in cooperation with the POS committee. As with a thesis, a creative component should be submitted to members of the POS committee two weeks before the final oral examination. However, no final submission of a creative component is turned in to the Graduate College for review and approval.

Final Oral Examination. Most master's candidates must pass final oral examinations. The final oral examination must be held by the final examination deadline date for the semester in which the degree is granted. All coursework in the program of study must either be completed or in progress before the final examination can be scheduled. This examination is oral; it may also include a written component if specified by the student's (POS) committee.

Graduate students must register at Iowa State for the equivalent of two credits, or for the R-credit course GR ST 600 (Examination Only) if no course work is needed, during the semester in which the final examination is taken. (Graduate students who are not required to take a final oral examination should complete all required coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.) Taking only an R-credit course where the fee is not equivalent to the 2-credit minimum charge is not acceptable for the term of the final oral examination. If the examination is taken during the interim between terms (including the first day of classes), registration can be for either the term before or the term after the examination is held.

The candidate is responsible for initiating the "Request for Final Oral Examination" form, which must be submitted to the Graduate College at least three weeks before the examination. This form can be obtained only from the student's program/department. The entire POS committee must be convened for the final oral examination. For more information on the final oral examination, see *the Graduate College Handbook*.

Graduate Student Approval Slip for Graduation. Every candidate for an advanced degree is required to complete a "Graduate Student Approval Slip for Graduation" form. It is sent to the major professor or program to give to the student after the "Request for Final Examination" form is received and approved by the Graduate College. Signatures are required by the major program, the Graduate College Thesis specialist (for those completing a thesis), and the Graduate College. Final clearance of academic requirements will be made when current term grades have been submitted and evaluated by the Graduate College.

All incompletes from previous terms must be completed by the deadline for completion of the Graduate Student Approval Slip. An incomplete or non-report grade that a student receives for the term of graduation will result in removal from that term's graduation list. The student will need to complete a new Application for Graduation and Graduate Student Approval Slip for the new term of graduation. If a conditional pass was recommended at the final oral examination, the major professor and the committee members, if so specified, must notify the Graduate College in writing no later than the due date for the Graduate Student Approval Slip for the term of graduation that the conditions have been met.

Specific Master's Degrees

The number of credits in a major for a master's degree will vary according to the degrees listed below. General credit requirements for all master's degrees include: a minimum of 30 graduate credits is required for all master's programs at ISU; at least 22 graduate credits must be earned at ISU unless noted in descriptions; any transfer of graduate credits from another institution must be recommended in the program of study by the POS committee; and graduate credit earned as a graduate student will be approved for transfer only if a B grade or better was earned. A transcript must accompany the POS form.

Master of Arts or Master of Science—Thesis

At least 30 credits of acceptable graduate work must be completed, not less than 22 of which must be earned from ISU. Students are expected to research and write a thesis that demonstrates independent and creative work. A minimum of 3 semester credits is required for thesis research.

Master of Arts or Master of Science—Nonthesis

In certain programs a nonthesis degree program is offered. (For more information on requirements, contact the individual program or department.) This option requires the satisfactory completion of at least 30 graduate credit hours of acceptable work (not including research credit), not less than 22 credits of which must be earned from Iowa State University, and satisfactory completion of a comprehensive final oral examination. In addition, every nonthesis master's program must present substantial evidence of individual accomplishment (e.g., a special report, capstone course, integrated field experience, annotated bibliography, or other creative endeavor). A minimum of two semester hours of such independent work (referred to as the creative component) is required on every program of study for a nonthesis master's degree and is applied toward the credit-hour requirement. This element of creative independent study must be explicitly identified on the program of study. Detailed requirements may vary with fields. Reference should be made to the *Courses and Programs* section in this catalog.

Master of Accounting. The Department of Accounting offers a 30-credit Master of Accounting graduate degree. The program requires 15 credits of graduate accounting courses, at least 9 credits of non-accounting graduate electives, a communications course, an international course from an approved list, and an optional creative component. At least 22 graduate credits must be earned at ISU. The degree is appropriate for any student wanting to pursue a variety of accounting careers. Additionally, the program is designed to help interested candidates meet the 150-hour education requirement for the CPA certification in Iowa. Since no final oral examination is required in the above professional program and its options, students should complete all coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.

Master of Agriculture. The major in professional agriculture is an off-campus, nonthesis program leading to the master of agriculture degree. It is available to students wishing to pursue graduate study in agriculture without taking formal coursework on campus. The program is considered to be a terminal master's degree. Students are required to take a minimum of two courses in each of three disciplines and complete 28 semester credits of formal coursework and four credits of creative component experience, resulting in a total of 32 graduate credits of coursework. At least 22 graduate credits must be earned at ISU. Courses are delivered via video-tapes, interactive video, world-wide web, on-and off-campus classes and workshops. Specific courses offered in the program and the location of the off-campus classes may be obtained from the departmental course listings, off-campus course catalog, or by contacting the Professional Agriculture Coordinator, 201 Curtiss Hall.

Master of Architecture. The Department of Architecture offers three master programs: M Arch I, M Arch II and M S A S. M Arch I (100 credits) is a non-thesis accredited professional degree in architecture. Students with an undergraduate degree other than architecture enroll in a 100-credit, seven semester program. Students with a B.A. or B.S. in architecture or other affiliated design fields are considered for advanced standing based on a review of their academic record. Students with advanced standing typically enroll for four semesters. Since no final oral examination is required in the M Arch I program, students should complete all coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.

The M Arch II (30 credits) is a post-professional degree in architecture with a required graduate thesis. Students with a B Arch, M Arch I or equivalent professional degree in architecture or other affiliated design fields may apply for this degree.

The M S A S (30 credits) is an interdisciplinary research degree in architecture with a required graduate thesis. This degree is for students with bachelor degrees in various fields that are interested in conducting graduate-level research on the built environment. At least 22 graduate credits must be earned at ISU for all the above programs.

Since no final oral examination is required in the above professional program and its options, students should complete all coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.

The M.Arch. II (30-credit) option is for students with a B.A. or B.S. in a 4-year degree program in architecture or a M.Arch.I degree. These students must complete a thesis. At least 22 graduate credits must be earned at ISU for all the above options.

Master of Arts in Teaching. This is a degree leading to teacher licensure. A range of graduate credits are required depending on the program offering the degree. The student must also demonstrate an ability to perform independent study through the completion of a creative component or thesis. At least 22 graduate credit hours must be earned at ISU.

Master of Business Administration. The College of Business offers a 48 graduate credit-hour program leading to a nonthesis master of business administration degree.

At least 22 graduate credits must be earned at ISU. Students may select courses in the traditional business disciplines or choose areas of specialization in accounting, agribusiness, family finanical planning, information systems, international business, marketing, and supply chain management.

Since no final oral examination is required, M.B.A. students should complete all required coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.

Master of Community and Regional Planning. The master of community and regional planning degree requires a minimum of 48 graduate semester credit hours. At least 22 graduate credits must be earned at ISU. This degree is available as a thesis or nonthesis option.

Master of Education. For the master of education degree, a range of 30 to 40 graduate credits are required. At least 22 graduate credits must be earned at ISU. The student demonstrates an ability to perform independent study through the completion of a creative component or a field-based activity.

Master of Engineering. The academic standards and the general level of attainment are the same for the master of engineering and master of science degrees. Master of engineering programs are offered to meet the needs for professionally oriented programs on campus and for off-campus professionally oriented programs at locations with adequate library and laboratory facilities. An appropriate number of credit hours in design, laboratory work, computation, or independent study is required as evidence of individual accomplishment. Of the minimum 30 graduate credits requirement, 22 graduate credit hours must be earned at ISU. For those Master of Engineering programs that do not require a final oral examination, students should complete all coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.

Master of Family and Consumer Sciences. The College of Human Sciences offers two nonthesis options leading to the degree master of family and consumer sciences. Both options are designed to enhance the skills of those holding the bachelor's degree so that they may meet the requirements of their present jobs or progress in their careers. The comprehensive option can be followed on- or off-campus and requires 36 graduate credits covering a variety of family and consumer sciences subject matter. The specialization option requires 36 credits and is offered on-campus from the following departments and programs: Dietetics, Family Financial Planning, Foodservice and Lodging Management, Gerontology, Human Development and Family Studies, Nutritional Sciences, and Textiles and Clothing. At least 22 graduate

credits must be earned at ISU. Both options require a written and oral integrative final exam.

Master of Fine Arts. For this degree a minimum of 54-61 graduate credits is required, including the completion of a thesis-exhibition or a thesis. At least 22 graduate credits must be earned at ISU.

Master of Landscape Architecture. The master of landscape architecture degree requires a minimum of 36 graduate credits and the satisfactory completion of a thesis or a creative component. At least 22 graduate credits must be earned at ISU.

Master of Public Administration. This is a professional degree program designed to provide training necessary for an administrator in a public or quasi-public bureaucracy. The MPA degree requires 37 graduate credit hours, which includes (a) 12 credit hours in Core Competency, (b) 12 credit hours in one of the Concentration areas, (c) 4 credit hours in other required courses, (d) up to 7 credit hours of electives, (e) 3 credit hours of Creative Component (a Capstone Project) or a minimum of 3 credit hours of research (thesis). Pre-service students are encouraged to obtain an internship for 3 credit hours. At least 22 graduate credits must be earned at ISU.

Master of School Mathematics. This degree is designed primarily for in-service secondary mathematics teachers. Its prescribed program of study requires 33 graduate credits, two of which come from the writing of an approved creative component, 15 from courses offered for graduate credit, and 13 from courses offered for nonmajor graduate credit. At least 22 credit hours must be earned at ISU.

Master's Double Degree Programs

A double degree requires fulfillment of the requirements for two graduate majors for which two differently named master's degrees and two diplomas are granted at the same time. For double degrees the final project (thesis or creative component) must integrate subject areas from both departments. One final oral examination must be held covering the combined thesis or creative component. Students planning to pursue double degrees must complete a double degree request form and submit it to the Dean of Graduate College for approval. Just one "Recommendation for Committee Appointment" form and one "Program of Study (POS)" form need to be submitted for the two degrees. However, two "Application for Graduation" forms, one for each degree, will need to be submitted. All forms should show clearly that the student is enrolled in a double-degree program.

Like other master's programs, three graduate faculty members can constitute a POS committee; however, POS committees for double degrees must include co-major professors from each of the majors. Although specific degree programs may require more, the program of study must include at least 44 hours of non-overlapping credit (22 for each major) in the two degrees.

Several such combinations are currently available: (1) Master of Architecture/Master of Business Administration; (2) Master of Architecture/Master of Community and Regional Planning; (3) Master of Community and Regional Planning/Master of Business Administration; (4) Master of Landscape Architecture/Master of Community and Regional Planning; (5) Master of Public Administration/Master of Community and Regional Planning; (6) Master of Public Administration/Master of Science in Information Assurance; (7) Master of Science in Statistics/Master of Business Administration; and (8) Master of Science in Information Systems/Master of Business Administration.

If a student outside one of the named areas is interested in an individually-developed double degree program, a written proposal for a double degree to serve those interests and needs must be submitted to the Dean of the Graduate College for review. See t*he Graduate College Handbook* for more information.

Drake University Law School/ Iowa State University Combined Degree

To provide training in the complementary fields of law, political science, and economics with a minimum amount of academic duplication, special arrangements for combined degree programs have been approved with the Drake University Law School. ISU and Drake offer a combined J.D.-M.A. in political science and J.D.-Ph.D. in economics. Drake Law School students are permitted to transfer the equivalent of nine semester credits of specified law courses to ISU for nonmajor graduate credit. Because of the difference in grading systems, the Law School grades are transferred as passes, provided the student has achieved a grade of C or better in those courses at Drake for the political science program or a grade of B or better for the economics program.

Applicants for either of the combined programs must meet the regular entrance requirements of, and be admitted to, both the Drake Law School and the ISU Graduate College.

Doctor of Philosophy

General Requirements

The degree doctor of philosophy is strongly research oriented. The primary requirements for the degree are: (1) high attainment and proficiency of the candidate in his or her chosen field, (2) development of a dissertation which is a significant contribution to knowledge and which shows independent and creative thought and work, and (3) successful passing of detailed examinations over the field of the candidate's major work, with a satisfactory showing of preparation in related courses. General requirements for Ph.D. candidates follow.

The Graduate College Handbook outlines the general requirements for completion of a graduate degree at ISU. Faculty in a major field have the responsibility for establishing educational objectives for their graduate program, including specific course requirements and research requirements appropriate to the master's or Ph.D. programs in the major. These requirements may place additional responsibilities on the student, the major professor, or the student's program of study (POS) committee beyond those listed in the Graduate College Handbook as deemed appropriate to the goals fo the major program.

Faculty and graduate students are active participants in the academic programs of Iowa State University. As active participants, they have a collective impact on the success of those programs and of the university in fulfilling its mission. Each graduate program is encouraged to implement a mechanism for responding to feedback from graduate students as a valuable resource for continuing improvement.

Appointment of the Student's Program of Study (POS) Committee. The POS committee for a doctoral program consists of at least five members of the graduate faculty. It must include at least three members, including the major professor, from within the student's major or program. The committee must include member(s) from different fields of emphasis so as to ensure diversity of perspectives. A term member of the graduate faculty may participate in the direction of a student's dissertation research as a co-major professor if a member of the graduate faculty serves as a co-major professor and jointly accepts responsibility for direction of the dissertation.

Changes to POS committee. Recommendations for changes in the POS committee must have the approval of the student, major professor, DOGE, and all committee members involved in the change (committee members who are on Faculty Professional Development Assignments, retired, or resigned do not have to sign) before seeking approval of the Graduate College. A form to seek approval is available in program offices or on the web at www.grad-college.iastate.edu/forms/forms.html. These changes must be approved by the Dean of the Graduate College before the preliminary or final oral examination is held. For more information on changes to the committee and to the Program of Study, see the *Graduate College Handbook*.

Program of Study. The student and the major professor develop the program of study with the consultation and approval of the POS committee. Early selection of a major professor, appointment of a POS committee, and development of a program of study are very important. It is recommended that the committee be formed as early as the second semester of graduate study. In no case can the committee be formed later than the term before the preliminary oral examination.

Credits. A minimum of 72 graduate credits must be earned for a Ph.D. degree. At least 36 graduate credits, including all dissertation research credits, must be earned at Iowa State University. At least 24 of these credits must be earned during two consecutive semesters or during a continuous period including two semesters and a summer session while in residence at the university. (This requirement does not apply to doctoral students who are employed more than half time at ISU). There is no specific university requirement regarding the number of credits to be taken inside or outside the major/program.

Transfer Credits. At the discretion of the POS committee, and with the approval of the program and the Graduate College, graduate credits earned as a graduate student at another institution or through a distance education program offered by another institution may be transferred if the grade was B or better. Such courses must have been acceptable toward an advanced degree at that institution and must have been taught by individuals having graduate faculty status at that institution. If a student wishes to transfer credits from graduate courses taken at or through another university as an undergraduate student, it is that student's responsibility to provide verification by letter from that institution that those graduate courses were not taken to satisfy undergraduate requirements for a degree.

A transcript must accompany the POS in order to transfer credits. The POS committee may ask for other materials, such as a course outline or accreditation of the institution, to evaluate the course. Transfer courses not completed when the POS is submitted must be completed before the term in which the student graduates. A transcript must then be submitted for review and final approval.

Research credits earned at another institution are generally not transferred. In rare circumstances, the transfer of S or P marks may be accepted for research credits only. It is the responsibility of the POS committee to obtain a letter from the responsible faculty member at the other institution stating that research credits recommended for transfer with S or P marks are considered to be worthy of a B grade or better.

Residency. At least 24 semester credits must be earned during two consecutive semesters or during a continuous period including two semesters and a summer session. This requirement does not apply to doctoral students who are employed at least half-time by Iowa State University and government laboratories located in Ames. Of the 72 graduate credits required for a Ph.D. at least 36 credits, including all dissertation research credits, must be earned under the supervision of the student's POS committee.

Major. A major is the area of study or academic concentration in which a student chooses to qualify for the award of a graduate degree. Majors are listed at the end of this section of the bulletin. Opportunities also exist for majoring in more than one area of study (co-major or joint major programs).

Minor. Students may request a minor in any program approved to grant a graduate degree and in programs approved to offer only a minor. Requirements for declared minors are determined by the minor program and the faculty member representing the minor field on the student's POS committee. The minor subject area must be tested at the preliminary oral and final oral examinations. A minor cannot be added to a program of study after the preliminary oral examination has been taken, nor can a minor be placed on the transcript after graduation, unless it was approved on the program of study, listed on all examination reports, and recorded on the "Application for Graduation" form (diploma slip). A student may not minor and major in the same field. A minor cannot be added to a degree that has already been awarded.

Time Limits. A student beginning a Ph.D. degree program at Iowa State with a master's degree from another institution is expected to complete the Ph.D. within five years, while a student beginning a Ph.D. degree program without the master's degree is expected to complete the program within seven years. If warranted, the Program of Study (POS) Committee may request by letter that the Dean of the Graduate College extend these time limits. Cases in which the student leaves Iowa State during his or her graduate career and later returns are dealt with individually by the student's program of study committee and the Graduate College. The inclusion in the program of study of coursework that is beyond the time limits ("over-age" courses) must be justified by the POS committee in a statement accompanying the submission of the program of study.

Preliminary Examination. The Graduate College requires a preliminary oral examination of Ph.D. degree students; most programs add a written portion to the preliminary oral examination. The Ph.D. degree preliminary oral examination rigorously tests a graduate student's knowledge of major, minor, and supporting subject areas as well as the student's ability to analyze, organize, and present subject matter relevant to the field. A "Request for Preliminary Examination" form must be submitted to the Graduate College by the major professor at least two weeks before the proposed date of the examination.

The following conditions should be met before the "Request for Preliminary Examination" form is submitted to the Graduate College: admitted to full admission status in a Ph.D. granting program, approved "Recommendation for Committee Appointment" form, approved POS form, English requirement met, not on probation, time limit not exceeded, qualifying examination (if required by program) passed, and registration for at least the equivalent of 2 credits, or for the R-credit course GR ST 600 (Examination Only) if no course work is needed, during the term in which the preliminary oral examination is taken. (Taking only an R-credit course where the fee is not equivalent to the 2-credit minimum charge is not acceptable for the term of the preliminary oral examination.)

A preliminary oral examination will not be scheduled for a student on provisional or restricted admission or on academic probation. Upon successful completion of the preliminary oral examination, the student is admitted to candidacy for the Ph.D. degree. If the graduate student fails all or part of the preliminary oral examination, the committee provides two options: gives a not pass and allows the student to retake the examination after six months or gives a not pass and does not allow the student to retake the examination. Six months must elapse between the first attempt and the next. The entire POS committee must be convened for the preliminary oral examination. The preliminary oral examination must be passed at least six months prior to the final oral examination. An exception to the rule is allowed if a request signed by the major professor(s) and the program's DOGE is approved by the Dean of the Graduate College.

Application for Graduation. Application for graduation should be made by the end of the first week of the semester (fall or spring) in which the student expects to receive the degree, or by the last day of the spring semester if graduation is planned during summer session. To apply for graduation, the student is required to submit to the Graduate College a signed "Application for Graduation" form, available in the program office or on the web at www.grad-college.iastate.edu/forms/ forms.html. Before submitting this form, a student must have submitted and had approved by the Graduate College a "Recommendation for Committee Appointment" form and a "Program of Study" form. Also the student must have been fully admitted to a program and have met the Graduate English requirement. Graduation may be delayed if the "Application for Graduation" form filing deadline is not met. If it becomes apparent that a student cannot graduate during the indicated term, he/she should call the Graduate College (515-294-4531) and cancel the previously submitted "Application for Graduation" form. The student must then file a new form for the next planned term of graduation.

Dissertation. A doctoral dissertation must demonstrate conclusively the ability of the author to conceive, design, conduct, and interpret independent, original, and creative research. It must attempt to describe significant original contributions to the advancement of knowledge and must demonstrate the ability to organize, analyze, and interpret data. In most instances, a dissertation includes a statement of purpose, a review of pertinent literature, a presentation of methodology and results obtained, and a critical interpretation of conclusions in relation to the findings of others. When appropriate, it involves a defense of objectives, design, and analytical procedures. Dissertation research should be worthy of publication and should appear in appropriate professional journals or in book form.

Responsibility for writing and editing of the dissertation rests with the student, under the supervision of the major professor, and not with the Graduate College. The Graduate College does not permit joint authorship of dissertations. It is the responsibility of the major professor to supervise the preparation of preliminary and final drafts of the dissertation, so as to assure the highest level of quality when the student presents the dissertation to the committee for final approval. Copies of the dissertation must be submitted to the POS committee at least two weeks before the final oral examination.

All theses and dissertations will be submitted electronically after the final oral examination is held. Please browse the Graduate College's web site (http://www.grad-college.iastate.edu/thesis/homepage.html) for new requirements, revised fees, and other pertinent information.

Shortly after the submission of the "Application for Graduation" form, a one-time, nonrefundable thesis fee is billed by the university accounting system. In addition, a graduation fee will be assessed by the Registrar's Office. This fee is nonrefundable if a student does not cancel his/her graduation by the Graduate College's cancellation deadline.

Final Oral Examination. The Ph.D. final oral examination, conducted after the dissertation is finished, is oral and often limited to a defense of the dissertation. To receive the degree at the end of a given semester, the student must hold the final oral examination before the final oral examination deadline for the semester.

The candidate is responsible for initiating the "Request for Final Oral Examination" form, which must be submitted to the Graduate College at least three weeks before the examination. This form can be obtained only from the student's program/department. The entire POS committee must be convened for the final oral examination. For more information on the final oral examination, see t*he Graduate College Handbook*.

Graduate Student Approval Slip for Graduation. Every candidate for an advanced degree is required to complete a "Graduate Student Approval Slip for Graduation" form. It is sent to the major professor or program to give to the student after the "Request for Final Examination" form is received and approved by the Graduate College. Signatures are required by the major program, the Graduate College Thesis specialist, and the Graduate College. Final clearance of academic requirements will be made when current term grades have been submitted and evaluated by the Graduate College.

All incompletes from previous terms must be completed by the deadline for completion of the Graduate Student Approval Slip. An incomplete or non-report grade that a student receives for the term of graduation will result in removal from that term's graduation list. The student will need to complete a new Application for Graduation and Graduate Student Approval Slip for the new term of graduation. If a conditional pass was recommended at the final oral examination, the major professor and the committee members, if so specified, must notify the Graduate College in writing no later than the due date for the Graduate Student Approval Slip for the term of graduation that the conditions have been met.

Graduate Majors

More information on each major can be found in the Courses and Programs section of this catalog under the department or program listed in parentheses after the degree information.

Accounting: M.Acc. (see *Accounting*)

Aerospace Engineering: M.Engr., M.S., Ph.D. (see *Aerospace Engineering*)

Agricultural Economics: M.S., Ph.D. (see *Economics*)

Agricultural Education: M.S., Ph.D. (see *Agricultural Education and Studies*)

Agricultural Engineering: M. Engr., M.S., Ph.D. (see *Agricultural Engineering*)

Agricultural History and Rural Studies: Ph.D. (see *History*)

Agricultural Meteorology: M.S., Ph.D. (see *Agronomy*)

Agronomy: M.S. (see *Agronomy*)

Analytical Chemistry: M.S., Ph.D. (see *Chemistry*)

Animal Breeding and Genetics: M.S., Ph.D. (see *Animal Science*)

Animal Ecology: M.S., Ph.D. (see *Natural Resource Ecology and Management*)

Animal Physiology: M.S., Ph.D. (see *Animal Science*)

Animal Science: M.S., Ph.D. (see *Animal Science*)

Anthropology: M.A. (see *Anthropology*)

Applied Linguistics and Technology: Ph.D. (see *English*)

Applied Mathematics: M.S., Ph.D. (see *Mathematics*)

Applied Physics: M.S., Ph.D. (see *Physics and Astronomy*)

Architectural Studies: M.S. (see *Architecture*)

Architecture: M. Arch., M. Arch./M.B.A., M. Arch./M.C.R.P. (see *Architecture*)

Art and Design: M.A. (see *Art and Design*)

Astrophysics: M.S., Ph.D. (see *Physics and Astronomy*)

Biochemistry: M.S., Ph.D. (see *Biochemistry, Biophysics and Molecular Biology*)

Bioinformatics and Computational Biology: M.S., Ph.D. (see *Bioinformatics and Computational Biology*)

Biomedical Sciences: M.S., Ph.D. (see *Biomedical Sciences*)

Biophysics: M.S., Ph.D. (see *Biochemistry, Biophysics and Molecular Biology*)

Biorenewable Resources and Technology: M.S., Ph.D. (see *Biorenewable Resources and Technology*)

Botany: M.S., Ph.D. (see *Botany*)

Business: M.S. (see *Business Administration*)

Business Administration: M.B.A., M. Arch./M.B.A., M.B.A./M.C.R.P., M.B.A./M.S. (Statistics), **M.B.A./M.S** (Information Systems) (see *Business Administration*)

Business and Technology: Ph.D. (see Business and Technology)

Chemical Engineering: M. Engr., M.S., Ph.D. (see *Chemical and Biological Engineering*)

Chemistry: M.S., Ph.D. (see *Chemistry*)

Civil Engineering: M.S., Ph.D. (see *Civil Engineering*)

Community and Regional Planning: M.C.R.P., M. Arch./M.C.R.P., M.B.A./M.C.R.P., M.L.A./M.C.R.P, M.P.A./M.C.R.P. (see *Community and Regional Planning*)

Computer Engineering: M.S., Ph.D. (see *Computer Engineering*)

Computer Science: M.S., Ph.D. (see *Computer Science*)

Condensed Matter Physics: M.S., Ph.D. (see *Physics and Astronomy*)

Creative Writing and Environment: M.F.A. (see *English*)

Crop Production and Physiology: M.S., Ph.D (see *Agronomy*)

Diet and Exercise: B.S./M.S. only (see *Food Science and Human Nutrition or Health and Human Performance*)

Earth Science: M.S., Ph. D. (see *Geological and Atmospheric Sciences*)

Ecology and Evolutionary Biology: M.S., Ph.D. (see *Ecology and Evolutionary Biology*)

Economics: M.S., Ph.D. (see *Economics*)

Education: M.Ed., M.Ed. Practitioner, M.S., Ph.D. (see *Curriculum and Instruction, Educational Leadership and Policy Studies*)

Electrical Engineering: M.S., Ph.D. (see *Electrical Engineering*)

Engineering Mechanics: M.Engr., M.S., Ph.D. (see *Engineering Mechanics*)

English: M.A. (see *English*)

Entomology: M.S., Ph.D. (see *Entomology*)

Environmental Science: M.S., Ph.D. (see *Environmental Science*)

Family and Consumer Sciences: M.F.C.S. (see *Family and Consumer Sciences, Master of*)

Family and Consumer Sciences Education: M.Ed., M.S., Ph.D (see *Family and Consumer Sciences Education and Studies*)

Fisheries Biology: M.S., Ph. D. (see *Natural Resource Ecology and Management*)

Food Science and Technology: M.S., Ph.D. (see *Food Science and Human Nutrition*)

Foodservice and Lodging Management: M.S., Ph.D. (see *Hotel, Restaurant, and Institution Management*)

Forestry: M.S., Ph.D. (see *Natural Resource Ecology and Management*)

Genetics: M.S., Ph.D. (see Genetics—Interdisciplinary)

Geology: M.S., Ph.D. (see *Geological and Atmospheric Sciences*)

Graphic Design: M.F.A. (see *Art and Design*)

High Energy Physics: M.S., Ph.D. (see *Physics and Astronomy*)

History: M.A. (see *History*)

History of Technology and Science: M.A., Ph.D. (see *History*)

Horticulture: M.S., Ph.D. (see *Horticulture*)

Human Computer Interaction: M.S., Ph.D. (see *Human Computer Interaction*)

Human Development and Family Studies: M.S., Ph.D. (see *Human Development and Family Studies*)

Immunobiology: M.S., Ph.D. (see *Immunobiology*)

Industrial and Agricultural Technology: M.S., Ph.D. (see *Technology Systems Management*)

Industrial Engineering: M.S., Ph.D. (see *Industrial Engineering*)

Information Assurance: M.S., M.S./M.P.A. (see *Information Assurance*)

Information Systems: M.S., M.S./M.B.A. (see *Management Information Systems*)

Inorganic Chemistry: M.S., Ph.D. (see *Chemistry*)

Integrated Visual Arts: M.F.A. (see *Art and Design*)

Interdisciplinary Graduate Studies: M.A., M.S (see *Interdisciplinary Graduate Studies*)

Interior Design: M.F.A. (see *Art and Design*)

Journalism and Mass Communication: M.S. (see *Journalism and Communication, Greenlee School of*)

Kinesiology: M.S., Ph.D. (see *Kinesiology*)

Landscape Architecture: M.L.A., M.L.A./M.C.R.P. (see *Landscape Architecture*)

Materials Science and Engineering: M.S., Ph.D. (see *Materials Science and Engineering*)

Mathematics: M.S., Ph.D. (see *Mathematics*)

Meat Science: M.S., Ph.D. (see *Animal Science, Food Science and Human Nutrition* (offered as Ph.D. only jointly with Animal Science))

Mechanical Engineering: M.S., Ph.D. (see *Mechanical Engineering*)

Meteorology: M.S., Ph.D. (see *Geological and Atmospheric Sciences*)

Microbiology: M.S., Ph.D. (see *Microbiology*)

Molecular, Cellular, and Developmental Biology: M.S., Ph.D. (see *Molecular, Cellular, and Developmental Biology*)

Neuroscience: M.S., Ph.D. (see *Neuroscience*)

Nuclear Physics: M.S., Ph.D. (see *Physics and Astronomy*)

Nutritional Sciences: M.S., Ph.D. (see *Nutritional Sciences*)

Operations Research (must be a joint major with Statistics): M.S. (see *Industrial Engineering/Statistics*)

Organic Chemistry: M.S., Ph.D. (see *Chemistry*)

Physical Chemistry: M.S., Ph.D. (see *Chemistry*)

Physics: M.S., Ph.D. (see *Physics and Astronomy*)

Plant Breeding: M.S., Ph.D. (see *Agronomy*)

Plant Pathology: M.S., Ph.D. (see *Plant Pathology*)

Plant Biology: M.S., Ph.D. (see *Plant Physiology*)

Political Science: M.A., (see *Political Science*)

Professional Agriculture: M.Ag. (see *Professional Agriculture*)

Psychology: M.S., Ph.D. (see *Psychology*)

Public Administration: M.P.A., M.P.A./M.C.R.P., M.P.A./M.S. (Information Assurance) (see *Political Science*)

Rhetoric and Professional Communication: Ph.D. (see *English*)

Rhetoric, Composition, and Professional Communication: M.A. (see *English*)

Rural Sociology: M.S., Ph.D. (see *Sociology*)

School Mathematics: M.S.M. (see *Mathematics*)

Science Education: M.A.T. (see *Curriculum and Instruction*)

Seed Technology and Business: M.S. (see *Seed Technology and Business*)

Sociology: M.S., Ph.D. (see *Sociology*)

Soil Science: M.S., Ph.D. (see *Agronomy*)

Statistics: M.S., M.B.A./M.S., Ph.D. (see *Statistics*)

Sustainable Agriculture: M.S., Ph.D. (see *Sustainable Agriculture*)

Systems Engineering: M.Engr. (see *Systems Engineering*)

Teaching English as a Second Language/Applied Linguistics: M.A. (see *English*)

Textiles and Clothing: M.S., Ph.D. (see *Textiles and Clothing*)

Toxicology: M.S., Ph.D. (see *Toxicology*)

Transportation: M.S. (see *Transportation*)

Veterinary Clinical Sciences: M.S. (see *Veterinary Clinical Science*)

Veterinary Microbiology: M.S., Ph.D. (see *Veterinary Microbiology and Preventive Medicine*)

Veterinary Pathology: M.S., Ph.D. (see *Veterinary Pathology*)

Veterinary Preventive Medicine: M.S. (see *Veterinary Diagnostic and Animal Production Medicine*)

Wildlife Biology: M.S., Ph.D. (see *Natural Resource Ecology and Management*)

Zoology: M.S., Ph.D (see *Zoology*)

Declared Minors

(in addition to the majors above which can also be minors)

Complex Adaptive Systems (see *Complex Adaptive Systems*)

Gerontology (see *Gerontology*)

Philosophy (see *Philosophy and Religious Studies*)

French (see *World Languages and Cultures*)

German (see *World Languages and Cultures*)

Latin (see *World Languages and Cultures*)

Linguistics (see *Linguistics*)

Russian (see *World Languages and Cultures*)

Spanish (see *World Languages and Cultures*)

Speech Communication (see *Speech Communication*)

Technology and Social Change (see *Technology and Social Change*)

Women's Studies (see *Women's Studies*)

Graduate Certificate Programs

A graduate certificate provides a mechanism for bestowing formal recognition of focused graduate study in a specialized area that is less comprehensive than required for a master's degree. At Iowa State University, a graduate certificate may be earned either before, after, or concurrently with the master's or doctoral degree. For more detailed information on certificate programs, browse the Graduate College web site at: www.grad-college.iastate.edu/publications/gchandbook/appendixd.html.

Advanced Medical Nutrition Therapy Certificate (see *http://www.fshn.hs.iastate.edu/grad/certificate.php*)

Biorenewable Resources and Technology Certificate (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/BRT-GradCert.html*)

Community College Leadership Certification (see www.cclp.hs.iastate.edu/)

Community College Teaching (see *http://www.cclp.hs.iastate.edu/teaching_learning.html*)

Dietetics Communication and Counseling Certificate (see *http://www.fshn.hs.iastate.edu/grad/certificate.php*)

Dietetics Management Certificate (see *http://www.fshn.hs.iastate.edu/grad/certificate.php*)

Environmental Engineering Certificate (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/environmental.html)*

Family Financial Planning Certificate (see *http://www.hs.iastate.edu/online/mfcs/ffp/homepage.php*)

Food Safety and Defense Graduate Certificate (see *http://www.fshn.hs.iastate.edu/grad/foodsafetycert.php*)

Forensic Sciences Certificate (see *http://www.chem.iastate.edu/certificate/)*

Gerontology Certificate (see *http://www.hs.iastate.edu/online/mfcs/gerontology/homepage.php*)

Geographic Information Systems Certificate (see *www.design.iastate.edu/GIS/*)

Graduate Student Teaching Certificate (see *http://www.celt.iastate.edu/gstc/homepage.html*)

Human Computer Interaction (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/hci.html*)

Information Assurance Certificate (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/infas.html*)

Power Systems Engineering Certificate (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/powersystems.html*)

Principal Licensure (Pre-LEAD) (see *http://www.elps.hs.iastate.edu/edadm/edadmhmpg3-prelead.php*)

Public Management Certificate (see *www.pols.iastate.edu/mpa.shtml*)

Seed Business Management (see *http://www.seeds.iastate.edu/class/certificates.htm*)

Seed Science and Technology (see *http://www.seeds.iastate.edu/class/certificates.htm)*

Special Education Certificate (see *http://www.teacher.hs.iastate.edu/addtnl_endorsements.php)*

Superintendent Licensure (see *www.elps.hs.iastate.edu/edadm/edadmhmpg3-acad.php)*

Systems Engineering (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/syscert.html*)

TESL (Teaching English as a Second Language) Certificate (see *http://www.public.iastate.edu/~apling/TESL_cert.html*)

First-Year Honors Program. Entering first-year students with outstanding high school records and academic ability may be eligible to participate in the First-Year Honors Program (FHP). The FHP, which is designed to introduce students to an honors education, consists of special honors sections of English 250 and Library 160, a FHP Seminar, and advising by honors advisers. Students may also choose to participate in the Honors Mentor Program, designed to introduce students to scholarship. Participants select an area of interest and are matched with faculty members conducting research in that area. Admission to the FHP is limited, and is based on past academic achievement, potential, and interest in an honors education.

Further information. Further information concerning the University Honors Program and the First-Year Honors Program can be obtained from the Honors Program Office in Jischke Honors Building or on the Honors webpage, www.honors.iastate.edu.

Dual-degree Programs

Students who complete the first three years in certain curricula at Iowa State and who satisfactorily complete the first year in a recognized medical, dental, veterinary medical, or law curriculum may then be awarded a bachelor's degree from Iowa State. (See Index, *Preprofessional Study.)*

Iowa Lakeside Laboratory

Iowa Lakeside Laboratory is an off-campus teaching and research facility situated on a 140-acre campus on West Okoboji Lake in Northwest Iowa. It is run cooperatively by Iowa State University, the University of Iowa, the University of Northern Iowa, and Drake University. Each summer Iowa State University students can take up to three undergraduate and/or graduate courses in archaeology, biology, ecology, environmental science, and/or geology for credit at Lakeside (see course listings under Iowa Lakeside Laboratory). All Lakeside courses are small, full-immersion, field-oriented courses that run for 1-4 weeks. Lakeside also offers a variety of short courses for teachers and a series of nontechnical short courses on various aspects of the natural history of Iowa. Information about Lakeside courses as well as registration and housing information can be obtained from the Biology Program Office, 103 Bessey Hall or on the Lakeside Web site, www.lakesidelab.org.

Regent Universities Student Exchange Program

Iowa State University students may take courses at either of the other two Regent universities for Iowa State resident credit. Regular, degree-bound students in good standing at any of the three Regent universities may attend another Regent university for a maximum of two semesters, and the credits earned at the other university will be counted as resident credit at the home institution. Approval for participation and credit in the exchange program must be obtained well in advance of registration since the department head must approve the acceptance of such credits if these are to apply to the major, and to ensure complete processing of the application between the cooperating universities within specified dates for enrollment. Detailed information and application forms for the exchange program are available from the Office of the Registrar.

National Student Exchange (NSE)

Iowa State University is a member of National Student Exchange. The NSE Consortium has 200 colleges and universities throughout North America providing academic and experiential exchange opportunities. Iowa State students with a cumulative GPA of at least 2.50 are eligible to apply. Credits earned as an NSE participant will be recorded on the students Iowa State transcript. Approval for credit in the NSE program should be sought from a student's academic adviser in advance of application. Detailed information and applications forms are available from:

National Student Exchange
1080 Hixson-Lied Student Success Center
(515) 294-6479
nse@iastate.edu
www.dso.edu/~nse

Study Abroad

Our planet is in a constant state of change, and occurrences in remote corners of the globe can profoundly impact our lives. It is clear from the effects of global warming, international trade, terrorism, and pandemics of one nature or the other that we cannot ignore what is happening beyond our shores and borders. Students who graduate without an understanding of other cultures, languages, business practices, and political systems are disadvan00taged both educationally and professionally. Studying abroad helps prepare students to meet the challenges of an increasingly interdependent global community. Further, study abroad is an adventure that challenges the student academically and provides real opportunities to interact with other cultures, languages, and lifestyles.

As a leading international university, Iowa State has a major commitment to study abroad, and the Study Abroad Center is the central administrative office responsible for providing these opportunities. We offer advising on study abroad, international internships, work, volunteer opportunities, and service-learning, and scholarships. The Center's library has a fine selection of travel books, information on international careers, cross-cultural orientation, social and business customs around the world, and travel bargains. The International Student Identity Card and passport photographs can also be obtained at the Center.

With over 250 study abroad programs available, from one week to an academic year in length and in nearly every major, students are able to find a program that meets their needs and interests so they can discover for themselves why study abroad is the most exciting academic adventure.

Exchange Programs offer students the opportunity to study abroad at a partner university while paying Iowa State tuition.

Semester in Australia, Canada, Greece, Ireland, Italy, New Zealand, or UK offers unlimited placement opportunities for students to study at some of our most popular destinations for the fall, spring, and in some cases summer.

Intensive Language Programs offer students a total immersion experience in French, German, Russian, or Spanish by studying in Québec, Canada (French), France, Germany, Russia, Mexico, Peru, or Spain. Summer and semester programs are available.

Group Programs led by our faculty offer Iowa State courses around the world. Short-term options can take you from the Antarctic to England and to more than 40 other destinations.

For additional information, contact:

Study Abroad
3224 Memorial Union
(515 294-6792)
www.studyabroad.iastate.edu

Courses and Programs

Information About Courses

Course Numbers

The courses in each department are numbered from 1 to 699, according to the following groups:

1-99	Courses not carrying credit toward a degree (zero credit).
100-299	Courses primarily for freshman and sophomore students.
300-499	Courses primarily for junior and senior students.
500-599	Courses primarily for graduate students, but open to qualified undergraduates.
600-699	Courses for graduate students.

Credits and Contact Hours

The academic value of each course is stated in semester credits. Each credit is normally earned by attending one (50-minute) hour of lecture or recitation per week for the entire semester, or by attending a laboratory or studio period of two or three hours per week. As a guideline, undergraduate students typically will be expected to spend two hours in preparation outside of class for each lecture or recitation hour; additional outside work may be required for laboratory or studio classes.

Each course states the number of semester credits assigned to the course, preceded in parentheses by the number of hours in class (contact hours) expected of the student. The first of the two contact-hour numbers indicates the number of lecture or recitation class hours per week for the semester. The second is the number of laboratory or studio hours required per week. Laboratory and studio hours may include some time devoted to lectures and recitations. For example, Com S 103 is listed as (3-2) Cr. 4. In that case, the course is 4 semester credits, 3 hours of lecture and two hours of laboratory each week.

The term "Cr. arr." means that the amount of credit is arranged in advance between the student and the instructor. The credit to be earned depends on the amount of work expected of the student, in accordance with the policy that some combination of teacher-student contact and outside work by the student involving at least three hours per week for the semester is required for each credit.

The term "Cr. R." means that the course is required in a certain curriculum or as cognate to one or more other courses. It is also used for cooperative education courses and for some optional inspection trips, study tours, and professional development courses for which numerical credit is not granted. An R credit course does not carry numerical credit toward a student's degree, but it does apply toward the degree. The R credit course is generally listed on the degree program as a requirement for a specific curriculum/major that must be completed prior to graduation. R credit courses may be graded using the A-F grading scale or the satisfactory/fail grading scale. All R credit courses are assigned a numerical value for purposes of enrollment certification. Requests by students to drop an R credit course will be processed as an administrative drop during period 2 and thus will not be counted against the student's drop limit and will not appear on the student's transcript. (*See Index, Schedule Changes.*)

Semester of Offering

Within each course description may be found one or more of the following letters: F. S. SS., indicating which term—fall, spring, summer session—of the academic year the course is offered. "Alt." is the abbreviation for alternate. If there is sufficient demand, courses may be offered more frequently than announced. Insufficient demand or unforeseen staffing problems may result in the cancellation of announced offerings. Students are advised to refer to the Schedule of Classes or consult with departments for up-to-date course schedule information.

Course Prerequisite

A prerequisite indicates the specific academic background or general academic maturity considered necessary for the student to be ready to undertake the course. Prerequisites are usually stated in terms of specific courses, but equivalent preparation is usually acceptable. An instructor may, however, direct a student whose background does not meet the stated prerequisite, or its equivalent, to drop the course. Conversely, an instructor may waive the prerequisite for a course for which he or she is responsible. Thus, permission of the instructor is understood to be an alternate to the stated prerequisites in all courses.

It is university policy that the instructor shall inform- the students at the beginning of each course if students who have not met the prerequisite requirements must drop the course. Course prerequisites are listed in the Schedule of Classes as well as in the Courses and Programs section of this publication.

Cross-listed Courses

A course, including its complete description, may be listed in two or more departments. The participating department or departments are noted in parentheses. Credit for the course may be obtained through any of the cross-listed departments.

Designators/Course Abbreviations

For abbreviations for designating departments and programs See *Index, Designators.*

Dual-listed Courses

Dual-listed courses permit undergraduate and graduate students to be in the same class but to receive credit under two different course numbers. Credit in the graduate course is not available to students who have received credit in the corresponding undergraduate course. Both graduates and undergraduates receive the same amount of credit for the course, but additional work is required of all graduate students taking the course under the graduate-level course number. This extra work may take the form of additional reading, projects, examinations, or other assignments as determined by the instructor. The instructor must be a member of the Graduate Faculty or a Graduate Lecturer. Each dual-listed course is designated in the catalog with the phrase "Dual-listed with," although the student's official transcript of credits, both graduate and undergraduate, does not identify dual-listed courses as such. There is a limit to the number of dual-listed course credits that may be used to meet the requirement for an advanced degree. (For information about procedures for requesting permission to offer dual-listed courses, faculty should consult the *Graduate Faculty Handbook*.)

Off-campus courses-Residential Credit

Iowa State University offers distance education courses over the Iowa Communications Network (ICN), by videotape and on the World Wide Web. These courses are the same as those offered on campus, carry residential credit, and are taught by ISU faculty members. Credit earned in off-campus courses becomes a part of the student's academic record at Iowa State University and may be used to meet degree requirements in the same manner as credit earned on campus.

Priority Enrollment

High demand for courses in certain areas has necessitated enrollment management for some courses. When enrollment priority is established for a course, first consideration is given to students whose curriculum/major explicitly requires the course.

Special Course Fees

Courses for which special course fees are assessed are designated in the *Schedule of Classes*. Special course fees may be assessed for such extraordinary costs as materials fees (which may include consumable materials or equipment replacement), field trip expenses, developmental Math fees, and camp fees. In some cases, special course fee amounts vary from term to term. Additional information on camp fees and the developmental Math fee may be found in the fees and expenses section. See *Index, Fees.*

Graduate Programs

Graduate Major

A major in the Graduate College is the area of academic professional concentration, approved by the Board of Regents, in which the student chooses to qualify for the award of a graduate degree.

Graduate Area of Specialization

Areas of specialization are indicated in the graduate statements of some departments. This is a subdivision of a major in which a strong graduate-level program is available. When approved by the Graduate College, such areas of specialization are shown parenthetically after the major on official records, including transcripts and thesis/dissertation title pages.

Interdepartmental Programs

Interdepartmental programs are available at both graduate and undergraduate levels. An interdepartmental program is an administrative structure usually not functioning as a department, ordinarily headed by a supervisory committee, and offering a degree with major(s) in that subject area. Interdepartmental programs have been officially approved and may offer courses.

Nonmajor Graduate Credit

All courses included on the Program of Study of a graduate student must be approved by the student's program of study committee. Usually courses in the major are selected from 500- and 600- level courses in the major. Courses outside of the major can be selected from other 500- and 600- level courses and from 300- and 400- level courses which have been approved for nonmajor graduate credit. In the catalog, the approved 300- and 400- level courses are indicated by the words "Nonmajor graduate credit" in the course description.

Accounting

Marvin L. Bouillon, Chair of Department

Professors: Hira, Ravenscroft

Professors (Emeritus): Brown, Elvik, Handy

Associate Professors: Bouillon, Dilla, Doran, Jeffrey, Kurtenbach

Associate Professors (Emeritus): Murphy

Assistant Professors: Denison, Gary, Janvrin, No, Terando

Assistant Professors (Adjunct): Curtis

Instructors (Adjunct): Duffy, Mazzitelli

Senior Lecturer: Clem

Lecturer: Christensen, Hashmi, Whittle

Undergraduate Study

For undergraduate curriculum in business, major in accounting, see *College of Business, Curricula*.

The primary purpose of accounting is to provide relevant information to both internal users (management) and external users such as investors, creditors, government, and the general public. Accounting is an integral part of the management of business and public organizations. Accountants, therefore, participate in planning, evaluating, and controlling the activities of the firm. Accounting is needed by external users in order to make investment decisions, grant or withhold credit, and, in the case of government, to collect revenue and gather statistical information. In order to provide useful information, accountants collect, analyze, synthesize, and report data in an understandable manner.

The instructional objective of the Accounting Program is to provide a well-rounded professional education in accounting. Such an education should provide the student with: (1) a mastery of basic accounting concepts; (2) an ability to think critically and creatively about accounting problems; (3) an ability to communicate effectively and work with others as a member of a team; (4) an awareness and sensitivity for dealing with ethical concerns.

The major in accounting is designed to give students a conceptual foundation as well as to provide a wide range of basic skills and analytical tools for use in reporting for both public and private concerns. Students who complete the accounting major are well prepared to accept positions in industry, government, and the public accounting profession. The requirements for the accounting major are met by successful completion of the following courses: Acct 383, 384, 386, 387, 485, and 497. See the CPA note below for the 150-hour education requirement for CPA certification in Iowa.

In addition, it is highly recommended that an accounting major include Business Law II (Acct 316). The Department of Accounting should be consulted for information on specific alternative plans of study.

The department also offers a minor for College of Business students with a different major. They are required to take 15 credits from a list of approved courses, of which 9 credits need to be stand alone.

CPA Note: In addition to the 18 credits of accounting required for the accounting major, candidates for the CPA exam must complete two additional accounting courses to sit for the CPA exam, for a total of 24 hours beyond principles. Students may use the electives shown above or petition to take graduate courses to fulfill the additional six hours. Business Law II (Accounting 316) is also highly recommended; please note this class does not count towards the aforementioned 24 hours required to sit for the exam. In order to be certified or licensed to practice in Iowa, students must complete 150 credits. Qualified students should consider taking the Master of Accounting to satisfy the 150-credit requirement. Juniors and seniors in accounting who are interested in graduate study should contact the Coordinator of the MAcc Program so you may complete your graduate degree in an efficient manner. For states outside Iowa, be sure to check local rules, as each state determines its own licensing requirements.

Graduate Study

The department offers work for a graduate degree - the masters of accounting (M.Acc.). This is a 30-hour degree, with an optional creative components. The program requires 15 hours of graduate accounting courses, at least 9 hours of nonaccounting graduate electives, a communications course and an international course from an approved list. Students who choose the creative component option may replace two required hours of accounting with the creative component. Included in the 15 required hours of graduate accounting courses is a 3-credit required course, Acct 598. The M.Acc. is appropriate for any student wanting to pursue a variety of accounting careers. The M.Acc. program is an efficient way for qualified candidates to meet the 150-hour education requirement for CPA certification in Iowa.

The department participates in the M.B.A. full-time and part-time programs. The M.B.A. program is a 48-credit, nonthesis, noncreative component curriculum. Twenty four of the 48 credits are core courses and the remaining 24 are graduate electives.

Within the M.B.A. program, students may develop an area of specialization in accounting. This specialization requires that 12 of the 24 credits of graduate electives be from accounting.

The specialization in accounting is designed to help meet the 150 hour education requirement for CPA certification in Iowa.

Courses primarily for undergraduate students

Acct 215. Legal Environment of Business. (3-0) Cr. 3. F.S.SS. *Prereq: Sophomore classification.* General history, structure, and principles of law. The legal system, as an agency of social control; good business practices, and tool for change. The court systems, Constitution, torts, contracts, administrative agencies, and agency law.

Acct 284. Financial Accounting. (3-0) Cr. 3. F.S.SS. *Prereq: 15 hours of credit at ISU or sophomore standing.* Introduction to the basic concepts and procedures of financial accounting from a user perspective. The course examines the accounting cycle, business terminology, basic control procedures, and the preparation and evaluation of financial reports, with an emphasis on financial statement analysis.

Acct 285. Managerial Accounting. (3-0) Cr. 3. F.S.SS. *Prereq: 284.* Preparation and use of internal managerial reports for decision-making, planning and performance evaluation.

Acct 316. Business Law. (3-0) Cr. 3. F.S. *Prereq: 215.* Continuation of 215. Sales under the Uniform Commercial Code, negotiable instruments, secured transactions, property transactions, partnerships, and wills and estates.

Acct 383. Intermediate Managerial Accounting. (3-0) Cr. 3. F.S. *Prereq: 285 or 508.* Generation, communication and use of information to assist management with planning, control, and decision making in manufacturing and service organizations. Includes traditional and contemporary models of cost estimation, assignment, and control, responsibility accounting, and nonrecurring decisions. Emphasis on developing written and oral communication skills, as well as spreadsheet capabilities.

Acct 384. Accounting Information Systems. (3-0) Cr. 3. *Prereq: 285.* Analysis of concepts and procedures underlying the automated accumulation and processing of accounting data. EDP internal control and audit techniques. Trends in accounting information systems.

Acct 386. Intermediate Accounting I. (3-0) Cr. 3. F.S. *Prereq: 285 or 508.* The conceptual framework of financial accounting. Communication of financial information on the income and retained earnings statements, statement of cash flows, and the balance sheet. Accounting concepts relating to current and operational assets of the firm.

Acct 387. Intermediate Accounting II. (3-0) Cr. 3. F.S. *Prereq: 386.* Financial accounting and reporting practices for business entities. Generally accepted accounting principles (GAAP) relative to firm liabilities, equity, income, taxes, employee benefits, leases, accounting changes and cash flows. Discussion of current issues in financial accounting.

Acct 483. Advanced Managerial Accounting. (Dual-listed with 583). (3-0) Cr. 3. *Prereq: 383 or 581.* Business simulation focusing on generation and communication of information to assist management with financial decision-making. Emphasis on developing teamwork, written communication, and oral presentation skills.

Acct 485. Principles of Federal Income Tax. (3-0) Cr. 3. F.S. *Prereq: 285 or 508.* An introduction to the fundamentals of income tax related to entities and individual taxpayers, and concepts applicable to all tax entities. Depreciation, like-kind exchanges, and capital gain treatment. Transaction planning to maximize participation in preferential tax opportunities. Nonmajor graduate credit.

Acct 486. Volunteer Income Tax Assistance. (0-2) Cr. 1. Repeatable. S. *Prereq: 284.* Introduction to and field work in the preparation of individual income tax returns (state and federal). Basic coverage of filing and residency Status, taxable income, exemptions, deductions, and credits. Tax software usage and online filing.

Acct 488. Governmental and Non-profit Institution Accounting. (3-0) Cr. 3. *Prereq: 387.* Budgeting, accounting, auditing, and financial reporting principles associated with private and public nonprofit organizations. Includes survey of state, local, municipal, and federal government accounting, as well as accounting for colleges, universities, public schools, health care facilities, voluntary health and welfare organizations and other not for profit entities. Nonmajor graduate credit.

Acct 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: 285, senior classification, permission of instructor.*

Acct 495. Advanced Accounting Problems. (Dual-listed with 595). (3-0) Cr. 3. *Prereq: 387.* Partnerships, branch operations, accounting for business combinations and affiliated companies, consolidated financial statements; reporting for multinational operations. Nonmajor graduate credit.

Acct 497. Introduction to Auditing. (3-0) Cr. 3. F.S. *Prereq: 384, 387 and Stat 326.* The conceptual framework of auditing. Professional ethics. External reporting concepts. Audit methodology including risk analysis, internal control, procedures for gathering evidence and the role of Statistical sampling in auditing. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Acct 508. Survey of Financial Accounting. (2-0) Cr. 2. *Prereq: Graduate classification.* A general introduction to financial accounting information. Financial

topics covered include the use and analysis of financial information, the regulatory environment, and the use of the internet and electronic spreadsheets as a means of accessing and analyzing financial data.

Acct 533. Data Management for Decision Makers. (Cross-listed with MIS). (3-0) Cr. 3. *Prereq: MIS 503.* Addresses data needs of functions such as marketing, finance, and production. Advanced skills needed to design, develop and use database, data warehousing and data mining systems for effective decision support. Emphasis on importance of contemporary technologies.

Acct 581. Accounting for Decision Making. (3-0) Cr. 3. *Prereq: 508 or equivalent.* Decision analysis applied to managerial accounting issues. Generation of information for management decision making and control. Responsibility accounting and non-recurring decisions.

Acct 582. Corporate Governance and Leadership. (Cross-listed with Mgmt). (3-0) Cr. 3. *Prereq: Mgmt 502 or permission.* Examination of top managers and corporate boards of directors in terms of roles, responsibilities, and tasks. Examination of corporate governance structure and functioning. Topics include CEO tenure and compensation, board monitoring and composition, board responsibility and accountability, board structure and performance, CEO and board roles in strategic management, shareholder and stakeholder representation, corporate social responsibility, ethics and corporate governance, international governance, and executive leadership style.

Acct 583. Advanced Managerial Accounting. (Dual-listed with 483). (3-0) Cr. 3. *Prereq: 383 or 581.* Business simulation focusing on generation and communication of information to assist management with financial decision-making. Emphasis on developing teamwork, written communication, and oral presentation skills.

Acct 585. Tax Implications of Business Decisions. (3-0) Cr. 3. *Prereq: 485.* The impact of federal tax legislation on the formation, operation and liquidation or reorganization of entities. Income-tax planning for executives.

Acct 586. Advanced Federal Taxation. (3-0) Cr. 3. F.S. *Prereq: 485.* Advanced topics in Federal Taxation. An in-depth study of partnership, corporation, fiduciary, and estate and give taxation. Tax administration, practice and tax planning are covered. Strongly recommended for those who plan a career in public accounting or taxation.

Acct 588. Governmental and Non-profit Institution Accounting. (3-0) Cr. 3. *Prereq: 387 or 592.* Budgeting, accounting, auditing, and financial reporting principles associated with private and public nonprofit organizations. Includes survey of state, local, municipal and federal government accounting, as well as accounting for colleges, universities, public schools, health care facilities, voluntary health and welfare organizations and other not for profit entities.

Acct 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor. For students* wishing to do individual research in a particular area of accounting.

Acct 591. Fraud Examination and Prevention. (3-0) Cr. 3. *Prereq: 497 or 508.* Principles and methodology of fraud detection and deterrence. Addresses the following: Causes and elements of fraud, costs to society, asset theft, financial statement representation, internal controls for fraud prevention, evidence gathering, and legal aspects of fraud.

Acct 592. Financial statement Analysis. (3-0) Cr. 3. *Prereq: 284 or 508.* The presentation and analysis of financial statement information from the point of view of the primary users of such data: owners and creditors. Topics covered will include the financial reporting system, the primary financial statements, and effects of accounting method choice on reported financial data, and firm valuation.

Acct 594. Business Valuation. (3-0) Cr. 3. *Prereq: 387 or 592.* Using financial statement analysis to value the firm. Topics covered include assessing how well a firm's financial statements reflect the economic effects of its resource management strategies and constructing proforma financial information that will serve as inputs to valuation models.

Acct 595. Advanced Accounting Problems. (Dual-listed with 495). (3-0) Cr. 3. *Prereq: 387.* Partnerships, branch operations, accounting for business combinations and affiliated companies, consolidated financial statements; reporting for multinational operations.

Acct 596. International Accounting. (3-0) Cr. 3. *Prereq: 386 or 508.* Accounting and reporting requirements and managerial issues faced by multinational corporations. The international environment of standard setting will be examined. Technical issues such as transfer pricing, inflation accounting and taxation will be discussed.

Acct 597. Advanced Auditing and Assurance Services. (3-0) Cr. 3. *Prereq: 497.* A study of advanced auditing and assurance issues. Topics include risk analysis, internal control, fraud detection, analytical procedures, evaluating operational and strategic objectives, and reporting and implementing audit findings.

Acct 598. Financial Accounting: Theory and Contemporary Issues. (3-0) Cr. 3. F. *Prereq: 387 or 592.* Theoretical discussion of the financial accounting and reporting environment. The usefulness of financial accounting information for decision making will be examined. A number of current financial accounting issues and the financial accounting standard setting process will be discussed and examined. MAcc students should take this course during their last semester.

Acct 599. Creative Component. Cr. 2. *Prereq: Admission to the Master of Accounting Program*. This course prepares students to complete their creative component project option in the Master of Accounting degree.

Aerospace Engineering

Thomas Shih, Chair of Department

Distinguished Professors: Soukoulis, R. B. Thompson

Distinguished Professors (Emeritus): D. Thompson, Young

Professors: Chandra, Chimenti, Durbin, Holger, Kelkar, Levitas, Lu, Oliver, Rajagopalan, Rothmayer, Rudolphi, Sarkar, Schmerr, Shih, Takle, Wang, Wie, Zachary

Professors (Emeritus): Akers, Greer, Inger, Iversen, Jenison, McConnell, McDaniel, Munson, Pierson, Rizzo, Rogge, Rohach, Tannehill, Tsai, Weiss, Wilson

Professors (Adjunct): Hsu, Nakagawa

Associate Professors: Bastawros, Bryden, Dayal, Hilliard, Hindman, Mitra, Sherman, Sturges

Associate Professors (Emeritus): Hermann, Seversike, Trulin, Vogel

Associate Professors (Adjunct): Biner, Cox, Roberts

Associate Professors (Collaborators): Flatau

Assistant Professors: Chung, Holland, Hong, Hu, Jacobson

Assistant Professors (Adjunct): Byrd, Gray

Assistant Professors (Collaborators): Chavez

Senior Lecturers: Deam, Haugli, Schaefer

Lecturers: Boylan

Undergraduate Study

For undergraduate curriculum in aerospace engineering leading to the degree bachelor of science, see College of Engineering, Curricula. This curriculum is accredited by the Engineering Accreditation Commission of ABET.

The aerospace engineer is primarily concerned with the design, analysis, testing, and overall operation of vehicles which operate in air, water, and space. The curriculum is designed to provide the student with an education in the fundamental principles of aerodynamics, flight dynamics, propulsion, structural mechanics, flight controls, design, testing, and space technologies. A wide variety of opportunities awaits the aerospace engineering graduate in research, development, design, production, sales, and management in the aerospace industry, and in many related industries in which fluid flow, control, and transportation problems play major roles.

A cooperative education program in aerospace engineering is available in cooperation with government agencies and industry. The usual four-year curriculum is extended over a five-year span to permit alternating industrial experience periods and academic periods. This arrangement offers valuable practical experience and financial assistance during the college years. See *College of Engineering, Cooperative Programs.*

Undergraduate Mission and Educational Objectives

The Department of Aerospace Engineering maintains an internationally recognized academic program in aerospace engineering via ongoing consultation with students, faculty, industry, and aerospace professionals. Results of these consultations are used in a process of continuous academic improvement to provide the best possible education for our students.

Mission statement: The mission of the aerospace engineering program is to prepare the aerospace engineering student for a career with wide-ranging opportunities in research, development, design, production, sales, and management in the aerospace industry and in the many related industries which are involved with the solution of multi-disciplinary, advanced technology problems.

Program Educational Objectives:

Graduates should be actively contributing, valued members in their chosen profession showing continued professional growth.

Graduates should use their strong foundation in science, mathematics, and engineering to create innovative practices and/or technologies.

Graduates should demonstrate teamwork, leadership, planning, and initiative in advancing organizational goals.

Graduates should act with integrity, based on an awareness of the impact of their work –economic, environmental, and Societal impact – and work to maintain high levels of cultural adaptability.

Graduates should demonstrate critical thinking and effective, multi-modal communication skills.

Graduates should strive to learn continuously through professional improvement opportunities and self study.

Graduates should work to ensure superior quality, customer satisfaction, and safety outcomes in their work.

Nondestructive Evaluation (NDE)
The NDE minor is multidisciplinary and open to undergraduates in the College of Engineering. The minor may be earned by completing 16 credits including:
(1) MatE/E M 362 and 362L
(2) Two courses (6-7 credits) from: E M 350, Aer E/E E/E M/Mat E 490 (in the area of NDE), M S E/E M 550.
(3) Two courses (6 credits) from: Aer E 321, 421, 422, 423, 426; E E 424; E M 424, 425; Mat E 418, 443, 444; M E 417, 418; Stat 305.

A combined average grade of C or higher is required in courses applied to the minor and the minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

Graduate Study

The department offers work for the degrees master of engineering, master of science, and doctor of philosophy with major in aerospace engineering, and minor work to students taking major work in other departments. For all graduate degrees it is possible to establish a co-major program with another graduate degree granting department. Within the aerospace program, work is available in the following areas: aerospace systems design, atmospheric and space flight dynamics, computational fluid dynamics, control systems, wind engineering, fluid mechanics, optimization, structural analysis, and non-destructive evaluation.

The degrees master of science and doctor of philosophy require an acceptable thesis in addition to the coursework. For the degree master of engineering, a creative component or suitable project is required. Appropriate credit is allotted for this requirement.

Minor work for aerospace engineering majors is usually selected from mathematics, physics, electrical engineering, engineering mechanics, mechanical engineering, materials science, meteorology, computer science, and computer engineering.

The normal prerequisite to major graduate work in aerospace engineering is the completion of a curriculum substantially equivalent to that required of aerospace engineering students at this university. However, because of the diversity of interests within the graduate programs in aerospace engineering, a student whose prior undergraduate or graduate education has been in allied engineering and/or scientific fields may also qualify. In such cases, it may be necessary for the student to take additional work to provide the requisite background. A prospective graduate student is urged to specify the degree program and the specific field(s) of interest on the application for admission.

Courses normally will be offered at the times stated in the course description. Where no specific time of offering is stated, the course may be offered during any semester provided there is sufficient demand.

Courses primarily for undergraduate students

Aer E 101H. Engineering Honors Orientation. Cr. R. F. *Prereq: Membership in the Freshman Honors Program.* Introduction to the College of Engineering and the Aerospace Engineering profession. Information concerning university, college, and department policies, procedures and resources with emphasis on the Freshman Honors Program. Topics include experiential education study abroad opportunities, and department mentorships.

Aer E 112. Orientation to Learning and Productive Team Membership. (Cross-listed with FS HN, Hort, TSM, NREM). (2-0) Cr. 2. F. Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

Aer E 160. Aerospace Engineering Problems With Computer Applications Laboratory. (2-2) Cr. 3. F.S. *Prereq: Satisfactory scores on mathematics placement assessments; credit or enrollment in Math 142, 165.* Solving aerospace engineering problems and presenting solutions through technical reports. Significant figures. SI units. Graphing and curve fitting. Flowcharting. Introduction to material balances, mechanics, electrical circuits, statistics engineering economics, and design. Spreadsheet programs. Introduction to UNIX/LINUX computing environments, and programming in FORTRAN. Team projects.
H. Honors. F.

Aer E 161. Numerical, Graphical and Laboratory Techniques for Aerospace Engineering. (3-2) Cr. 4. F.S. *Prereq: 160 or equivalent course.* Computer solutions to aerospace engineering problems using the FORTRAN language and Matlab(R), with emphasis on numerical methods. Introduction to computing environments including UNIX/LINUX. Graphical description of geometrical objects with emphasis on aerospace design. Solid modeling using computer graphics software. Develop proficiency with basic instrumentation utilized in subsequent Aerospace Engineering laboratory courses. Computational and Statistical analysis of lab results. Written and oral technical reports, team projects.
H. Honors. S.

Aer E 192. Aerospace Seminar. Cr. R. S. (1-0) Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities, specifically experiential learning and study abroad. Academic program planning, departmental symposium participation.
H. Honors.

Aer E 243. Aerodynamics I. (3-0) Cr. 3. F.S. *Prereq: Grade of C- or better in 261, Math 265, enrollment in 243L.* Introduction to fluid mechanics and aerodynamics. Fluid properties, statics, and kinematics. Conservation equations in differential and integral form. Bernoulli's equation. Dimensional analysis. Basic potential flow concepts and solutions. Examples of numerical methods. Applications of multi-variable calculus to fluid mechanics and aerodynamics.

Aer E 243L. Aerodynamics Laboratory I. (0-3) Cr. 0.5. F.S. *Prereq: Enrollment in 243.* Introduction to fluid dynamic principles and instruments in aerodynamics through laboratory studies and experiments. Report writing.

Aer E 261. Introduction to Performance and Design. (4-0) Cr. 4. F.S. *Prereq: 161, Math 166, Phys 221.* Introduction to aerospace disciplinary topics, including: aerodynamics, structures, propulsion, and flight dynamics with emphasis on performance.

Aer E 265. Scientific Balloon Engineering and Operations. (Cross-listed with Mteor). (0-2) Cr. 1. Repeatable. F. Engineering aspects of scientific balloon flights. Integration of science mission objectives with engineering requirements. Operations team certification. FAA and FCC regulations, communications, and command systems. Flight path prediction and control.**Aer E 290. Independent Study.** Cr. arr. Repeatable. *Prereq: Sophomore classification, approval of the department.*

A. Flight ground instruction
B. In-flight training (Prereq: 301.)
C. Other

Aer E 291. Aerospace Seminar. Cr. R. F. (1-0) Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Academic program planning, departmental symposium participation.
H. Honors

Aer E 292. Aerospace Seminar. Cr. R. S. (1-0) Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Academic program planning, departmental symposium participation. Satisfactory-fail only.
H. Honors

Aer E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course prior to commencing work. Satisfactory-fail only.

Aer E 301. Flight Experience. Cr. R. F. *Prereq: Credit or enrollment in 355.* Two hours of in-flight training and necessary ground instruction. Course content prescribed by the Aerospace Engineering Department. Six hours of flight training certified in a pilot log book can be considered by the course instructor as evidence of satisfactory performance in the course. Satisfactory-fail only.

Aer E 311. Gas Dynamics. (3-0) Cr. 3. S. *Prereq: 243, M E 330, enrollment in 311L.* Properties of liquids and gases, review of thermodynamic processes and relations, energy equation, compressible flow, shock and expansion waves, isentropic flow, Fanno and Rayleigh flow. Nonmajor graduate credit.

Aer E 311L. Gas Dynamics Laboratory. (0-3) Cr. 0.5. S. *Prereq: 243, 243L, enrollment in 311.* Introduction to experimental compressible flow and propulsion principles, techniques and instruments through laboratory studies and experiments. Report writing.

Aer E 321. Flight Structures Analysis and Laboratory. (2.5-1) Cr. 3. F. *Prereq: E M 324.* 3 hours of lecture weekly and laboratory alternating weeks. Determination of flight loads. Materials selection for flight applications. Analysis of flight structures including trusses, beams, frames, and shear panels employing classical and finite element methods. Laboratory experiments on flight structures. Nonmajor graduate credit.

Aer E 331. Flight Control Systems I. (3-0) Cr. 3. S. *Prereq: 355.* Linear system analysis. Control system designs using root-locus and frequency response methods. Applications in flight control systems. Nonmajor graduate credit.

Aer E 343. Aerodynamics II. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 311 and enrollment in 343L.* Incompressible, subsonic, transonic, supersonic, hypersonic flow over airfoils and wings. Viscous flow theory. Laminar boundary layers. Transition and turbulent flow. Nonmajor graduate credit.

Aer E 343L. Aerodynamics Laboratory II. (0-2) Cr. 1. S. *Prereq: Enrollment in 343.* Advanced concepts in aerodynamics and propulsion through laboratory experience. Experiments include model tests. Techniques in subsonic and supersonic measurements. Report writing.

Aer E 351. Astrodynamics I. (3-0) Cr. 3. F. *Prereq: E M 345, Aer E 261, Credit or enrollment in Aer E 243.* Introduction to astrodynamics. Two-body motion. Geocentric, lunar and interplanetary trajectories and applications. Launch and atmospheric re-entry trajectories. Nonmajor graduate credit.

Aer E 355. Aircraft Flight Dynamics and Control. (3-0) Cr. 3. F. *Prereq: 261, Math 267, E M 345.* Aircraft rigid body equations of motion, linearization, and modal analysis. Longitudinal and lateral-directional Static and dynamic stability analysis. Flight handling characteristics analysis. Longitudinal and lateral-directional open loop response to aircraft control inputs. Aircraft flight handling qualities. Nonmajor graduate credit.

Aer E 361. Computational Techniques for Aerospace Design. (2-2) Cr. 3. F.S. *Prereq: 243, Math 267, E M 324, E M 345.* Advanced programming, workstation environment, and development of computational tools for aerospace analysis and design. Nonmajor graduate credit.

Aer E 391. Aerospace Seminar. Cr. R. F. (1-0) Professional skills development activities including: interviewing, program of study specialization considerations, post baccalaureate study options, career planning.

Aer E 392. Aerospace Seminar. Cr. R. S. (1-0) Professional skills development activities including: program of study specialization considerations, post baccalaureate study options, career planning. Preliminary senior design project planning and mentor selection. Satisfactory-fail only.

Aer E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period. Students must register for this course prior to commencing work. Satisfactory-fail only.

Aer E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* Professional work period, one semester maximum per academic year. Students must register for this course prior to commencing work. Satisfactory-fail only.

Aer E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course prior to commencing work. Satisfactory-fail only.

Aer E 411. Aerospace Vehicle Propulsion I. (3-0) Cr. 3. F. *Prereq: 311.* Atmospheric propulsion system performance and cycle analysis. Momentum theorem, thrust and propulsive efficiency. Thermodynamics of compressible flow with heat and work addition. Components and principles of turbojets and turbofans. Rocket engines and ramjet principles. Nonmajor graduate credit.

Aer E 412. Aerospace Vehicle Propulsion II. (3-0) Cr. 3. *Prereq: 343, 411.* Electricity and magnetism. Plasma physics. Ion engine performance. Introduction to advanced electromagnetic propulsion systems. Energy sources and nuclear propulsion. Low thrust mission analysis. Space mission requirements Nonmajor graduate credit.

Aer E 417. Experimental Mechanics. (Cross-listed with E M). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: E M 324.* Introduction of different aspects of measuring deformation, strains, and stress for practical engineering problems. Strain gage theory and application. Selected laboratory experiments. Nonmajor graduate credit.

Aer E 421. Advanced Flight Structures. (2.5-1) Cr. 3. S. *Prereq: 321, Math 266 or 267.* Analysis of indeterminate flight structures including finite element laboratory. Static analysis of complex structural components subject to thermal and aerodynamic loads. Analytical and finite element solutions for stresses and displacements of membrane, plane stress, plate structures. Buckling of beams, frames, and plate structures. Introduction to vibration of flight structures. Steady state and transient structural response using normal modal analysis. Nonmajor graduate credit.

Aer E 422. Aeroelasticity. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 421 or E M 450 or M E 450.* Vibration theory. Steady and unsteady flows. Mathematical foundations of aeroelasticity, static and dynamic aeroelasticity. Linear unsteady aerodynamics, nonsteady aerodynamics of lifting surfaces. Stall flutter. Aeroelastic problems in civil engineering structures. Aeroelastic problems of rotorcraft. Experimental aeroelasticity. Selected wind tunnel laboratory experiments. Nonmajor graduate credit.

Aer E 423. Composite Flight Structures. (2-2) Cr. 3. *Prereq: E M 324; Mat E 272.* Fabrication, testing and analysis of composite materials used in flight structures. Basic laminate theory of beams, plates and shells. Manufacturing and machining considerations of various types of composites. Testing of composites for material properties, strength and defects. Student projects required. Nonmajor graduate credit.

Aer E 426. Design of Aerospace Structures. (1-6) Cr. 3. *Prereq: E M 324.* Detailed design and analysis of aerospace vehicle structures. Material selection, strength, durability and damage tolerance, and validation analysis. Design for manufacturability. Nonmajor graduate credit.

Aer E 432. Flight Control Systems II. (3-0) Cr. 3. *Prereq: 331.* Aircraft lateral directional stability augmentation. Launch vehicle pitch control system design. Control of flexible vehicles. Satellite attitude control. Flight control designs based on state-space methods. Introduction to sample-data systems. Nonmajor graduate credit.

Aer E 442. V/STOL Aerodynamics and Performance. (3-0) Cr. 3. *Prereq: 355.* Introduction to the aerodynamics, performance, stability, control and critical maneuvering characteristics of V/STOL vehicles. Topics include hovercrafts, jet flaps, ducted fans and thrust vectored engines. Nonmajor graduate credit.

Aer E 446. Computational Fluid Dynamics. (3-0) Cr. 3. *Prereq: 343.* Introduction to modern computational fluid dynamics. Finite difference and finite volume methods. Explicit, implicit, and iterative techniques. Solutions of elliptic, parabolic, and hyperbolic equations. Emphasis on applications. Commercial software. Nonmajor graduate credit.

Aer E 448. Fluid Dynamics of Turbomachinery. (Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: M E 335 or equivalent.* Applications of principles of fluid mechanics and thermodynamics in performance analysis and design of turbomachines and related fluid system components. Nonmajor graduate credit.

Aer E 451. Astrodynamics II. (3-0) Cr. 3. *Prereq: 351.* Simple orbit determination and prediction. Advanced orbit maneuvers, single-, double-, and triple-impulse; fixed-impulse, finite-duration. 3-D rigid-body dynamics, Euler's equations, satellite stabilization and attitude control. Earth gravity field models and gravity harmonics, orbit perturbations, variational methods, relative orbital mechanics, Clohessy-Wiltshire equations. Nonmajor graduate credit.

Aer E 461. Modern Design Methodology with Aerospace Applications. (2-2) Cr. 3. F.S. *Prereq: 361, 311, 321, 351, 355.* Introduction to modern engineering design methodology. Computational constrained optimal design approach including selection of objective function, characterization of constraint system, materials and strength considerations, and sensitivity analyses. Nonmajor graduate credit.

Aer E 462. Design of Aerospace Systems. (1-4) Cr. 3. F.S. *Prereq: 461.* Fundamental principles used in engineering design of aircraft, missile, and space systems. Preliminary design of aerospace vehicles.

Aer E 464. Spacecraft Systems. (3-0) Cr. 3. *Prereq: 351.* An examination of spacecraft systems including attitude determination and control, power, thermal control, communications, propulsion, guidance, navigation, command and data handling, and mechanisms. Explanation of space and operational environments as they impact spacecraft design. Includes discussion of safety, reliability, quality, maintainability, testing, cost, legal, and logistics issues. Nonmajor graduate credit.

Aer E 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Cpr E, E E, Engr, I E, Mat E, M E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing, and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

Aer E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or senior classification, approval of the department.*
A. Aero and/or Gas Dynamics
B. Propulsion
C. Aerospace Structures
D. Flight Dynamics
E. Spacecraft Systems
F. Flight Control Systems
G. Aeroelasticity
H. Honors
I. Design
J. Non-destructive Evaluation
K. Wind Engineering
L. Multi-functional Ultra-light Structures
O. Other

Aer E 491. Aerospace Seminar. Cr. R. F.S. (1-0) Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Engineering ethics case studies and discussions. Academic program planning, departmental symposium participation.

Aer E 492. Aerospace Seminar. Cr. R. F.S. (1-0) Professional skills development activities. Writing and presentation of a technical paper at the department's Aerospace Symposium or at a recognized student or professional meeting of the American Institute of Aeronautics and Astronautics (AIAA). Satisfactory-fail only.

Aer E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

Aer E 499. Senior Project. Cr. arr. Repeatable. F.S. *Prereq: Senior classification, credit or enrollment in 491.* Development of aerospace principles and concepts through individual research and projects. Written report.

Courses primarily for graduate students, open to qualified undergraduate students

Aer E 514. Advanced Mechanics of Materials. (Cross-listed with E M). (3-0) Cr. 3. F. *Prereq: E M 324.* Theory of stress and strain, stress-strain relationships. Unsymmetrical bending, curved beams, shear center. Torsion of thin-walled noncircular sections. Equilibrium, compatibility equations. Airy stress functions. Membrane stresses in shells, thick-walled cylinders.

Aer E 517. Experimental Mechanics. (Cross-listed with E M). (3-2) Cr. 4. Alt. S., offered 2010. *Prereq: E M 510 or 514 or 516.* Fundamental concepts for Force, displacement, stress, and strain measurements. Strain gages. Full field deformation measurements with laser interferometry and digital image processing. Advanced experimental concepts at the micro and nano scale regimes.

Aer E 521. Airframe Analysis. (3-0) Cr. 3. F. *Prereq: 421 or E M 424.* Analysis of Static stresses and deformation in continuous aircraft structures. Various analytical and approximate methods of analysis of isotropic and anisotropic plates and shells.

Aer E 522. Design and Analysis of Composite Materials. (3-0) Cr. 3. F. *Prereq: E M 324.* Composite constituent materials, micro-mechanics, laminate analysis, hygro-thermal analysis, composite failure, joining of composites, design of composite beams and plates, honeycomb core, manufacturing of composites, short fiber composites, and demonstration laboratory.

Aer E 524. Numerical Mesh Generation. (3-0) Cr. 3. *Prereq: Math 385, proficiency in programming.* Introduction to modern mesh generation techniques. Structured and unstructured mesh methods, algebraic and PDE methods, elliptic and hyperbolic methods, variational methods, error analysis, Delaunay triangulation, data structures, geometric modeling with B-spline and NURBS surfaces, surface meshing.

Aer E 525. Finite Element Analysis. (Cross-listed with E M). (3-0) Cr. 3. S. *Prereq: E M 425, Math 385.* Variational and weighted residual approach to finite element equations. Emphasis on two- and three-dimensional problems in solid mechanics. Isoparametric element formulation, higher order elements, numerical integration, imposition of constraints and penalty, convergence, and other more advanced topics. Use of two- and three-dimensional computer programs. Dynamic and vibrational problems, eigenvalues, and time integration. Introduction to geometric and material nonlinearities.

Aer E 531. Automatic Control of Flight Vehicles. (3-0) Cr. 3. S. *Prereq: 331.* Applications of classical and modern linear control theory to automatic control of flight vehicles. Spacecraft attitude control. Control of flexible vehicles. Linear-quadratic regulator design applications.

Aer E 532. Compressible Fluid Flow. (Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: M E 335 or Aer E 541.* Thermodynamics of compressible flow. Viscous and inviscid compressible flow equations. One dimensional steady flow; isentropic flow, normal shock waves oblique and curved shocks, constant area flow with friction and heat transfer. Linear theory and Prandtl-Glauert similarity. Method of characteristics. Subsonic, transonic, supersonic and hypersonic flows.

Aer E 541. Incompressible Flow Aerodynamics. (3-0) Cr. 3. F. *Prereq: 343 or M E 335.* Kinematics and dynamics of fluid flow. Derivation of the Navier-Stokes, Euler and potential flow equations. Introduction to generalized curvilinear coordinates. Ideal fluids. Two-dimensional and three-dimensional potential flow. Complex variable methods.

Aer E 543. Viscous Flow Aerodynamics. (3-0) Cr. 3. S. *Prereq: 541.* Navier-Stokes equations. Incompressible and compressible boundary layers. Similarity solutions. Computational and general solution methods. Introduction to stability of laminar flows, transition and turbulent flow.

Aer E 545. Advance Experimental Technique for Thermal-Fluid Studies. (3-0) Cr. 3. S. *Prereq: 343 or M E 335 or E M 378.* Introduction of various experimental techniques widely used for fluid mechanics, aerodynamics, heat transfer, and combustion studies. Pressure gauge and transducers; Pitot tube; hot wire anemometry; shadowgraph and Schlieren Photography; laser Doppler velocimetry; particle image velocimetry (PIV); advanced PIV techniques (stereo PIV, 3-D PIV, Holograph PIV, microscopic PIV); laser induced fluorescence; pressure sensitive painting, temperature sensitive painting; molecular tagging velocimetry; molecular tagging thermometry. Extensive application and demonstration laboratory experiments will be included.

Aer E 546. Computational Fluid Mechanics and Heat Transfer I. (Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 541 or ME 538.* Introduction to finite difference and finite volume methods used in modern engineering. Basic concepts of discretization, consistency, and stability. Applications of numerical methods to selected model partial differential equations.

Aer E 547. Computational Fluid Mechanics and Heat Transfer II. (Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: M E 546.* Application of computational methods to current problems in fluid mechanics and heat transfer. Methods for solving the Navier-Stokes and reduced equation sets such as the Euler, boundary layer, and parabolized forms of the conservation equations. Introduction to relevant aspects of grid generation and turbulence modeling.

Aer E 551. Orbital Mechanics. (3-0) Cr. 3. F. *Prereq: 351.* Review of 2-body problem. Orbital maneuvers. Relative motion in orbit. Orbit perturbation analysis. Gravity field expansions and effects on orbiters. 3-body problem with applications.

Aer E 556. Guidance and Navigation of Aerospace Vehicles. (3-0) Cr. 3. F. *Prereq: 331.* Principles of guidance systems for spacecraft, launch vehicles, homing and ballistic missiles. Optimal guidance. Interplanetary transfer guidance with low thrust. Principles of inertial navigation. Theory and applications of the Global Positioning System. Celestial navigation procedures. Application of Kalman filtering to recursive navigation theory.

Aer E 565. Systems Engineering and Analysis. (Cross-listed with E E, I E). (3-0) Cr. 3. *Prereq: Coursework in basic Statistics.* Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated systems. Life-cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test evaluation, and systems engineering planning and organization. Not available for degrees in industrial engineering.

Aer E 566. Avionics Systems Engineering. (Cross-listed with E E). (3-0) Cr. 3. S. *Prereq: E E 565.* Avionics functions. Applications of systems engineering principles to avionics. Top-down design of avionics systems. Automated design tools.

Aer E 569. Mechanics of Composite and Combined Materials. (Cross-listed with E M). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: E M 324.* Mechanics of fiber-reinforced materials. Micromechanics of lamina. Macromechanical behavior of lamina and laminates. Strength and interlaminar stresses of laminates. Failure criteria. Stress analysis of laminates. Thermal moisture and residual stresses. Joints in composites.

Aer E 570. Wind Engineering. (Cross-listed with E M). (3-0) Cr. 3. F. *Prereq: E M 378, 345.* Atmospheric circulations, atmospheric boundary layer wind, bluff-body aerodynamics, aeroelastic phenomena, wind-tunnel and full-scale testing, wind-load code and standards, effect of tornado and thunderstorm winds, design applications.

Aer E 572. Turbulence. (Cross-listed with Ch E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 543 or M E 538.* Qualitative features of turbulence. Statistical and spectral representation of turbulent velocity fields: averages, moments, correlations, length and time scales and the energy cascade. Averaged equations of motion, closure requirements, Reynolds stress, dissipation rate. Isotropic turbulence, homogeneous shear flows, free shear flows, wall bounded flows. Scalar transport, particulate transport.

Aer E 573. Random Signal Analysis and Kalman Filtering. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 370 or 411 or Math 341 or 395.* Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

Aer E 574. Optimal Control. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* The optimal control problem. Variational approach. Pontryagin's principle. Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

Aer E 575. Introduction to Robust Control. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. *Prereq: E E 577.* Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H2, Hoo, and I1 control problems. Tools for robustness analysis and synthesis.

Aer E 576. Digital Feedback Control Systems. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 475 or Aer E 432 or M E 411 or 414 or Math 415; and Math 267.* Sampled data, discrete data, and the z-transform. Design of digital control systems using transform methods; root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

Aer E 577. Linear Systems. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 414 or Math 415; and Math 307.* State variable and input-output descriptions of linear continuous-time and discrete time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by state feedback. Design of feedback systems. Stability of linear dynamical systems.

Aer E 578. Nonlinear Systems. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* Classification of nonlinear control systems. Existence and uniqueness of solutions. Approximate analysis methods. Periodic orbits. Concept of stability and Lyapunov stability theory. Absolute stability of feedback systems. Input-output stability. Passivity.

Aer E 581. Perturbation Methods. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Math 267.* Mathematical perturbation methods with applications to ordinary differential equations. Perturbation expansions. Order of magnitude and gauge functions. Matched asymptotic expansions. Boundary layer problems. Multiple scales. Resonance and mode coupling. Solvability conditions for differential equations. Physical and engineering applications.

Aer E 590. Special Topics. Cr. arr. Repeatable.
A. Aero and/or Gas Dynamics
B. Propulsion
C. Aerospace Structures
D. Flight Dynamics
E. Spacecraft Systems
F. Flight Control Systems
G. Aeroelasticity
H. Viscous Aerodynamics
I. Design
J. Hypersonics
K. Computational Aerodynamics
L. Optimization
M. Non Destructive Evaluation
N. Wind Engineering

Aer E 591. Graduate Student Seminar Series. Cr. R. Repeatable. Presentation of professional topics by department graduate students. Development of presentation skills used in a professional conference setting involving question and answer format.

Aer E 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

Aer E 647. Advanced High Speed Computational Fluid Dynamics. (Cross-listed with M E). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 547.* An examination of current methods in computational fluid dynamics. Differencing strategies. Advanced solution algorithms. Grid generation. Construction of complex CFD algorithms. Current applications. Use of state of the art CFD codes.

Aer E 690. Advanced Topics. Cr. arr. Repeatable.
A. Aero and/or Gas Dynamics
B. Propulsion
C. Aerospace Structures
D. Flight Dynamics
E. Spacecraft Systems
F. Flight Control Systems
G. Aeroelasticity

H. Viscous Aerodynamics
I. Design
J. Hypersonics
K. Computational Aerodynamics
L. Non Destructive Evaluation
M. Wind Engineering

Aer E 697. Engineering Internship. Cr. R. Repeatable. *Prereq: Permission of DOGE (Director of Graduate Education), graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

Aer E 699. Research. Cr. arr. Repeatable.

African and African American Studies

www.las.iastate.edu/AfricanAmericanStudies/

Interdepartmental Undergraduate Program

Undergraduate Study

African and African American Studies, a cross-disciplinary program in the College of Liberal Arts and Sciences, offers students the opportunity to explore the African Americans' experience and African American contributions to American culture. Students in the program analyze and learn about African American experiences through the study of history, literature, art, religion, and Society. They gain knowledge and develop skills and sensitivities to help them function effectively in today's diverse Society.

African and African American Studies at Iowa State University is an expanding program. Most of the courses in the program satisfy general education requirements in the College of Liberal Arts and Sciences, the human relations requirement for teachers, and the university's diversity requirement. Students can minor or even design their own Interdisciplinary Studies major with an emphasis in African American Studies. Relevant courses are offered through other departments.

A minor in African and African American Studies requires six courses in the program with a minimum of 18 credits, including Introduction to African American Studies (Af Am 201) and Seminar in African American Culture (Af Am 460). The remaining credits must come from at least two departments, with at least two courses taken at the junior level or above. Independent study and internship opportunities are available for credit, but do not count in the minimum requirements for the minor.

Graduate Study

Several courses are open for nonmajor graduate credit. See individual listings for more information.

Courses primarily for undergraduate students

Af Am 201. Introduction to African American Studies. (3-0) Cr. 3. F.S. An interdisciplinary introduction to the study of African American culture. Includes history, the social sciences, literature, religion, and the arts, as well as conceptual frameworks for investigation and analysis of the African American experience.

Af Am 325. Peoples and Cultures of Africa. (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 201 or 306 recommended.* Origins and distribution of peoples of Africa; geographical characteristics as related to culture types, including early civilizations; a comparative examination of economic, subsistence, language, social and political organization, and religious systems throughout the continent; change processes, the impact of colonialism, and the nature of contemporary African Societies.

Af Am 330. Ethnic and Race Relations. (Cross-listed with Soc). (3-0) Cr. 3. F.S.SS. *Prereq: Soc 130 or 134.* Analysis of ethnic and race relations, particularly in America; emphasis on the Sociology and psychology of race and ethnic relations.

Af Am 334. African American Religious Experience. (Cross-listed with Relig). (3-0) Cr. 3. F. *Prereq: Prior course work in Religious Studies or African American Studies required.* Examination of the African American experience from the perspective of black religion and the black church, with attention to political, economic, and social, as well as spiritual, concerns. Nonmajor graduate credit.

Af Am 347. African American Literature to 1960. (Cross-listed with Engl). (3-0) Cr. 3. *Prereq: Engl 250.* Intensive study of African American writing, possibly including slave narratives, Harlem Renaissance works, literature of social protest, and Forerunners of contemporary works that reveal key thematic, stylistic, and historical range of the literature. Nonmajor graduate credit.

Af Am 348. Contemporary African American Literature. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Engl 250.* Intensive reading in literature by African Americans from 1960 to the present. Nonmajor graduate credit.

Af Am 350. African American Women. (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: 3 credits in Womens' Studies or African American Studies.* Economic, social, political and cultural roles of African American women in the U.S. Includes literary, philosophical, and artistic expressions. Myths and realities explored. Nonmajor graduate credit.

Af Am 353. History of African Americans I. (Cross-listed with Hist). (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Examines African roots of black culture and the African American experience in the United States from the colonial period through the Civil War. Topics include Atlantic Slave Trade, slavery and American identity, abolition, the emergence of Black Nationalism, and black participation in the Civil War.

Af Am 354. History of African Americans II. (Cross-listed with Hist). (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Explores African American political thought and political action from Reconstruction to the present. Topics include rise of Jim Crow segregation, urban migration, Garvey movement, Harlem Renaissance, Depression and world wars, Pan-Africanism, civil rights, Black Power, and black feminism.

Af Am 460. Seminar in African American Culture. (3-0) Cr. 3. S. Intensive study of a selected topic in African-American Studies in one or more disciplines. Selected readings of various authors, movements, eras, or genres. Primary and secondary source materials. Nonmajor graduate credit.

Af Am 490. Independent Study. Cr. arr. Repeatable.

Courses offered by other departments

Engl 349. Topics in Multicultural Literatures of the United States. (3-0) Cr. 3. See English.

Relig 475. Seminar: Issues in the Study of Religion. (3-0) Cr. 3. See Philosophy and Religious Studies

Agricultural Education and Studies

Robert Martin, Chair of Department

University Professors (Emeritus): Williams

Professors: Acker, Honeyman, Martin, G. Miller, W. Miller

Professors (Emeritus):Carter, CrawFord, Gamon, Gauger, Hoerner, Lawrence, Parsons, Trede

Associate Professors: Grudens-Schuck, McEowen

Associate Professors (Emeritus): Bruene, Jones

Assistant Professors: Dollisso, Esters, Morris, Polito, Retallick, Steiner

Lecturers: Brown, Paulsen

Undergraduate Study

For undergraduate curricula in agricultural education and agricultural studies leading to the degree bachelor of science, see College of Agriculture, Curricula.

The department offers two curricula for students desiring to enter careers in agriculture and related fields. These curricula are agricultural education and agricultural studies. The agricultural education curriculum prepares persons for careers as agricultural education instructors and educational specialists for industry and governmental agencies. The agricultural education curriculum has two options, teacher certification and communications. The agricultural studies curriculum prepares persons for careers in production agriculture and agricultural industry. Graduates of both curricula accept positions in agricultural business, industry, agencies, and production agriculture.

Graduates will have a broad base of agricultural knowledge, and will be skilled in decision making, planning, organizing, presenting, and evaluating information. Through the successful completion of the required coursework, active participation in clubs and organizations, and the acquisition of technical skills and experiences associated with work experiences, internships, and international travel, graduates of our baccalaureate programs will meet the university, college, and departmental outcomes in the following nine areas: 1) professional, interpersonal, and cross-cultural communications; 2) Problem-solving/critical thinking; 3) leadership; 4) entrepreneurship; 5) life-long learning; 6) ethics; 7) environmental awareness; 8) U.S. diversity; and 9) international perspectives.

More information regarding the departmental learning outcomes can be found at www.ageds.iastate.edu/assessment/agedsindex.htm.

The department offers a minor in agricultural education which may be earned by completion of a minimum of 15 credits in agricultural education and studies courses, with a minimum of two courses at the 400 level. Courses that can be taken for a minor are 211, 310, 311, 315, 412 or 418, 414, 450, 490, 496, and 499.

Visit the departmental website at www.AgEds.iastate.edu/

Graduate Study

The department offers the degrees master of science and doctor of philosophy with a major in agricultural education, a specialization in agricultural extension education, opportunities for emphasis in international agricultural education, and a minor for students majoring in other curricula. Graduate students who have earned a bachelor's degree in an agricultural discipline may plan a course of study that leads to teacher certification. Candidates pursuing the master of science degree may do so by completing either a thesis or nonthesis-program of study.

Students have an opportunity to develop competence in disciplinary foundations and ethics, program planning, learning theory, instructional methods, program leadership and administration, program evaluation, research methodologies, data analysis and interpretation, writing for publication, and grantsmanship.

The department administers the interdepartmental graduate program in professional agriculture designed for off-campus students pursuing a master of agriculture degree; see *Off-Campus Credit Courses and Programs.*

The department also cooperates in the international development studies option of the General Graduate Studies Program.

Courses and workshops are offered, both on and off campus, for extension educators, teachers, and industry personnel.

Courses primarily for undergraduate students

AgEds 110. Orientation. (1-0) Cr. 0.5. F. Orientation to the department. Careers in agriculture.
A. Agricultural Education
B. Agricultural Studies
C. General Agriculture

AgEds 111. Orientation for Agricultural Excellence Scholars. (1-0) Cr. 1. Repeatable. F. *Prereq: Enrollment as an agricultural excellence scholar.* The roles of professionals in agriculture, academic preparation for assuming the role of a professional in agriculture, and meeting the demands of the scholar's curriculum.

AgEds 112. Agriculture Biotechnology Colloquium. (1-0) Cr. 1. S. *Prereq: Enrollment as an agricultural excellence scholar.* The scientific basis of biological and social sciences in agriculture.

AgEds 211. Early Field Based Experience. (1-0) Cr. 1. Repeatable. F.S.SS. *Prereq: 110.* Five days on-site in an agricultural setting observing competencies and issues in problem solving, decision-making, initiative taking, teamwork, leadership, written and oral communications, critical thinking and creativity. When students register it is their responsibility to make an appointment with the departmental coordinator (very early in the semester) to plan their experience.
A. High School Agriculture Program
B. Extension
C. Agricultural Industries and Agencies

AgEds 215. Career Seminar. (1-0) Cr. 1. F.S. *Prereq: Sophomore classification.* Overview of career opportunities. Evaluation of interests and accomplishments and setting career goals. Development of job search and interviewing skills. Establishing networks of job contacts.

AgEds 290. Special Problems in Agricultural Education and Studies. Cr. arr. Repeatable. F.S.SS.

AgEds 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AgEds 310. Foundations of Agricultural Education Programs. (2-0) Cr. 2. S. Historical development of agricultural education programs. Philosophic premises, program goals and objectives. Educational and social issues impacting the implementation of agricultural education programs.

AgEds 311. Presentation and Sales Strategies for Agricultural Audiences. (3-0) Cr. 3. F.S. Utilizing instructional methods, techniques, and problem solving, presentation and sales strategies with agricultural audiences.

AgEds 312. Science With Practice. (1-3) Cr. 2. F.S. *Prereq: College of Agriculture and Life Sciences majors only.* A planned learning experience wherein each student and faculty mentor develops a learning agreement that encompasses specific activities and expectations. Students are engaged in reflective activities that include journals, micro-reflections, formal presentations, and a comprehensive portfolio. Students will be able to recognize and articulate what is learned through the experience and transfer what is learned to future experiences.

AgEds 315. Personal and Professional Leadership in Agriculture. (3-0) Cr. 3. F.S. Learn leadership theories and group facilitation skills for personal and professional applications in agricultural education, industry, and communities.

AgEds 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AgEds 401. Planning Agriculture and Life Sciences Education Programs. (Dual-listed with 501). (3-0) Cr. 3. F. *Prereq: 310.* Responsibilities of an agricultural education teacher, curriculum development, experiential learning opportunities including FFA and SAE, and assessment and maintenance of program quality.

AgEds 402. Methods of Teaching in Agriculture and Life Sciences. (Dual-listed with 502). (3-0) Cr. 3. F. *Prereq: Concurrent enrollment in 401.* Topics include: principles of teaching and learning, individualized and group methods, application of learning, instructional management, special populations, and evaluation.

AgEds 412. Internship in Agricultural Education and Studies. Cr. arr. Repeatable. F.S.SS. *Prereq: 211, junior classification in AgEds and permission of instructor.* A supervised two to twelve week learning experience in an approved learning setting with application to educational, agricultural and/or environmental practices and principles. Nonmajor graduate credit.

AgEds 414. Developing Agricultural Education Programs in Non-formal Settings. (2-0) Cr. 2. S. *Prereq: 211 and permission of instructor.* Basic concepts in planning, conducting, and evaluating educational programs in non-formal settings. Includes programming for youth and adults in Extension, agricultural industry, and related agencies. Nonmajor graduate credit.

AgEds 416. Pre-Student Teaching Experience in Agricultural Education. Cr. 1. F.S. *Prereq: 211, 402 and admission to teacher education program.* A one-week field-based experience in an approved secondary agricultural education program. Concurrent enrollment in 417 is required.

AgEds 417. Supervised Teaching in Agriculture and Life Sciences. Cr. arr. Repeatable. F.S. *Prereq: 211, 402 and admission to teacher education program.* Supervised teaching in public schools.

AgEds 418. Supervised Extension Experience. Cr. arr. Repeatable. F.S.SS. *Prereq: 211, junior classification, permission of instructor.* Supervised professional experience in an approved county, area or State Cooperative Extension Service office. Nonmajor graduate credit.

AgEds 450. Farm Management and Operation. (1-6) Cr. 3. Repeatable. F.S.SS. *Prereq: Econ 235, Econ 330, junior classification.* Participation in the management and operation of a diversified Iowa farm. The class is responsible for the plans, records, and decisions for buying and selling the farm's livestock, crops, and equipment. Special speakers on current topics. May be taken for credit 3 times at different times of the year with permission of the instructor. Nonmajor graduate credit.

AgEds 451. Agricultural Law. (3-2) Cr. 4. S. *Prereq: Senior classification.* The legal framework impinging upon decision-making by firms, families, and individuals, real and personal property, contracts, secured transactions, negotiable instruments, debtor-creditor relations, bankruptcy, farm income tax organization of firms, intergenerational property transfers, trusts and farm estate planning, civil and criminal liabilities, environmental law, federal and state regulatory powers. Nonmajor graduate credit.

AgEds 488. Methods of Teaching Agricultural Mechanics. (2-3) Cr. 3. F.S. Methods and management techniques in agricultural mechanics laboratories. Emphasis will be on safety, mechanical skills development and management of students, facilities, equipment, and materials.

AgEds 490. Independent Study in Agricultural Education and Studies. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior or senior classification, permission of instructor.*
A. Philosophy, Curriculum, and Methods
B. Leadership, Evaluation, and Administration
C. Business, Industry, and Production Agriculture
D. Extension and International Agriculture
E. Instructional Technology
F. Environmental Issues
G. Entrepreneurship
H. Honors
I. Communications

AgEds 496. Agricultural Travel Course. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Limited enrollment. Extended field trips to study agriculture and education related topics. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students. Nonmajor graduate credit.
A. International
B. Domestic

AgEds 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AgEds 499. Undergraduate Research. Cr. arr. F.S.SS. *Prereq: Permission of instructor, adviser, and departmental chair.* Research experience in agricultural education and studies with application to selected problems.

Courses primarily for graduate students, open to qualified undergraduate students

AgEds 501. Planning Agriculture and Life Sciences Education Programs. (Dual-listed with 401). (3-0) Cr. 3. F. *Prereq: 310.* Responsibilities of an agricultural education teacher, curriculum development, experiential learning opportunities including FFA and SAE, and assessment and maintenance of program quality.

AgEds 502. Methods of Teaching in Agriculture and Life Sciences. (Dual-listed with 402). (3-0) Cr. 3. F. *Prereq: Concurrent enrollment in 501.* Topics include principles of teaching and learning, individualized and group methods, application of learning, instructional management, special populations, and evaluation.

AgEds 510. Introduction to Research in Agricultural Education. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Determining your research focus; developing research problems and objectives; reviewing the literature and establishing a theoretical framework; establishing procedures for data collection and analysis; ethical issues.

AgEds 514. Organizing Agricultural Information for Professional and Scientific Meetings. (1-2) Cr. 2. F. *Prereq: Graduate classification in agriculture.* Concepts and practices in planning, preparing, and presenting materials used in professional meetings and scientific papers by agriculturalists with special emphasis on computerized delivery methods.

AgEds 520. Instructional Methods for Adult and Higher Education in Agriculture and Natural Resources. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Theory and practice of adult education. Teaching and learning in formal and non-formal instructional programs for adult learners.

AgEds 524. Program Development and Evaluation in Agricultural and Extension Education. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Theories and practice of program planning for nonformal education. Addresses use of program logic modeling and considers critical theories of planning to address power and interests in program development, needs assessment, and evaluation.

AgEds 533. Introduction to Learning Theory in Agricultural Education. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Introduction to a variety of theoretical perspectives of learning and how they may be used within the context of agricultural education. Emphasis will be on the major domains of learning, developmental considerations, basic assumptions, concepts, and principles of various learning theories; understanding how each theoretical perspective may be used in both formal and non-formal educational settings.

AgEds 550. Foundations of Agricultural Education. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Philosophical premises, ethical principles, historical development, contextual applications, and knowledge bases for agricultural education.

AgEds 552. Data Analysis and Interpretation. (2-0) Cr. 2. F. *Prereq: 510.* Strategies for analyzing, interpreting, and reporting quantitative research data in the social and behavioral sciences.

AgEds 561. Technology Transfer and the Role of Agricultural and Extension Education. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* The impact of agricultural and extension education processes on development and their role in the transfer of agricultural technology. Utilizing situational analysis techniques to analyze and solve problems in international agricultural education programs.

AgEds 590. Special Topics in Agricultural Education. Cr. arr. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education.*
A. Curriculum
B. Methods
C. Philosophy
D. Evaluation
E. Administration
F. Leadership
G. Guidance
I. Instructional Technology
J. Extension
K. International Agriculture
L. Program Planning

AgEds 593. Workshop in Agricultural Education. Cr. arr. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education.*
A. Curriculum
B. Methods
C. Evaluation
D. Administration
E. Leadership
F. Extension
G. Program Planning
H. Instructional Technology
M. Biotechnology Workshop

AgEds 599. Creative Component. Cr. arr. Repeatable. F.S.SS. For nonthesis M.S. degree programs.

Courses for graduate students

AgEds 604. Evaluation in Agricultural and Extension Education. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 401 or 524.* Criteria and procedures for designing and facilitating evaluations of programs in agricultural and extension education. Critique of evaluation theories. Match quantitative and qualitative methods and instruments to evaluation contexts. Evaluation reporting and utilization.

AgEds 615. Seminar in Agricultural Education. (1-0) Cr. 1. Repeatable. F.S.SS. Satisfactory-fail only.
A. Writing for publication
B. Ethics
C. Grant writing
D. Career planning
E. Contemporary issues

AgEds 617. Professional Internship for Agricultural Educators. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Analysis of the roles and activities of professionals in agricultural education. Supervised professional field-based experience in public and private settings. Satisfactory-fail only.

AgEds 625. Leadership, Administration, Supervision and Management of Agricultural Education Programs. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Graduate classification.* Principles and best practices for leading, administering, supervising, and managing agricultural education programs. Analyzing selected case studies that apply theory to practice in agricultural situations.

AgEds 699. Research. Cr. arr. Repeatable.

Agricultural Engineering

(Administered by the Department of Agricultural and Biosystems Engineering)

Rameshwar Kanwar, Chair of Department

Distinguished Professor: Brown

Distinguished Professors (Emeritus): H. Johnson

University Professors: Bern

University Professors (Emeritus): Baker

Professors: Chen, Downing, Glanville, Harmon, Hoff, Hurburgh, L. Johnson, Kanwar, Misra, Schwab, Van Leeuwen, Xin

Professors (Emeritus): Beer, Bekkum, Buchele, Bundy, Hazen, Hoerner, Keeney, Lovely, Maney, Mangold, Marley, Melvin, Miller, Pedersen, Riley, R. Smith

Professors (Collaborators): Laflen

Associate Professors: Anex, Bhandari, Birrell, Brumm, Burns, Freeman, Koziel, Mickelson, Raman, Steward, Tim

Associate Professors (Emeritus): Anderson, Greiner, Lorimor

Associate Professors (Collaborators): Han

Assistant Professors: Darr, Grewell, Helmers, Kaleita-Forbes, Keren, Kim, Soupir, Tang, Yu

Assistant Professors (Emeritus): Boyd, Bradshaw

Assistant Professors (Adjunct): Inyang, Shahan, Tong

Assistant Professors (Collaborators): Dunn, Malone

Lecturer: Snell

Undergraduate Study

For the undergraduate curriculum in agricultural engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission of ABET.

Agricultural Engineering Curriculum Educational Goal, Objectives, and Learning Outcomes: The goal of the curriculum in agricultural engineering is to train students to integrate basic physical and biological sciences with engineering design principles to solve problems related to production, processing, storage, handling, distribution, and use of food, feed, fiber and other biomaterials, and the management of related natural resources worldwide.

The agricultural engineering bachelor of science degree program has the following educational objectives for its graduates. Two to five years after graduation, through the professional practice of engineering, graduates should:

1. Have demonstrated competence in methods of analysis involving use of Mathematics, fundamental physical and biological sciences, engineering sciences, and computation needed for the practice of biological systems engineering in food, fiber, energy and environmental companies and agencies.

2. Have developed skills necessary to the design process; including the abilities to think creatively, to formulate problem statements, to communicate effectively, to synthesize information, and to evaluate and implement problem solutions.

3. Be capable of addressing issues of ethics, safety, professionalism, cultural diversity, globalization, environmental impact, and social and economic impact in engineering practice.

4. Have demonstrated continuous professional and technical growth, with practical experience, so as to be licensed as a professional engineer or achieve that level of expertise

5. Demonstrated the ability to:

a. be a successful leader of multi-disciplinary teams,
b. efficiently manage multiple simultaneous projects,
c. work collaboratively,
d. implement multi-disciplinary systems-based solutions,
e. apply innovative solutions to problems through the use of new methods or technologies,
f. contribute to the business success of their employer, and
g. build community

The agricultural engineering degree program outcomes are statements that describe what our students are expected to know and be able to do by the time of graduation. To meet the established agricultural engineering program educational objectives, the expected outcomes for agricultural engineering bachelor of science graduates are:

a) an ability to apply knowledge of mathematics, science, and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) an ability to function on multi-disciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) achievement of the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and Societal context
i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
l) proficiency in mathematics through differential equations
m) proficiency in biological and engineering sciences
n) competence in the application of engineering to agriculture, aquaculture, food, Forestry, human, natural resource, or other biological systems.

Graduates find employment in diverse ag- and bio-related industries and government agencies dealing with agricultural machines and buildings, animal and environmental control, grain processing and handling, soil and water resources, food, and biotechnology. Their work involves engineering design, development, testing, research, manufacturing, consulting, sales, and service. The department has cooperative programs established for interested and qualified students. The four-year curriculum is extended over a five-year period and interspersed with work periods at cooperating organizations. This plan offers valuable practical experience and financial assistance during the years in college

The department also offers a bachelor of science curriculum in biological systems engineering. See College of Engineering, Curricula. Additionally, the department offers bachelor of science curricula in agricultural systems technology and in industrial technology. See College of Agriculture and Life Sciences, Curricula.

Well-qualified juniors and seniors in agricultural engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue a bachelor of science degree in agricultural engineering and a master of science degree in agricultural engineering. Refer to Graduate Study for more information.

Graduate Study

The department offers work for the degrees master of science, master of engineering, and doctor of philosophy with a major in agricultural engineering, and offers minor work for students in other majors. Within the agricultural engineering major the student may specialize in:

- advanced machinery engineering (agricultural safety and health, sensors and artificial intelligence, controls and automation, precision agriculture, and biorenewables)
- animal and plant production engineering (air emissions measurement and abatement, animal welfare, environmental control in animal housing, manure treatment, crop modeling, plant stress physiology, precision agriculture, and decision support systems)
- environmental stewardship engineering (erosion control, drainage/water management, pollutant fate and transport, nutrients management, wetlands, vegetated filter/buffer strips, hydrological/water quality/crop modeling, geographic information science (GIS)

- remote sensing, water quality, and watershed management, or
- process engineering for food safety and value addition (processing technologies and systems for adding value, quality management systems, agricultural product, marketing practices and standards, instrumentation for grain, seed, and food quality enhancement).

A prerequisite to graduate work is the completion of an undergraduate curriculum substantially equivalent to that required of agricultural engineering undergraduate students at this institution. However, because of the diversity of interests within the graduate programs in agricultural engineering, a student may qualify for graduate study even though the undergraduate training has been in a discipline other than agricultural engineering. Supporting work will be required depending on the student's background and area of interest with requirements defined by departmental graduate student guidelines: www.iastate.edu/grad_students.asp

Well-qualified juniors and seniors in agricultural engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue a bachelor of science degree in agricultural engineering and a master of science degree in agricultural engineering. Under concurrent enrollment, students are eligible for assistantships and simultaneously take undergraduate and graduate courses.

For the master of science program, at least 30 credits of acceptable graduate work must be completed with a minimum of 22 credits of course work; corresponding numbers for the master of engineering program are 32 and 27. For the doctor of philosophy degree, at least 72 credits of acceptable graduate work must be completed with a minimum of 42 credits of course work. All Ph.D. students must complete a teaching/extension experience prior to graduation.

The department also offers both master of science and doctor of philosophy degrees in industrial and agricultural technology (see Graduate Majors).

The department also participates in interdepartmental majors in environmental science, sustainable agriculture, biorenewable resources and technology, human and computer interaction, and toxicology (see Index).

Courses primarily for undergraduate students

A E 110. Experiencing Agricultural and Biosystems Engineering. (0-2) Cr. 1. S. Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of agricultural and biosystems engineering. Report writing, co-ops, internships, careers, registration planning.

A E 201. Entrepreneurship and Internship Seminar. (Cross-listed with BSE, TSM). (1-0) Cr. 1. F.S. *Prereq: Sophomore classification in A E, AST, BSE or ITec.* 8 week course. Overview of the entrepreneurial process and its importance in the economy and the engineering/technical workplace. Preparation for internship experiences. Relationship of workplace competencies to entrepreneurship, intrapreneurship, and internships; portfolios.

A E 216. Fundamentals of Agricultural and Biosystems Engineering. (Cross-listed with BSE). (2-2) Cr. 3. S. *Prereq: 110, Engr 160, credit or enrollment in Math 166.* Application of Mathematics and engineering sciences to mass and energy balances in agricultural and biological systems. Emphasis is on solving engineering problems in the areas of heat and mass transfer, air and water vapor systems; animal production systems, grain systems; food systems, hydrologic systems, and bioprocessing.

A E 271. Engineering Applications of Parametric Solid Modeling. (1-2) Cr. 1. F.S. *Prereq: Engr 170 or TSM 116 or equivalent.* 8 week-course. Creating, editing, and documenting part and assembly models using Solidworks.

A E 272. Parametric Solid Models, Drawings, and Assemblies Using Pro/ENGINEER. (1-2) Cr. 1. F.S. *Prereq: Engr 170 or TSM 116 or equivalent.* 8 week-course. Applications of Pro/ENGINEER software. Create solid models of parts and assemblies. Utilize the solid models to create design documentation: standard drawing views, dimensions, and notes.

A E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

A E 301. Leadership and Ethics Seminar. (Cross-listed with BSE, TSM). (1-0) Cr. 1. F.S. *Prereq: 201.* 8 week course. Leadership and ethics experiences through case studies and seminar presentations by practitioners. Relationship of workplace competencies to leadership and ethics; portfolios.

A E 316. Applied Numerical Methods for Agricultural and Biosystems Engineering. (Cross-listed with BSE). (2-2) Cr. 3. F. *Prereq: Engr 160, Math 266.* Computer aided solution of agricultural engineering problems by use of numerical techniques and Mathematical models. Systems analysis and optimization applicable to agricultural and biological systems.

A E 325. Biorenewable Systems. (Cross-listed with Agron, An S, BusAd, Econ, TSM). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing.

A E 340. Functional Analysis and Design of Agricultural Field Machinery. (2-2) Cr. 3. F. *Prereq: 110, 203, 216.* Principles of operation, design, selection, testing and evaluation of agricultural field machinery and systems. Functional and mechanical performances. Crop and soil interaction with machines. Machine systems, including land preparation, crop establishment, crop protection, harvesting and post-harvest, materials handling systems.

A E 342. Agricultural Tractor Power. (2-3) Cr. 3. S. *Prereq: M E 330 or Ch E 381 or M E 231.* Thermodynamic principles and construction of tractor engines. Fuels, combustion, and lubrication. Kinematics and dynamics of tractor power applications; drawbar, power take-off and traction mechanisms. Nonmajor graduate credit.

A E 363. Agri-Industrial Applications of Electric Power and Electronics. (3-2) Cr. 4. F. *Prereq: Phys 222.* Single phase and three phase circuit design. Electrical safety. Electric motors and controls. Programmable logic controllers. Digital logic, instrumentation and sensors. Nonmajor graduate credit.

A E 388. Sustainable Engineering and International Development. (Cross-listed with C E, E E, M E, Mat E). (2-2) Cr. 3. F. *Prereq: Junior classification in engineering.* Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as non-government organizations (NGOs). Course readings, final project/design report.

A E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period.

A E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* One semester maximum per academic year professional work period.

A E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

A E 401. Professionalism Seminar. (Cross-listed with BSE, TSM). (1-0) Cr. 1. F.S. *Prereq: 301.* 8 week course. Examination of professionalism in the context of engineering and technology. Time, project and personnel management. Communications and professional portfolios. Professional licensure. Transition to professional careers.

A E 403. Modeling and Controls for Agricultural Systems. (Dual-listed with 503). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 363, Math 267.* Modeling dynamic systems with ordinary differential equations. Introduction to state variable methods of system analysis. Analysis of mechanical, electrical, and fluid power systems. Analytical and numerical solutions of differential equations. Introduction to classical control theory. Feedback and stability examined in the s domain. Frequency response as an analytical and experimental tool. MATLAB will be used throughout the course for modeling.

A E 404. Instrumentation for Agricultural and Biosystems Engineering. (Dual-listed with 504). (2-2) Cr. 3. F. *Prereq: 363 or Cpr E 281.* Interfacing techniques for computer-based data acquisition and control systems. Basic interfacing components including A/D and D/A conversion, signal filtering, multiplexing, and process control. Sensors and theory of operation applied to practical monitoring and control problems.

A E 406. Applied Computational Intelligence for Agricultural and Biological Systems. (Dual-listed with 506). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: 216 or equivalent, Math 166, Stat 305.* Applications of biologically inspired computational intelligence tools to solve problems in agricultural and biological systems. Introduction to Artificial Neural Networks, Support Vector Machines, Fuzzy Logic, Genetic Algorithms, Bayesian and Decision Tree Learning. Fundamental machine vision techniques will be introduced in the first part of course and integrated into the lab exercises for learning different computational intelligence techniques. MATLAB will be used throughout the course for algorithm implementation.

A E 408. GIS and Natural Resources Management. (Dual-listed with 508). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: Working knowledge of computers and Windows environment.* Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS.

A E 411. Bioprocessing and Bioproducts. (Dual-listed with 511). (Cross-listed with BioE, BSE, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

A E 413. Fluid Power Engineering. (Cross-listed with M E). (2-2) Cr. 3. F. *Prereq: Credit or enrollment in E M 378 or M E 335, A E 216 or M E 270.* Properties of hydraulic fluids. Performance parameters of fixed and variable displacement pumps and motors. Hydraulic circuits and systems. HydroStatic transmissions. Characteristics of control valves. Analysis and design of hydraulic systems for power and control functions. Nonmajor graduate credit.

A E 415. Agricultural Engineering Design I. (Cross-listed with BSE). (1-2) Cr. 2. F.S. *Prereq: 271 or 272, E M 324.* Identification of current design problems in agricultural engineering. Development of alternate solutions using creativity and engineering analysis and synthesis techniques. Nonmajor graduate credit.

A E 416. Agricultural Engineering Design II. (Cross-listed with BSE). (1-2) Cr. 2. F.S. *Prereq: 415.* Selection of promising solutions to design problems identified in 415 for development by design teams. Presentation of designs through oral and written reports and prototypes. Nonmajor graduate credit.

A E 424. Air Pollution. (Dual-listed with 524). (Cross-listed with C E, EnSci). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology.
E. Agricultural sources of pollution

A E 431. Design and Evaluation of Soil and Water Conservation Systems. (Dual-listed with 531). (2-3) Cr. 3. F. *Prereq: E M 378 or Ch E 356.* Hydrology and hydraulics in agricultural and urbanizing watersheds. Design and evaluation of systems for the conservation and quality preservation of soil and water resources. Use and analysis of hydrologic data in engineering design; relationship of topography, soils, crops, climate, and cultural practices in conservation and quality preservation of soil and water for agriculture. Small watershed hydrology, water movement and utilization in the soil-plant-atmosphere system, agricultural water management, best management practices, and agricultural water quality.

A E 436. Design and Evaluation of Soil and Water Monitoring Systems. (Dual-listed with 536). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: A E 431 or permission of the instructor.* Development of monitoring systems that support effective planning, performance evaluation, modeling, or environmental impact assessment of soil-, water-, and waste-management systems. Typical soil and water pollutants and physical, chemical, and biological characteristics that affect sample location and timing. Sample collection, documentation, chain-of-custody, and quality assurance procedures.

A E 451. Food and Bioprocess Engineering. (Dual-listed with 551). (3-0) Cr. 3. F. *Prereq: 216 and M E 436 or Ch E 357, or FS HN 351 and Math 266 or 267.* Application of engineering principles and Mathematical modeling to the quantitative analysis of food and bioprocessing systems. Physical/chemical characteristics of foods and biological systems, flow processes, thermal processes and separation processes.

A E 466. Multidisciplinary Engineering Design. (Cross-listed with Aer E, Cpr E, E E, Engr, I E, Mat E, M E.) (1-4) Cr. 3. Repeatable. F.S. Prereq: Student must be within two semesters of graduation and receive permission of the instructor. Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

A E 469. Grain Processing and Handling. (Dual-listed with 569). (2-3) Cr. 3. S. *Prereq: 216.* Cereal grain and oilseed properties, quality measurement, processing, and end-use value. Design of drying systems using computer simulation. Corn wet and dry milling. Soybean oil extraction. Grain handling systems.

A E 472. Design of Environmental Modification Systems for Animal Housing. (Dual-listed with 572). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 216, M E 330.* Principles and design of animal environmental control systems. Insulation, heat and mass transfer, fans, ventilation, air distribution, heating and cooling equipment, energy use, duct design, control strategies.

A E 478. Wood Frame Structural Design. (Dual-listed with 578). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 216, E M 324.* Design of light-framed wood structures using LRFD and ASD design procedures. Includes analysis of wind, snow, dead, and live loads. Applications include animal housing and machine storage. Fasteners, laminated posts, truss design and use of National Design Specifications.

A E 490. Independent Study. Cr. arr. Repeatable.
B. Biosystems Engineering
C. Computer-aided Design
E. Environmental Systems
F. Food Engineering
H. Honors
O. Occupational Safety
P. Power and Machinery Engineering
Q. Structures
R. Process Engineering
S. Environmental and Natural Resources Systems
U. Waste Management

A E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduate students

A E 503. Modeling and Controls for Agricultural Systems. (Dual-listed with 403). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 363, Math 267.* Modeling dynamic systems with ordinary differential equations. Introduction to state variable methods of system analysis. Analysis of mechanical, electrical, and fluid power systems. Analytical and numerical solutions of differential equations. Introduction to classical control theory. Feedback and stability examined in the s domain. Frequency response as an analytical and experimental tool. MATLAB will be used throughout the course for modeling. Individual and/or group projects required for graduate credit.

A E 504. Instrumentation for Agricultural and Biosystems Engineering. (Dual-listed with 404). (2-2) Cr. 3. F. *Prereq: 363 or Cpr E 281.* Interfacing techniques for computer-based data acquisition and control systems. Basic interfacing components including A/D and D/A conversion, signal filtering, multiplexing, and process control. Sensors and theory of operation applied to practical monitoring and control problems. Individual and group projects required for graduate credit.

A E 506. Applied Computational Intelligence for Agricultural and Biological Systems. (Dual-listed with 406). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: 216 or equivalent, Math 166, Stat 305.* Applications of biologically inspired computational intelligence tools to solve problems in agricultural and biological systems. Introduction to Artificial Neural Networks, Support Vector Machines, Fuzzy Logic, Genetic Algorithms, Bayesian and Decision Tree Learning. Fundamental machine vision techniques will be introduced in the first part of course and integrated into the lab exercises for learning different computational intelligence techniques. MATLAB will be used throughout the course for algorithm implementation. Individual and/or group projects required for graduate credit.

A E 508. GIS and Natural Resources Management. (Dual-listed with 408). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: Working knowledge of computers and Windows environment.* Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS. In addition to other assignments, graduate students will prepare research literature reviews on topics covered in class and develop enterprise applications.

A E 511. Bioprocessing and Bioproducts. (Dual-listed with 411). (Cross-listed with BSE, BRT, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

A E 515. Integrated Crop and Livestock Production Systems. (Cross-listed with Agron, An S, SusAg). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: SusAg 509.* Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

A E 524. Air Pollution. (Dual-listed with 424). (Cross-listed with C E, EnSci). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above or permission of instructor.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology.
E. Agricultural sources of pollution

A E 531. Design and Evaluation of Soil and Water Conservation Systems. (Dual-listed with 431). (Cross-listed with EnSci). (2-3) Cr. 3. F. *Prereq: E M 378 or Ch E 356.* Hydrology and hydraulics in agricultural and urbanizing watersheds. Design and evaluation of systems for the conservation and quality preservation of soil and water resources. Use and analysis of hydrologic data in engineering design;

relationship of topography, soils, crops, climate, and cultural practices in conservation and quality preservation of soil and water for agriculture. Small watershed hydrology, water movement and utilization in the soil-plant-atmosphere system, agricultural water management, best management practices, and agricultural water quality. Graduate students will prepare several research literature reviews on topics covered in the class in addition to the other assignments.

A E 533. Erosion and Sediment Transport. (Cross-listed with EnSci). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 422 or C E 372, Math 266.* Soil erosion processes, modified universal soil loss equation and its application to conservation planning, sediment properties, initiation of sediment motion and over land flow, flow in alluvial channels and theory of sediment transport, channel stability, reserves sedimentation, wind erosion, BMPs for controlling erosion.

A E 536. Design and Evaluation of Soil and Water Monitoring Systems. (Dual-listed with 436). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: 431/531.* Development of monitoring systems that support effective planning, performance evaluation, modeling, or environmental impact assessment of soil-, water-, and waste-management systems. Typical soil and water pollutants and physical, chemical, and biological characteristics that affect sample location and timing. Sample collection, documentation, chain-of-custody, and quality assurance procedures. In addition to other assignments, graduate students will prepare several research literature reviews on topics covered in the class and develop monitoring plans.

A E 551. Food and Bioprocess Engineering. (Dual-listed with 451). (3-0) Cr. 3. F. *Prereq: 216 and M E 436 or Ch E 357, or FS HN 351 and Math 266 or 267.* Application of engineering principles and Mathematical modeling to the quantitative analysis of food and bioprocessing systems. Physical/chemical characteristics of foods and biological systems, flow processes, thermal processes and separation processes. Term paper required for graduate credit.

A E 569. Grain Processing and Handling. (Dual-listed with 469). (2-3) Cr. 3. S. *Prereq: 216.* Cereal grain and oilseed preservation, quality measurement, and end-use value. Design of drying systems using computer simulation. Corn wet and dry milling. Soybean oil extraction. Grain handling systems. Individual and group projects required for graduate credit.

A E 572. Design of Environmental Modification Systems for Animal Housing. (Dual-listed with 472). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 216, M E 330.* Principles and design of animal environmental control systems. Insulation, heat and mass transfer, fans, ventilation, air distribution, heating and cooling equipment, duct design, and controls. Individual and group projects required for graduate credit.

A E 578. Wood Frame Structural Design. (Dual-listed with 478). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 216, E M 324.* Design of light-framed wood structures. Includes analysis of wind, snow, dead, and live loads. Applications include animal housing and machine storage. Fasteners, laminated posts, truss design and use of National Design Specifications. Individual project required for graduate credit.

A E 590. Special Topics. Cr. arr. Repeatable.
B. Biosystems Engineering
F. Food Engineering
O. Occupational Safety
P. Power and Machinery Engineering
Q. Structures and Environment
R. Process Engineering
S. Water and Environment
U. Waste Management

A E 598. Technical Communications for a Master's Degree. (Cross-listed with TSM). Cr. 1. F.S.SS. A technical paper draft based on the M.S. thesis or creative component is required of all master's students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on M.S. thesis or creative component is required of all master's students. This presentation must be in a form that satisfies the normal presentation requirements of a professional Society. The presentation itself (oral or poster) may be made at a professional Society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Satisfactory-fail only.

A E 599. Creative Component. Cr. arr. Repeatable.

Courses primarily for graduate students

A E 601. Graduate Seminar. (Cross-listed with TSM). (1-0) Cr. 1. F. Keys to writing a good MS thesis or PhD dissertation. How to begin formulating research problems. Discussion of research problems, review of literature, research hypothesis, objectives, methods, procedures, and reports. Research grant proposals, patents and intellectual property rights, and international research centers of excellence will be discussed.

A E 610. Foundations of Sustainable Agriculture. (Cross-listed with Anthr, Soc, SusAg, Agron). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging systems of agriculture in terms of core concepts of sustainability and their theoretical contexts.

A E 690. Advanced Topics. Cr. arr. Repeatable.

A E 694. Teaching Practicum. (Cross-listed with TSM). Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification and permission of instructor.* Graduate student experience in the agricultural and biosystems engineering departmental teaching program.

A E 697. Engineering Internship. Cr. R. Repeatable. *Prereq: Permission of department chair, graduate classification.* One semester and one summer maximum per academic year professional work period.

A E 698. Technical Communications for a Doctoral Degree. (Cross-listed with TSM). Cr. 1. F.S.SS. A technical paper draft based on the dissertation is required of all Ph.D. students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on the dissertation is required of all Ph.D. students. This presentation must be in a form that satisfies the normal presentation requirements of a professional Society. The presentation itself (oral or poster) may be made at a professional Society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Satisfactory-fail only.

A E 699. Research. Cr. arr. Repeatable.
B. Biosystems Engineering
C. Computer-aided Design
E. Environmental Systems
F. Food Engineering
O. Occupational Safety
P. Power and Machinery Engineering
Q. Structures
R. Process Engineering
S. Environment and Natural Resources
U. Waste Management

Agronomy

Kendall Lamkey, Chair of Department

Distinguished Professors: Fehr, Horton

Distinguished Professors (Emeritus): Frey, Hallauer, Pesek, Russell, Shaw

Professors: P. Anderson, Arritt, Barnhart, Beavis, Burras, Chen, Cianzio, Cruse, Elmore, Fales, Gallus, Gutowski, Hartzler, Killorn, Lamkey, Lee, Liebman, Loynachan, Mallarino, Miller, Moore, Mullen, Owen, P. Peterson, T. Peterson, Sandor, Sawyer, Schnable, Tabatabai, Takle, Taylor, Thompson, Wang, Westgate, Wolt

Professors (Emeritus): M. Anderson, Atkins, Benson, Burris, Campbell, I. Carlson, R. Carlson, Fenton, Green, Hodges, Imsande, Keeney, Larson, Pearce, Schafer, Schaller, A. Scott, Shibles, Shrader, Skrdla, Stritzel, H. Thompson, L. Thompson, Troeh, Voss, Wedin, Whigham, Woolley, Yarger

Professors (Collaborators): Hatfield, Jaynes, Karlen, Kaspar, Laird, Logsdon, Masters, Palmer, Shoemaker

Associate Professors: Al-Kaisi, Becraft, Bhattacharyya, Dekker, Delate, Knapp, Lubberstedt, Manu, Wiedenhoeft

Associate Professors (Collaborators): Cambardella, Grant, Kovar, Moorman, Pollak, Sauer, M. Scott

Assistant Professors: Goggi, Heaton, Henning, Hornbuckle, Pedersen, Polito, Salas-Fernandez

Assistant Professor (Adjunct): Fu

Assistant Professors (Collaborators): Blanco, Cannon, Edwards, Gardner, Graham, Guan, Singer, Widrlechner

Lecturers: Christensen, Ciha, Dobill, McAndrews, Sleugh, Zdorkowski

Undergraduate Study

For undergraduate curriculum in Agronomy, see *College of Agriculture, Curricula.*

The Department of Agronomy has a curriculum noted for its scientific rigor and breadth in crop science, soil science, agricultural meteorology, and plant breeding. It prepares students for science-based professional positions, graduate study, or research careers across the spectrum of Agronomy.

The curriculum provides both flexibility and direction for students by offering four in-depth options: crop management and business, agroecology, soil and environmental science, quality and plant breeding and biotechnology. A minimum of 15 credits of Agronomy courses must be earned at Iowa State for students transferring from other institutions. The program also has many opportunities for undergraduate students to be involved in cutting edge research and international agriculture.

Graduates have the theoretical and practical knowledge needed for efficient and sustainable production of food, feed, fuel, and fiber. Graduates are skilled in communications, critical thinking, problem solving, and working effectively with others.

They understand the ethical, cultural, and environmental dimensions of issues facing professionals in agriculture and natural resources.

An Agronomy major prepares students for employment in agricultural business and industry, agricultural service organizations, crop production and soil management, environmental and natural resource management, and farm management. Graduates pursue careers in the seed, fertilizer, and agricultural chemical industries as field Agronomists, crop and soil management specialists, research technicians, sales and marketing specialists, and production managers. State and federal agencies employ Agronomists as extension specialists, county extension directors, environmental and natural resource specialists, research associates, soil surveyors, soil conservationists, and in regulatory agencies as plant, food, and grain inspectors. Additional areas of work open to Agronomists include integrated pest management, land appraisal, agricultural finance, turfgrass management, and the home lawn care industry.

The department offers an international scholar program leading to a credentialed title of "Agronomy International Scholar" for agronomy majors who have distinguished themselves in global understanding and international experience. Contact the department for requirements.

The department offers work for a minor in Agronomy. Students are required to complete an approved minor program that includes Agron 114, 154, 212, 354, and 6 additional credits, of which a minimum of 3 credits must be at the 300+ level. Nine credits for the Agronomy minor must be earned at Iowa State.

Graduate Study

The department offers programs that lead to the degrees master of science and doctor of philosophy, with majors in agricultural meteorology; crop production and physiology with optional specializations in seed science and weed science; plant breeding; and soil science with specialization in soil chemistry, soil fertility, soil management, soil Microbiology and biochemistry, soil morphology and genesis, or soil physics. Minor work is offered for students with majors in other departments. A M.S. nonthesis option is available for students desiring a general degree program with additional coursework and a written creative component substituting for thesis research.

Graduates have a broad knowledge base germane to their area of study. They are trained to integrate and apply knowledge to different situations. Students develop skills in scientific reasoning, organization, and logical presentation of ideas.

The department offers a Master of Science degree in Agronomy designed for the continuing education of professional Agronomists. The Program is taught at a distance using computer-based instructional media. It is a nonthesis degree requiring completion of a written creative component.

The department cooperates in the interdepartmental program in professional agriculture; interdepartmental majors in ecology and evolutionary biology; genetics; MCDB (molecular, cellular, and developmental biology); plant physiology; sustainable agriculture; and environmental science.

Prerequisite to major work in this department is completion of an undergraduate degree program with emphasis on Agronomic, biological, and physical sciences.

Courses primarily for undergraduate students

Agron 105. Leadership Experience. Cr. R. F.S.SS. A participatory experience in activities or completion of a course that enhances the development of leadership and group-dynamic skills. See adviser for departmental requirements.

Agron 110. Professional Development in Agronomy: Orientation. (0.5-0) Cr. 0.5. F. Orientation to college life, the profession of Agronomy, and the Agronomy curriculum.

Agron 114. Principles of Agronomy. (2-3) Cr. 3. F.S. Mullen. A foundation course in Agronomy applying crop, soil, and environmental sciences in understanding agricultural systems in the world. Includes introductory concepts of plant, soil, tillage, pest, environmental, and sustainable aspects of crop production. Off-campus version offered through internet by interactive computer courseware.

Agron 120. Introduction to Renewable Resources. (Cross-listed with Env S, NREM). (3-0) Cr. 3. F.S. Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

Agron 154. Fundamentals of Soil Science. (2-2) Cr. 3. F.S. *Prereq: Chem 163.* Manu. Introduction to physical, chemical, and biological properties of soils, their formation, classification, and distribution. Use of soil survey and computer databank information in balancing Agronomic, economic, and environmental concerns in soil management. Credit for only one of Agron 154, 155, or 156 may be applied toward graduation.

Agron 155. Soils for Horticultural Scientists. (2-2) Cr. 3. F.S. *Prereq: Chem 163.* Restricted to students in Horticulture. Manu. Physical, chemical and biological properties of natural and manufactured soils. Use of soil information when producing plants on natural and manufactured soils. Credit for only one of Agron 154, 155, or 156 may be applied toward graduation.

Agron 156. Soils for Urban Use. (2-2) Cr. 3. F.S. Restricted to students outside the College of Agriculture. Manu. Fundamental properties of soils and their application to urban Settings. Development of a site plan for area of land using data from soil survey and computerized data bank information. Field trip. Credit for only one of Agron 154, 155 or 156 may be applied toward graduation.

Agron 160. Water Resources of the World. (Cross-listed with Geol, Mteor, Env S). (3-0) Cr. 3. S. Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in Society and the environment.

Agron 206. Introduction to Meteorology. (Cross-listed with Mteor). (3-0) Cr. 3. F.S. Basic concepts in meteorology, including atmospheric measurements, radiation, stability, precipitation, winds, fronts, forecasting, and severe weather. Applied topics include global warming, ozone depletion, world climates and weather safety. Self-study laboratory assignments utilize interactive computerized exercises, worksheets and computerized real-time forecasting. Self-study section may be available to distant education students.

Agron 210. Professional Development in Agronomy: Career Planning. (1-0) Cr. 1. F. *Prereq: Sophomore classification.* Career planning, résumé and cover letter preparation, and interviewing techniques. Career orientation through invited speakers.

Agron 212. Crop Growth, Productivity and Management. (3-2) Cr. 4. F.S. *Prereq: 114.* Production and management practices for corn, soybean, small grain, and forage crops common to Midwestern U.S. agriculture. Emphasis on growth and development, plant characteristics, management practices, crop use, quality, and problem-solving.

Agron 260. Soils and Environmental Quality. (Cross-listed with Env S). (3-0) Cr. 3. F.S. Burras. Role of soils in environmental quality and natural resources management. Emphasis on soil erosion and conservation, water quality, and environmental planning. Saturday field trip.

Agron 283. Pesticide Application Certification. (Cross-listed with Ent, For, Hort). (2-0) Cr. 2. S. Holscher. Core background and specialty topics in agricultural, and Horticultural pesticide applicator certification. Students can Select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

Agron 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator, sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Agron 310. Professional Development in Agronomy: Work Experience. Cr. R. F.S.SS. Professional work experience in Agronomy. See adviser for departmental requirements. Satisfactory-fail only.

Agron 311. Professional Internship in Agronomy. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Agron 110, Agronomy majors only, permission of instructor before internship begins.* Wiedenhoeft. A supervised learning experience in a professional setting related to crop production, plant breeding, soil science or environmental science.

Agron 316. Crop Structure-Function Relationships. (3-0) Cr. 3. F.S. *Prereq: Biol 211.* Knapp. Basic principles concerning the growth, development, and production of crop communities in relation to their environment. Nonmajor graduate credit.

Agron 317. Principles of Weed Science. (2-2) Cr. 3. F. *Prereq: Biol 211.* Hartzler. Biology and ecology of weeds. Interactions between weeds and crops. Principles and practices of integrated weed management systems. Herbicide mechanisms, classification, and fate in plants and soils.

Agron 317L. Principles of Weed Science Laboratory. (0-3) Cr. 1. F. *Prereq: Enrollment in Agron 317.* Optional lab to accompany Agron 317. Identification, biology and management of important weeds of Agronomic and Horticultural habitats. Field trips.

Agron 320. Genetics, Agriculture and Biotechnology. (Cross-listed with Gen). (3-0) Cr. 3. F.S. *Prereq: Biol 212.* Transmission genetics with an emphasis on applications in agriculture, the structure and expression of the gene, how genes behave in populations and how recombinant DNA technology can be used to improve agriculture. Credit for graduation will not be allowed for more than one of the following: Gen 260, 313, 320 and Biol 313 and 313L.

Agron 325. Biorenewable Systems. (Cross-listed with A E, An S, BusAd, Econ, TSM). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing.

Agron 330. Crop and Seed Identification Laboratory. (0-4) Cr. 2. S. *Prereq: 114.* Identification, Agronomic and binomial classification of crops, weeds, and diseases. Analysis of crop seed samples for contaminants of weed and other crop seeds.

Agron 331. Intercollegiate Crops Team. (0-6) Cr. 2. F.S. *Prereq: Permission of instructor.* Intensive training in preparation for intercollegiate competition in national crops contests.

Agron 334. Forage Crop Management. (3-0) Cr. 3. F.S. *Prereq: 114.* Barnhart. Production and management of forage crops; concepts applied to yield, quality, and stand persistence; systems of forage utilization including grazing, hay, and silage. Students enrolling for graduate credit will be expected to complete an additional class project. Nonmajor graduate credit.

Agron 338. Seed Science and Technology. (Cross-listed with Hort). (2-3) Cr. 3. F. *Prereq: 114 or Hort 221, Biol 211.* Goggi. Seed production, maturation, dormancy, vigor, deterioration, and related aspects of enhancement, conditioning, storage, and quality evaluation. Aspects of the seed industry and regulation of seed marketing.

Agron 342. World Food Issues: Past and Present. (Cross-listed with Env S, FS HN, T SC). (3-0) Cr. 3. F.S. *Prereq: Junior classification.* Zdorkowski, Ford. Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects. Nonmajor graduate credit.
H. Honors Section. (Honors Program students only.)

Agron 351. Turfgrass Establishment and Management. (Cross-listed with Hort). (3-0) Cr. 3. F. *Prereq: Hort 221 or Agron 114 or Biol 211.* Principles and practices of turfgrass propagation, establishment, and management. Specialized practices relative to professional lawn care, golf courses, athletic fields, highway roadsides, and seed and sod production. The biology and control of turfgrass pests. Nonmajor graduate credit.

Agron 351L. Turfgrass Establishment and Management Laboratory. (Cross-listed with Hort). (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 351.* Those enrolled in the Horticulture curriculum are required to take 351L in conjunction with 351 except by permission of the instructor. Nonmajor graduate credit.

Agron 354. Soils and Plant Growth. (Cross-listed with Hort). (3-0) Cr. 3. F.S. *Prereq: Agron 154 and Biol 101 or 211.* Killorn or Loynachan. Effects of chemical, physical, and biological properties of soils on plant growth, with emphasis on nutritive elements, pH, organic matter maintenance, and rooting development. Nonmajor graduate credit.

Agron 354L. Soils and Plant Growth Laboratory. (Cross-listed with Hort). (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 354.* Henning. Laboratory exercises in soil testing that assess a soil's ability to support nutritive requirements for plant growth.

Agron 356. Site-Specific Crop and Soil Management. (3-3) Cr. 4. F. *Prereq: 114 and 354.* Polito. Development of solutions to crop and soil management problems in consultation with a producer-client. Identification of client needs, gathering technical information, and use of geographic information systems as a tool for making crop and soil management decisions. Development and presentation of solutions for crop and soil management issues confronting the client. Emphasis will be placed on identifying and solving complex problems that require integration of biological, physical, chemical, and economic components within a crop and soil management system. Nonmajor graduate credit.

Agron 360. Environmental Soil Science. (Cross-listed with EnSci). (2-3) Cr. 3. S. *Prereq: Agron 260 or Geol 100 or 201.* Burras and Killorn. Application of soil science to contemporary environmental problems; comparison of the impacts that different management strategies have on short- and long-term environmental quality and land development. Emphasis on participatory learning activities.

Agron 370. Field Experience in Soil Description and Interpretation. (0-3) Cr. 1. Repeatable. F.S. *Prereq: 154 and permission of instructor.* Sandor. Description and interpretation of soils in the field and laboratory, emphasizing hands-on experience. Evaluation of soil information for land use. Students may participate in intercollegiate judging contests.

Agron 392. Systems Analysis in Crop and Soil Management. (2-3) Cr. 3. F.S. *Prereq: 316, 354.* Wiedenhoeft. Management strategies at the level of the farm field. Emphasis will be on participatory learning activities.

Agron 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Agron 402. Watershed Hydrology. (Cross-listed with EnSci, Geol, Mteor, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

Agron 402I. Watershed Hydrology and Surficial Processes. (Cross-listed with Ia LL, EnSci). Cr. 4. SS. *Prereq: Four courses in physical or biological sciences or engineering.* Effects of geomorphology, soils, and land use on transport of water and materials (nutrients, contaminates) in watersheds. Fieldwork will emphasize investigations of the Iowa Great Lakes watershed. Nonmajor graduate credit.

Agron 404. Global Change. (Dual-listed with 504). (Cross-listed with EnSci, Env S, Mteor). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Nonmajor graduate credit.

Agron 405. Environmental Biophysics. (Dual-listed with 505). (Cross-listed with Mteor, EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities. Nonmajor graduate credit.

Agron 406. World Climates. (Cross-listed with Mteor, EnSci). (3-0) Cr. 3. F. *Prereq: Agron/Mteor 206.* Arritt. Distribution and causes of different climates around the world. Effects of climate and climate variations on human activities including Society, economy and agriculture. Current issues such as climate change and international efforts to assess and mitigate the consequences of a changing climate. Semester project and in-class presentation required. Nonmajor graduate credit.

Agron 407. Mesoscale Meteorology. (Dual-listed with 507). (Cross-listed with Mteor). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 166 and Mteor 454.* Arritt, Gallus. Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

Agron 410. Professional Development in Agronomy: Senior Forum. (1-0) Cr. 1. F.S. *Prereq: Senior classification.* Development of an appropriate content for professionalism. Topics include professional certification, ethics, and maintaining an active network of information sources and professional contacts in support of lifelong learning. Student interpretation, writings, presentations, and discussions.

Agron 417. Evolutionary Ecology of Weeds. (Dual-listed with 517). (3-0) Cr. 3. *Prereq: 317* Dekker. Ecology and evolution of invasive plants and weeds in habitats disturbed by humans. Life history trait evolution and adaptation to agricultural opportunities and the consequent processes of invasion, colonization, enduring occupation and population shifts. Roles played by mating systems and biodiversity, soil seed pools and community assembly, competitive interactions with neighbors and fitness.

Agron 421. Introduction to Plant Breeding. (Cross-listed with Hort). (3-0) Cr. 3. F. *Prereq: Gen 320 or Biol 313.* Breeding methods used in the genetic improvement of self-pollinated, cross-pollinated and asexually reproducing Agronomic and Horticultural crops. Applications of biotechnology techniques in the development of improved cultivars. Nonmajor graduate credit.

Agron 446. International Issues and Challenges in Sustainable Development. (Cross-listed with Globe, IntSt). Cr. 4. S. *Prereq: 3-credit biology course, Sophomore or higher classification, permission of Instructor.* Mullen. Interdisciplinary study and analysis of agricultural, biophysical, environmental, sociological, economical, political, and historical factors affecting sustainable development of communities and countries from art and science perspectives. International field experience with foreign language training required. A program fee is charged to students for international study abroad.

Agron 450. Issues in Sustainable Agriculture. (Cross-listed with Env S). (3-0) Cr. 3. F. Zdorkowski. Agricultural science as a human activity; contemporary agricultural issues from agroecological perspective. Comparative analysis of intended and actual consequences of development of industrial agricultural practices.

Agron 452. GIS for Geoscientists. (Dual-listed with 552). (Cross-listed with Geol, EnSci). (2-2) Cr. 3. F. *Prereq: Geol 100, Geol 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses. Nonmajor graduate credit.

Agron 459. Environmental Soil and Water Chemistry. (Dual-listed with 559). (Cross-listed with EnSci). (3-3) Cr. 4. F. *Prereq: Agron 354 or EnSci 360; Chem 164, 165, or 178; Math 140. Chem 211 or 231 recommended.* Thompson. An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, and applications to contemporary environmental issues. Nonmajor graduate credit.

Agron 463. Soil formation and Landscape Relationships. (Dual-listed with 563). (Cross-listed with EnSci). (2-4) Cr. 4. S. *Prereq: Agron 154 or 260.* Sandor. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for one of Agron 463 or 463I may be applied for graduation. Nonmajor graduate credit.

Agron 463I. Soil formation and Landscape Relationships. (Dual-listed with 563I).(Cross-listed with EnSci, Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: 154 or 260.* Burras. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for one of Agron 463 or 463I may be applied for graduation. Nonmajor graduate credit.

Agron 477. Soil Physics. (Dual-listed with 577). (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: 354. Recommended: Math 166.* Horton. The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

Agron 484. Organic Agricultural Theory and Practice. (Dual-listed with 584). (Cross-listed with Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 9 cr. in biological or physical sciences.* Delate & DeWitt. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and Socio-economic processes and policies in organic agriculture from researcher and producer perspectives. Nonmajor graduate credit.

Agron 485. Soil and Environmental Microbiology. (Dual-listed with 585). (Cross-listed with EnSci, Micro). (2-3) Cr. 3. F. *Prereq: 154 or 402, Micro 201 (Micro 203 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues. Nonmajor graduate credit.

Agron 490. Independent Study. Cr. 1-3. Repeatable maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in Agronomy; permission of instructor in specialty area after consultation.* Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.
E. Entrepreneurship
G. General
H. Honors
Z. Service Learning

Agron 491. Seed Science Internship Experience. (Cross-listed with TSM, Hort). Cr. arr. Repeatable. F.S.SS. *Prereq: Agron 338, advanced approval and participation of employer and instructor.* A professional work experience and creative project for seed science secondary majors. The project requires the prior approval and participation of the employer and instructor. The student must submit a written report.

Agron 493. Workshop in Agronomy. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Staff. Workshop experience in crops, soils, or agricultural meteorology. Nonmajor graduate credit.

Agron 495. Agricultural Travel Course Preparation. Cr. R. Repeatable. F.S. *Prereq: Permission of instructor.* Limited enrollment. Students enrolled in this course intend to register for Agron 496 the following term. Topics will include the agricultural industries, climate, crops, culture, economics, geography, history, livestock, marketing, soils, and preparation for travel to locations to be visited.

Agron 496. Agricultural Travel Course. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Limited enrollment. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on crop and livestock production. Location and duration of tours will vary. Tour expenses paid by students. Check with department for current offerings.
A. International Tour
B. Domestic Tour

Agron 497. Agroecology Field Course. (3-0) Cr. 3. F. *Prereq: Jr. or Sr. classification with at least 8 credits in Agronomy.* A one-week intensive class, offered off-campus. Student will visit farms within the Midwest and analyze the sustainability of each farm.

Agron 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

Agron 500. Orientation Seminar. (2-0) Cr. 1. F. *Prereq: International Agronomy graduate students only.* Loynachan. An introduction to Iowa and U.S. agriculture for international scholars in Agronomic majors. Field trips when possible. Departmental role in the functioning of research, teaching, and extension in fulfilling the charge given the land-grant university.

Agron 501. Crop Growth and Development. (3-0) Cr. 3. F. *Prereq: 114, Math 140, Chem 163, Biol 101.* Physiological processes in crop growth, development and yield: photosynthesis, respiration, water relations, mineral nutrition, assimilate partitioning, seedling vigor, light interception and canopy growth, root growth, reproduction and yield. Required course for the Master of Science in Agronomy degree program.

Agron 502. Chemistry, Physics, and Biology of Soils. (3-0) Cr. 3. F. *Prereq: 114, 154, Biol 101, Chem 163, and Math 140.* Soil chemical, physical, and biological properties that control processes within the soil, their influence on plant/soil interactions, and soil classification. Basic concepts in soil science and their applications. Required course for the Master of Science in Agronomy degree program.

Agron 503. Climate and Crop Growth. (3-0) Cr. 3. F. *Prereq: 114 and Math 140.* Applied concepts in climate and agricultural meteorology with emphasis on the climate-agriculture relationship and the micro-climate-agriculture interaction. Basic meteorological principles are also presented to support these applied concepts. Required course for the Master of Science in Agronomy degree program.

Agron 504. Global Change. (Dual-listed with 404). (Cross-listed with Mteor, EnSci). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior, senior, or graduate standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change.

Agron 505. Environmental Biophysics. (Dual-listed with 405). (Cross-listed with Mteor, EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities. Semester project required.

Agron 507. Mesoscale Meteorology. (Dual-listed with 407). (Cross-listed with Mteor). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 166 and Mteor 454.* Arritt, Gallus. The physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure. Semester project and in-class presentation required.

Agron 508. Biophysical Crop Ecology. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 505.* Taylor. Principles of resource capture (light and water) applied to growth and development. Ecological implications of radiation, temperature, moisture, and the biological properties of size, shape, resistance to water vapor loss, and absorptivity to solar and thermal radiation. Physiological stress in the soil, plant, atmosphere continuum.

Agron 509. Agroecosystem Analysis. (Cross-listed with Anthr, Soc, SusAg). (3-4) Cr. 3. F. *Prereq: Senior or above classification.* Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (agronomic, economic, ecological, social, etc), and scales of operation.

Agron 510. Crop Improvement. (Cross-listed with STB). (3-0) Cr. 3. F. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* A study of the basic principles and methods in the genetic improvement of crop plants. Methods used in manipulating genomes through the use of biotechnology. Methods of cultivar development. Quantitative procedures for describing response to selection. Analysis of the relationship of reproductive characters and growth characteristics to response to selection.

Agron 511. Crop Improvement. (3-0) Cr. 3. S. *Prereq: 114, Math 140, Chem 163, Biol 101.* Basic principles in the genetic improvement of crop plants. Methods of cultivar development in self-pollinated and cross-pollinated crop species. Required course for the Master of Science in Agronomy degree program.

Agron 512. Soil-Plant Environment. (3-0) Cr. 3. S. *Prereq: 502. Recommended 501.* Loynachan. Soil properties and their impact on soil/plant relationships. Soil structure, aeration, moisture, and nutrients will be discussed in the context of soil fertility and environmental quality management. Required course for the Master of Science in Agronomy degree program.

Agron 513. Quantitative Methods for Agronomy. (3-0) Cr. 3. S. *Prereq: 114, Math 140, Stat 104.* Quantitative methods for analyzing and interpreting Agronomic information. Principles of experimental design, hypothesis testing, analysis of variance, regression, correlation, and graphical representation of data. Use of JMP for organization, analyzing, and presenting data. Required course for the Master of Science in Agronomy degree program.

Agron 514. Integrated Pest Management. (3-0) Cr. 3. SS. *Prereq: 114, 501, Math 140, Chem 163, Biol 101. Recommended: 502, 503.* Principles and practices of weed science, entomology, and plant pathology applied to crop production systems. Biology, ecology and principles of integrated crop pest management. Required course for the Master of Science in Agronomy degree program.

Agron 515. Integrated Crop and Livestock Production Systems. (Cross-listed with A E, SusAg, An S). (3-0) Cr. 3. F. *Prereq: 509.* Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

Agron 516. Crop Physiology. (3-0) Cr. 3. S. Westgate. Investigation of Molecular, whole plant, and plant community processes essential to biomass production and seed formation, and analysis of molecular approaches to overcome the limitations imposed on these processes by the environment.

Agron 517. Evolutionary Ecology of Weeds. (Dual-listed with 417). (3-0) Cr. 3. S. *Prereq: 317.* Dekker. Ecology and evolution of invasive plants and weeds in habitats disturbed by humans. Life history trait evolution and adaptation to agricultural opportunities and the consequent processes of invasion, colonization, enduring occupation and population shifts. Roles played by mating systems and biodiversity, soil seed pools and community assembly, competitive interactions with neighbors and fitness.

Agron 518. Microwave Remote Sensing. (Cross-listed with E E, Mteor). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 265 or equivalent or permission of instructor.* Hornbuckle. Microwave remote sensing of Earth's surface and atmosphere. Overview of relevant electromagnetic theory and antenna theory. Planck emission and the radiative transfer equation. The electrical properties of natural materials at microwave frequencies. Specific examples include remote sensing of atmospheric temperature and water vapor, precipitation, and soil and vegetation water content.

Agron 519. Herbicide Physiology and Biochemistry. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 317; Biol 330.* Owen. Herbicide mechanisms of action, selectivity, uptake, and translocation. Specific sites of herbicide action as they affect plant physiology. Herbicide resistance in weeds and crops. Implications of herbicides on weed management.

Agron 521. Principles of Cultivar Development. (3-0) Cr. 3. F. *Prereq: 421; Stat 401.* Theoretical and practical analysis of alternative breeding methods to improve crop plants. Strategies to incorporate germplasm resources, develop populations, maximize genetic gain, and use marker-assisted selection. Relationship of breeding methods to commercial seed production.

Agron 522. Field Methods in Plant Breeding. (0-6) Cr. 2. SS. *Prereq: 521.* Field experience in planning and conducting plant breeding research for germplasm and cultivar development. Satisfactory-fail only.

Agron 526. Field Plot Technique. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Stat 401.* Moore. Planning experiments for agricultural research, analysis of data, and concepts in data interpretation.

Agron 527. Plant Genetics. (3-0) Cr. 3. S. *Prereq: Gen 410.* Bhattacharyya. Fundamental genetic and cytogenetic concepts from plant perspective including recombination, linkage analysis, genetic and molecular mapping, male sterility, self incompatibility, apomixis, and polyploid evolution.

Agron 529. Publishing in Plant Science Journals. (Cross-listed with Hort, NREM). (2-0) Cr. 2. S. *Prereq: Permission of instructor; evidence of a publishable unit of the student's research data.* Process of preparing a manuscript for submission to a refereed journal in the biological sciences. Emphasis on publishing self-generated data from thesis or dissertation research.

Agron 530. Ecologically Based Pest Management Strategies. (Cross-listed with SusAg, Ent, Pl P). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: SusAg 509.* Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

Agron 531. Crop Ecology and Management. (3-0) Cr. 3. F. *Prereq: 501, 502, 503. Recommended: 512, 514.* Ecological principles underlying crop production systems. Crop production in the context of management approaches, system resources and constraints,

and interactions. Emphasis on the ecology of row and forage crops common to the Midwest. Required course for the Master of Science in Agronomy degree program.

Agron 532. Soil Management. (3-0) Cr. 3. F. *Prereq: 501, 503, 512. Recommended 513.* Evaluates the impact of various soil management practices on soil and water resources. Combines and applies basic information gained in Agron 502 and Agron 512. Emphasizes the Agronomic, economic, and environmental effects of soil management strategies. Required course for the Master of Science in Agronomy degree program.

Agron 533. Crop Protection. (3-0) Cr. 3. F. *Prereq: 514.* Integrated management systems for important crop pests. Cultural, biological and chemical management strategies applicable to major crops grown in the Midwest. Required course for the Master of Science in Agronomy degree program.

Agron 534. Seed and Variety, Testing and Technology. (Cross-listed with STB). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* The components of seed quality and how they are assessed in the laboratory, including traits derived from modern biotechnology. The impact of new technologies on seed quality testing. Variety maintenance procedures and breeder seed. Variety identification: phenotype and grow-out trials, isozyme testing, and DNA marker testing. Procedures for evaluating varieties. The variance tests appropriate for fixed effects analysis of variance. Statistical inference and stratification for yield trials. Use of strip plot testing.

Agron 535. Introduction to the Seed Industry. (Cross-listed with STB). Cr. 1. *Prereq: Curriculum requires undergraduate specialization in a business or biological science.* An analysis of the defining characteristics of the seed industry and introduction to the Master in Seed Technology and Business curriculum. The tasks of crop improvement and seed production will be analytically related to basic management functions and classifications of management activities that are used in the study of business administration. Management tasks and roles will be analyzed in related to the public policy issues that shape the seed industry, including ethical and economical approaches to biotechnology, intellectual property, and corporate responsibility.

Agron 536. Quantitative Methods for Seed. (Cross-listed with STB). (1-0) Cr. 1. F. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Quantitative Methods for analyzing and interpreting Agronomic and business information for the seed industry. Principles of experimental design and hypothesis testing, regression, correlation and graphical representation of data. Use of spreadsheets for manipulating, analyzing and presenting data.

Agron 537. Plant Stress Biology. (Cross-listed with Hort, EEOB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 330A or equivalent and BBMB 404-405.* Physiology and molecular biology of plant responses to environmental stress. Emphasis on the role of hormones and hormone interactions in governing stress responses. Lectures are prepared from journal papers that elucidate key mechanisms controlling responses to drought, flooding, salt, nutrient deficiencies, freezing, pathogens and herbivores. Plants studied include genetic model systems and crops of Horticultural and Agronomic value.

Agron 538. Seed Physiology. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: 338; Chem 231 or Chem 331.* Goggi. Physiological aspects of seed development, maturation, longevity, dormancy, and germination. Emphasis on current literature and advanced methodology.

Agron 539. Seed Conditioning and Storage. (Cross-listed with STB). (2-0) Cr. 2. F. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* The technical operations which may be carried out on a seed lot from harvest until it is ready for marketing and use. The opportunities for quality improvement and the risks of deterioration which are present during that time. Analysis of the costs of and benefits of operations. Evaluation of equipment based on benefits to the customer and producer. Interpretation of the role of the conditioning plant and store as focal points within the overall operations of a seed company.

Agron 541. Applied Agricultural Meteorology. Cr. 2-3. F.S.SS. *Prereq: 206 or upper division Biological Science.* Taylor. Applied concepts in agricultural meteorology. Basic concepts of weather and of crop/climate relationships influencing production, protection, yield and associated production risk factors. Self study sections are available to resident and to distant education students all semesters. Credit for only one of Agron 503 or 541 may be applied toward graduation.

Agron 546. Organizational Strategies for Diversified Farming Systems. (Cross-listed with Soc, Hort, SusAg). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: SusAg 509.* Examination of the organization and operation of complex, diversified farming systems using tools and perspectives drawn from ecology, Agronomy, and Sociology. The course includes a significant field component focused on an Iowa farm.

Agron 547. Seed Production. (Cross-listed with STB). (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of instructor.* Survey of crop production; including management of soil fertility, planting dates, populations, weed control, and insect control. Analysis of the principles of seed multiplication and the key practices which are used to ensure high quality in the products. Field inspection procedures and production aspects that differ from other crop production. Foundation seed production. Analysis of the typical organization of field production tasks. Resources and capabilities required. Survey of differences in seed production strategies between crops and impact of differences on management of seed production.

Agron 551. Growth and Development of Perennial Grasses. (Cross-listed with Hort). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Junior or senior or graduate classification or permission of instructor.* The grass plant. Selected topics on anatomy, morphology, and physiology relative to growth and development of perennial grasses. Emphasis on growth and development characteristics peculiar to grasses and variations of such characteristics under natural and managed conditions.

Agron 552. GIS for Geoscientists. (Dual-listed with 452). (Cross-listed with Geol, EnSci). (2-2) Cr. 3. F. *Prereq: Geol 100, Geol 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscience data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

Agron 553. Soil-Plant Relationships. (Cross-listed with EnSci). (3-0) Cr. 3. F. *Prereq: Agron 354.* Killorn. Composition and properties of soils in relation to the nutrition and growth of plants.

Agron 554. Advanced Soil Management. (2-0) Cr. 2. Alt. F., offered 2009. *Prereq: 354; Math 165.* Cruse. Implications of soil management on the soil environment and root activity. Effect of soil physical properties on soil erosion.

Agron 555. Soil Clay Mineralogy. (Cross-listed with Geol). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Agron 473, Chem 178. Recommend: Geol 311.* Structure and behavior of clay minerals in soil environments, with emphasis on layer silicates and on Fe, Mn, and Al oxides.

Agron 555L. Soil Clay Mineralogy Laboratory. (Cross-listed with Geol). (0-3) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in 555.* Thompson. Application of X-ray diffraction, thermal analysis, infrared spectroscopy, and chemical analyses to identification and behavior of clay minerals in soils.

Agron 558. Laboratory Methods in Soil Chemistry. (Cross-listed with EnSci). (2-3) Cr. 3. F. *Prereq: Agron 354 and Chem 178 or 211.* Tabatabai. Experimental and descriptive inorganic and organic analyses. Operational theory and principles of applicable instruments, including spectrophotometry, atomic and molecular absorption and emission spectroscopy, mass spectrometry, X-ray diffraction and fluorescence, gas and ion chromatography, and ion-selective electrodes.

Agron 559. Environmental Soil and Water Chemistry. (Dual-listed with 459). (Cross-listed with EnSci). (3-3) Cr. 4. F. *Prereq: Agron 354 or EnSci 360; Chem 164, 165, or 178; Math 140. Chem 211 or 231 recommended.* Thompson. An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, chemical-equilibrium speciation programs, and applications to contemporary environmental issues.

Agron 561. Population and Quantitative Genetics for Breeding. (Cross-listed with An S). (4-0) Cr. 4. F. *Prereq: Stat 401.* Population and quantitative genetics for plant and animal genetics. Study of the genetic basis and analysis of variation in quantitative traits in domestic or experimental populations using phenotypic and molecular marker data, including estimation of heritability and other genetic parameters, linkage analysis and mapping of quantitative trait loci, and the impact of inbreeding, heterosis, and genotype-by-environment interaction.

Agron 563. Soil formation and Landscape Relationships. (Dual-listed with 463). (Cross-listed with EnSci). (2-4) Cr. 4. S. *Prereq: 154 or 260.* Sandor. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for one of Agron 563 or 563I may be applied for graduation.

Agron 563I. Soil formation and Landscape Relationships. (Dual-listed with 463I).(Cross-listed with EnSci, Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: 154 or 260.* Burras. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for only Agron 563 or 563I may be applied for graduation.

Agron 565. Professional Practice in the Life Sciences. (Cross-listed with PI P, An S, BCB, Hort, Micro, V MPM). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.
A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

Agron 570. Risk Assessment for Food, Agriculture and Veterinary Medicine. (Cross-listed with VDPAM, Tox). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 104 or consent of instructor: Wolt, Hurd.* Risk assessment principles as applied to biological systems. Exposure and effects characterization in human and animal health and ecological risk assessment. Risk analysis frameworks and regulatory decision-making. Introduction to quantitative methods for risk assessment using epidemiological and distributional analyses. Uncertainty analysis.

Agron 575. Soil Formation and Transformation. (Cross-listed with EnSci). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 463 or equivalent.* Advanced study of soil formation, emphasizing relationships among soils, landscapes, environment, humans, and land use.

Agron 577. Soil Physics. (Dual-listed with 477). (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: 354. Recommended: Math 166.* Horton. The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

Agron 578. Laboratory Methods in Soil Physics. (Cross-listed with EnSci). (0-3) Cr. 1. S. *Prereq: 577 concurrent.* Horton. Methods of measuring soil physical properties such as texture, density, and water content, and transport of heat, water, and gases.

Agron 584. Organic Agricultural Theory and Practice. (Dual-listed with 484). (Cross-listed with Hort, SusAg). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 9 cr. in biological or physical sciences.* Delate & DeWitt. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and Socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

Agron 585. Soil and Environmental Microbiology. (Dual-listed with 485). (Cross-listed with EnSci, Micro). (2-3) Cr. 3. F. *Prereq: 154 or 402, Micro 201 (Micro 203 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

Agron 590. Special Topics. Cr. arr. Repeatable. *Prereq: 15 credits in Agronomy.* Literature reviews and conferences on selected topics in crops, soils, or agricultural meteorology according to needs and interest of student.

Agron 591. Agronomic Systems Analysis. (3-0) Cr. 3. S. *Prereq: 511, 513, 531, 532, 533.* Analysis of cropping systems from a problem-solving perspective. Case studies will be used to develop the students' ability to solve Agronomic problems. Required course for the Master of Science in Agronomy degree program.

Agron 592. Current Issues in Agronomy. (3-0) Cr. 3. S. *Prereq: 501, 503, 511, 512, 513, 514.* Study and discussion of topics of current interest to the field of Agronomy. While Agron 591 deals with Agronomics at the farm and landscape level, Agron 592 seeks to address issues on a broader scale including off-farm agricultural impacts. Required course for the Master of Science in Agronomy degree program.

Agron 593. Workshop in Agronomy. (1-0) Cr. 1. SS. *Prereq: 501, 502, 503, 514 (or current enrollment). Recommended: 511, 512, 513.* Practical field and laboratory experience integrating coursework in climatology, crops, and soils. Workshop includes lectures, labs and local agri-business tours. Required course for the Master of Science in Agronomy degree program.

Agron 595. Seed Quality, Production, and Research Management. (Cross-listed with STB). (3-0) Cr. 3. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Advanced survey of the organization, staff capabilities and management characteristics typical in seed production and crop improvement in seed enterprises. Analysis of the use of quality information in the management of seed operations and sales. Process management applications for seed. Production planning for existing capacity. Analysis of the manager's tasks in the annual cycle and how the tasks of these managers relate to the general categories of business management roles. Difference in management strategies used with different situations and groups of employees.

Agron 599. Creative Component. Cr. arr. *Prereq: Nonthesis M.S. option only.* A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.
A. Agricultural Meteorology
B. Crop Production and Physiology
C. Plant Breeding
D. Soil Chemistry
E. Soil Fertility
F. Soil Management
G. Soil Microbiology and Biochemistry
H. Soil Morphology and Genesis
I. Soil Physics
K. Seed Science
L. Weed Science
M. Agronomy

Courses for graduate students

Agron 600. Seminar. (1-0) Cr. 1. Repeatable. F.S. Reports and discussion of recent literature and research.
A. Plant Breeding.
B. Soils. F.S.
C. Crop Production and Physiology. F.S.

Agron 609. Agricultural Meteorology Conference. (1-0) Cr. 1. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Literature reviews and conferences with instructor on special problems relating to agricultural meteorology, beyond the scope of current courses offered.

Agron 610. Foundations of Sustainable Agriculture. (Cross-listed with SusAg, A E, Anthr, Soc). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging agricultural systems in terms of the core concepts of sustainability and their theoretical contexts.

Agron 616. Advanced Topics in Plant Physiology and Biochemistry. (4-0) Cr. 4. Alt. S., offered 2010. *Prereq: Graduate classification; permission of instructor.* Westgate. An in-depth treatment of physiological, biochemical and molecular processes regulating plant growth and development. Emphasis on individual study followed by in-class presentations and discussion.

Agron 621. Advanced Plant Breeding. (3-0) Cr. 3. S. *Prereq: 521, 526, 561; Gen 410.* Lamkey. Estimation and interpretation of genetic effects and variances of plant populations, analysis of mating designs, heritability estimation, intra- and interpopulation selection methods, prediction of genetic gain, inbreeding and heterosis, classification and development of parental materials, selection indices, and combining ability analysis.

Agron 625. Genetic Strategies in Plant Breeding. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 521, Gen 410.* Lee. Evaluation of genetic, molecular, and cellular approaches to crop improvement; gene transfer methods. Application and role of basic plant biology in breeding programs and processes; genome structure and function, gene isolation, expression, regulation, and modification. Integration of molecular and cellular methods in breeding strategies; analysis of alternative breeding methods, regulatory and ethical issues.

Agron 655. Advanced Soil Fertility. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 553.* Evaluation of soil fertility and fertilizers; theory and applications.

Agron 677. Advanced Soil Physics. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: 577; Math 266, 267. Recommended: Com S 207.* Horton. The flow and distribution of water, chemicals, and heat in soils. Physical principles and applications.

Agron 685. Advanced Soil Biochemistry. (Cross-listed with Micro, EnSci). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Agron 585.* Tabatabai. Chemistry of soil organic matter and biochemical transformations brought about by microorganisms and enzymes in soils.

Agron 696. Research Seminar. (Cross-listed with BBMB, GDCB, PlBio, Hort, For). Cr. 1. Repeatable. Research seminars by faculty and graduate students. Satisfactory-fail only.

Agron 698. Agronomy Teaching Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification in Agronomy and permission of instructor.* Graduate student experience in the Agronomy teaching program. Satisfactory-fail only.

Agron 699. Research. Cr. arr. Repeatable.
A. Agricultural Meteorology
B. Crop Production and Physiology
C. Plant Breeding
D. Soil Chemistry
E. Soil Fertility
F. Soil Management
G. Soil Microbiology and Biochemistry
H. Soil Morphology and Genesis
I. Soil Physics
J. Plant Physiology
K. Seed Science
L. Weed Science

Air Force Aerospace Studies

www.iastate.edu/~airforce/

Col. James Cramp, Chair of Department

Professors: Cramp

Assistant Professors (Adjunct): Menschner, Morgan, Wendelin

Undergraduate Study

The objectives of the Department of Air Force Aerospace Studies are to provide qualified students the opportunity to earn a commission as an officer in the active duty Air Force, and to build better citizens for those not interested in joining the Air Force.

The curriculum is divided into two basic phases, the general military course (GMC) and the professional officer course (POC). The GMC is introductory and consists of four consecutive 1-hour courses normally taken during the freshman and sophomore years. GMC completion is not a prerequisite for entry into the POC, although it is recommended by the department.

Prior to entry into the POC, most students complete field training at an Air Force base. Students who have completed the GMC participate in a 4-week program, which provides a concentrated experience in the Air Force environment. The training program includes junior officer training, aircraft and aircrew orientation, career orientation, survival training, an introduction to typical base functions, and physical training. A 6-week training program is provided for those students entering the POC who did not complete the GMC. This program includes all that is offered in the 4-week program, plus academic and leadership laboratory experiences included in the on-campus GMC courses.

Selection for the professional officer course is on a competitive basis, and cadets enrolling in this course must meet certain academic, mental, physical, and moral standards. Qualified cadets may be selected as flight candidates and receive flight instruction prior to attending Undergraduate Pilot Training (UPT) or Undergraduate Navigator Training (UNT). Upon enrollment in the POC, all cadets are required to complete a contractual agreement with the Air Force, which obligates them to 4 years of active duty as an officer in the United States Air Force. Air Force active duty commitment is 10 years for pilots and 6 years for navigators. Uniforms and AFROTC texts are supplied to the cadets, and those in the POC receive a subsistence allowance between $450-500 per month.

Students who fail to observe the contract terms may be called to active duty in an enlisted grade or be required to repay monies received from the Air Force.

Air Force ROTC scholarships are available and provide payment of full tuition and fees. In addition, Scholarship cadets receive between $$300-500 monthly subsistence allowance and $900 per year book allowance. Upon acceptance of a scholarship, the student executes a contract with the Air Force. Scholarships can be awarded for periods of 2, 3, or 4 years, with up to 1 additional year for qualified applicants in selected majors. To determine eligibility and initiate application procedures for the scholarship program, interested students should contact the department.

Entry into the program is not dependent on departmental major or year in the university. The AFROTC program is open to both male and female students.

The College of Liberal Arts and Sciences offers a minor in military studies. Requirements for the minor include taking a minimum of 15 credits of ROTC instruction, which may be taken from one or a number of the ROTC programs. At least 6 credits must be in courses numbered 300 or above.

Courses primarily for undergraduate students

AFAS 101. Leadership Laboratory I. (0-2) Cr. 1. F. Instructions on Air Force customs and courtesies; drill and ceremonies, issuing military commands, physical training, studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 102. Leadership Laboratory II. (0-2) Cr. 1. S. Continuation of AFAS 101. Air Force customs and courtesies; drill and ceremonies, issuing military commands, instructing team members, physical training, directing and evaluating the preceding skills, studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 141. Foundations of the United States Air Force. (1-0) Cr. 1. F. Basic introduction to the United States Air Force and Air Force Reserve Officer Training Corps. Mission and organization of the Air Force, officership and professionalism, military customs and courtesies, Air Force officer opportunities, and communication skills. Leadership Laboratory is mandatory for AFROTC cadets complements this course by providing cadets with followership experiences.

AFAS 142. Foundations of the United States Air Force. (1-0) Cr. 1. S. A continuation of 141. Topics include Air Force installations, Air Force core values, leadership and team building, further study of interpersonal communication, the Oath of Office and Commissioning. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 151. Air Force Physical Training. (0-2) Cr. 1. Repeatable. S. F. *Prereq: Enrollment as a cadet in an Air Force Aerospace Studies Class.* Use of basic military training skills and instruction to develop confidence, leadership, communication skills and physical fitness. The team approach is utilized in the instruction and application of Air Force physical fitness requirements. Students will learn various Air Force physical fitness techniques as well as how to conduct physical fitness sessions. Full participation in all events will be determined based on student's physical and medical eligibility. Satisfactory-fail only.

AFAS 201. Leadership Laboratory I. (0-2) Cr. 1. F. Instruction for junior cadets on Air Force customs and courtesies, drill and ceremonies, issuing military commands, instructing, physical training, directing, and evaluating the preceding skills, the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Continued military training related to wearing the uniform, engaging in military customs and courtesies, and participating in military ceremonies. This laboratory is required if applying for the POC. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 202. Leadership Laboratory II. (0-2) Cr. 1. S. A continuation of AFAS 201, instructing junior cadets on Air Force customs and courtesies, drill and ceremonies, issuing military commands, instructing, physical training, directing, and evaluating the preceding skills, the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Continued military training related to wearing the uniform, engaging in military customs and courtesies, and participating in military ceremonies. This laboratory is required if applying for the POC. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 241. The Evolution of USAF Air & Space Power I. (1-0) Cr. 1. F. Examines the general aspects of air and space power through a historical perspective. Utilizing this perspective, the course covers a time period from the first balloons and dirigibles to the Korean War. Historical examples are provided to illustrate the development of Air Force capabilities (competencies), and missions (functions) to demonstrate the evolution of what has become today's USAF air and space power. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 242. The Evolution of USAF Air & Space Power II. (1-0) Cr. 1. S. Examines the general aspects of air and space power through a historical perspective. Utilizing this perspective, the course covers a time period from the Korean War to the space-age global positioning systems of the Persian Gulf War. Historical examples are provided to illustrate the development of Air Force capabilities (competencies), and missions (functions) to demonstrate the evolution of what has become today's USAF air and space power. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 301. Leadership Laboratory I. (0-3) Cr. 1. F. Mid-level management of leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if taking AFAS 341 and pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 302. Leadership Laboratory II. (0-3) Cr. 1. S. Continuation of AFAS 301, mid-level management of leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 341. Air Force Leadership Studies I. (3-0) Cr. 3. F. *Prereq: 141, 142, 241, and 242.* Continuation of the study of leadership, management fundamentals, professional knowledge, Air Force personnel and evaluation systems, leadership ethics, and the communication skills required of an Air Force junior officer. Case studies are used to examine Air Force leadership and management situations as a means of demonstrating and exercising practical application of the concepts being studied. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 342. Air Force Leadership Studies II. (3-0) Cr. 3. S. *Prereq: 341.* A continuation of the study of leadership, management fundamentals, professional knowledge, Air Force personnel and evaluation systems, leadership ethics, and the communication skills required of an Air Force junior officer. Case studies are used to examine Air Force leadership and management situations as a means of demonstrating and exercising practical application of the concepts being studied. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 401. Leadership Laboratory I. (0-3) Cr. 1. F. Advanced leadership experiences involving the planning and controlling of the upper level management of military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if taking AFAS 441 and pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 402. Leadership Laboratory II. (0-3) Cr. 1. S. Advanced leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if taking AFAS 442 and pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 441. National Security Affairs & Preparation for Active Duty I. (3-0) Cr. 3. F. *Prereq: 342.* Examines the national security process to include the development of U.S. Policy and strategy; structure of the Department of Defense: advanced study of Joint and Air Force Doctrine; and, advanced study of joint operations. Examines administrative actions and military law as they pertain to force management. Includes a regional studies component with focus on Africa, Latin America, South Asia and East Asia. Begins preparation for active duty through emphasis on current issues affecting professional military officers. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 442. National Security Affairs & Preparation for Active Duty II. (3-0) Cr. 3. S. *Prereq: 342.* Continuation of AFAS 441. Extends examination of the national security process to a full spectrum of officer, enlisted, and civilian force management issues. Extends the regional studies component through focus on Europe, Russia and the Middle East. Continues preparation for active duty through emphasis on current issues affecting professional military officers. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

American Indian Studies

(Interdepartmental Undergraduate Minor)

Program Director: Sidner Larson

The American Indian Studies Program is a cross-disciplinary program in the College of Liberal Arts and Sciences that emphasizes perspectives from American Indian Studies, Anthropology, art, history, literature, political science and Sociology. The primary goal of the American Indian Studies program is to conduct interdisciplinary investigations of the intellectual practices, lived history, values, political Status, rights, and responsibilities of tribal nations. Students have the opportunity to learn about the cultural heritage of American Indians, their historical relationship with non-Indians, and their participation in contemporary American

Society. They analyze the tropes and techniques common to American Indian oral and written literatures; comparison/contrast of American Indian cultures to mainstream and other world cultures; and, articulation of the role American Indians are playing in approaches to modern social and environmental issues.

The courses in the American Indian Studies Program provide added background for students whose career interests may include multicultural education, human Services, legal services, or public administration.

Within the College of Liberal Arts and Sciences, courses in American Indian Studies can be used as electives, in a minor, or in an interdisciplinary studies major (for details, see *Index, Interdisciplinary Studies*). Students majoring in another college who wish to use these courses should consult with their advisers.

A minor in the College of Liberal Arts and Sciences must include at least 15 credits of courses in the field. A minor in American Indian Studies must include 210, two courses chosen from among the following: 310, 322, 332 and 346, and two additional courses chosen from the program courses listed below. The American Indian Studies Program Committee will, upon application by the student and review of the program, certify that the student has completed a minor in American Indian Studies.

Because course offerings vary from year to year, any student interested in a minor in American Indian Studies should contact the American Indian Studies office for advising. (See *Index, LAS Cross-Disciplinary Programs*.)

Courses primarily for undergraduate students

Am In 210. Introduction to American Indian Studies. (3-0) Cr. 3. F.S.SS. Introduction to the multidisciplinary aspects of American Indian Studies. Topics include literature, the arts, history, anthropology, sociology, education, and contemporary Indian politics. Guest lectures, media presentations, and discussion of assigned readings.

Am In 240. Introduction to American Indian Literature. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: Credit in or exemption from Engl 150.* Appreciation of oral and written forms of American Indian literatures. Tropes and techniques in oral, visual and written texts. Focus on the role of American Indians in interdisciplinary approaches to modern social and environmental issues as expressed in literary works.

Am In 310. Topics in American Indian Studies. (3-0) Cr. 3. Repeatable. F.S. Issues within specific topical areas of American Indian Society and culture, such as social work with Indian families, tribal government, and environmental policy.

Am In 315. Archaeology of North America. (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 202 or 308.* Prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; culture-historical sequences of major culture areas; linkages of archaeological traditions with selected ethnohistorically known Native American groups.

Am In 322. Peoples and Cultures of Native North America. (Cross-listed with Anthr). (3-0) Cr. 3. F.SS. *Prereq: Anthr 201 or Am In 210.* Origin, distribution, and traditional life of native peoples of North America. Survey of culture areas; ecology and subsistence, language, kinship, life cycle, political, economic, and religious systems; impact of European contact.

Am In 323. Topics in Latin American Anthropology. (Cross-listed with Anthr). (3-0) Cr. 3. Repeatable. *Prereq: Anthr 201 or 306 recommended.* Exploration of contemporary Latin American social dynamics within specific historical, political and economic contexts; discussion of current ethnographic approaches to studying key Sociocultural issues in Latin America. Topics vary each time offered.
A. Violence and Memory
B. Social movements and Democracy
C. Race, Class and Gender
D. Regional Focus

Am In 328. American Indian Religions. (Cross-listed with Relig). (3-0) Cr. 3. An introduction to the beliefs and rituals of Native American religious traditions, with attention to cultural and historical contexts and implications. Nonmajor graduate credit.

Am In 342. American Indian Women Writers. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Engl 250.* Literature of American Indian women writers which examines their social, political, and cultural roles in the United States. Exploration of American Indian women's literary, philosophical, and artistic works aimed at recovering elements of identity, redescribing stereotypes, resisting colonization, and constructing femininity. Nonmajor graduate credit.

Am In 346. American Indian Literature. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Engl 250.* Survey of literature by Native Americans from pre-Columbian tales and songs to contemporary novels and poetry. Nonmajor graduate credit.

Am In 420. Cultural Continuity and Change on the Prairie-Plains. (Cross-listed with Anthr). (3-0) Cr. 3. F. *Prereq: Anthr 315 or 322.* Ecological adaptations, sociocultural changes, and continuities of traditions among Prairie and Plains Indian groups through time; impacts of Euro-American Society and technology on Indians of the Great Plains; perspectives from ecology, archaeology, ethnology, history, and contemporary literary sources.

Am In 426. Topics in Native American Architecture. (Cross-listed with Dsn S, Arch). (3-0) Cr. 3. Repeatable. F.S. *Prereq: Junior classification.* History, theory, and principles of Native American/American Indian architecture, landscape architecture and planning considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 426 may be applied to degree program. Nonmajor graduate credit.

Am In 432. Current Issues in Native North America. (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 201 or 306; 322 or Am In 210 recommended.* Conditions and issues of contemporary Native Americans; historical background of eighteenth and nineteenth century Indian-White relationships; examination of legal Status, the reservation system, treaty violations, Indian militancy, education and urbanization, self-determination, social impact of resource development, and other current concerns.

Am In 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in American Indian Studies; permission of instructor.* Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits in Am In 490 may be counted toward graduation.

Courses offered by other departments

Anthr 428. Topics in Archaeological Laboratory Methods and Techniques. See *Anthropology*.

Anthr 429. Archaeological Field School. See *Anthropology*.

C I 280C. Pre-Student Teaching Experience: Native American Tutoring. See *Curriculum Instruction.*

Hist 370. History of Iowa. See *History*.

Hist 465. The American West. See *History*.

Pol S 312. Minicourse in American Government and Politics. See *Political Science.* Acceptable only when offered as a course in American Indian tribal government and political theory.

Soc 330. Ethnic and Race Relations. See *Sociology*.

Animal Science

www.ans.iastate.edu/

Maynard Hogberg, Chair of Department

Distinguished Professors: Anderson, Beitz, Lamont, Rothschild, Sebranek

Distinguished Professors (Emeritus): Freeman, Jacobson, Sell, Trenkle, Willham

University Professors: Kenealy

University Professors (Emeritus): Parrish

Professors: Ahn, Baas, Berger, Brant, Cordray, Dekkers, Dickson, Fernando, Garrick, Harris, Hoffman, Hogberg, Honeyman, Kilmer, E. Lonergan, S. Lonergan, Loy, Mabry, Morrical, Nissen, Olson, Prusa, Robson, Russell, Spike, M. Spurlock, Strohbehn, Tuggle, Xin

Professors (Emeritus): Brackelsberg, Ewan, Foreman, Haynes, Holden, Jurgens, Kiser, Marple, Owings, Rouse, Rust, Speer, Stevermer, Stromer, Topel, Voelker, Wickersham, Wilson, Wunder, Young, Zimmerman, Zmolek

Professors (Collaborators): Clutter, Horst, Kehrli, Nonnecke, Quigley, Reinhardt, Scanes

Associate Professors: Auwerda, Cunnick, Huiatt, Jeftinija, Patience, Reecy, Skaar, Spurlock, Stalder, Timms, Tyler, Youngs

Associate Professors (Collaborators): Frye, Gunsett, Kerr, Mahanna, Sosnicki

Assistant Professors: Butters-Johnson, Ellinwood, Gabler, Ross, Selsby

Assistant Professors (Collaborators): Bonner, Campbell, Lippolis, McVicker, Pita, Rathmacher

Senior Lecturer: Boury

Lecturers: Ferwerda, Olsen, Thayne

Clinician: Leuschen

Undergraduate Study

The Department of Animal Science Undergraduate Program intends for its graduates to be able to detail the symbiotic relationship of animals and humans, to solve the complex problems of animal enterprise management, and to apply their knowledge and skills in a technically demanding global community. To enable learners to pursue a wide array of career interests, the department offers learning experiences ranging from the basic to the applied sciences. The department's undergraduate degree program has 10 major program goals. They are to provide a comprehensive animal science education in (1) science, (2) animal management, and (3) agri-business. In addition, our program strives to create an environment developing: (4) effective communication skills, (5) skills enabling students to gather and integrate information to solve problems, (6) self learners, (7) leaders and team builders, and (8) awareness of domestic and global issues driving changes in the animal industries. Our program also works to (9) provide career skills appropriate to job market needs, and (10) provide superior counseling for fulfilling individual student objectives.

Learner outcomes for each of these goals, for each of our courses, and other information defining the program can be found at our web site: www.ans.iastate.edu/.

The department offers the degrees bachelor of science in animal science and bachelor of science in dairy science, as well as complementary work toward admission to schools of law, medicine, and veterinary medicine which may be done while satisfying requirements for the degree bachelor of science degree (see Index). A minimum of 15 credits of animal science coursework must be

earned at Iowa State University. A combined bachelor of science and master of science in animal science is also offered.

The department offers a minor in Animal Science. The minor requires: 101, 114, 214, 214L, one course from: 216, 223, 224, 225, 226, 229, 235, 270, two courses from: 319, 331, 352, 360. A total of 9 credits must be earned at Iowa State University in animal science coursework that meets a degree requirement for the B.S. degree in animal science. Students interested in the Animal Science minor should contact an Animal Science advisor.

The department offers a minor in Meat Science. The minor requires: 270, 360, 460; one course from: 489, 490C, six credits from: FS HN 311, 403, 405, 406, 410, 412, 419, 420, 471, Micro 407. Students majoring in Animal Science will NOT be allowed to count the 9 required credits (270, 360, 460) toward their Animal Science degree. Students interested in the Meat Science minor should contact an Animal Science advisor.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in animal breeding and genetics; animal nutrition; meat science; animal physiology; and animal science. Minor work is offered in these areas to students taking major work in other departments.

A strong undergraduate program is required for students interested in graduate study. Fundamental training in biology, chemistry, mathematics, and statistics is requisite to a satisfactory graduate program. Graduate programs in animal science include supporting work in areas such as agronomy; anatomy; microbiology; biochemistry; chemistry; economics; food science and human nutrition; genetics; physics; physiology; and statistics. Students may choose graduate programs involving a co-major with one of these areas. Graduate work in meat science is offered as a co-major in animal science and food science and human nutrition.

The department also cooperates in the interdepartmental program in professional agriculture and interdepartmental majors in genetics, immunobiology, MCDB (molecular, cellular, and developmental biology), nutritional sciences, and toxicology (see *Index*).

The foreign language requirement, if any, is established on an individual basis by the program-of-study committee appointed to guide the work of the student.

Courses primarily for undergraduate students

An S 101. Working with Animals. (1-3) Cr. 2. F.S. A hands-on introductory course in skills for proper care and management of domestic animals. Husbandry skills including health observation, animal movement, identification, management procedures, and environmental assessment are covered.

An S 110. Orientation in Animal Science and ISU. Cr. R. F.S. Orientation to the university and Department of Animal Science. Challenges and opportunities available to the professional animal agriculturalist. Professional goal setting, portfolio development, and development of interpersonal skills in the context of pursuing a career in animal science.

An S 114. Survey of the Animal Industry. (2-0) Cr. 2. F.S.SS. Ways domestic animals serve the basic needs of humans for food, shelter, protection, fuel, and emotional well-being. Terminology, basic structures of the industries surrounding the production, care, and marketing of domestic animals in the U.S.

An S 115. Horsemanship and Equitation. (0-4) Cr. 1. Repeatable. F.S. An S 115 can be taken for a maximum of three times for credit. Satisfactory-fail only.
A. Beginner Hunt Seat Equitation.
B. Beginner Jumping. Prereq: 115C, or able to walk, trot, and canter.
C. Intermediate Hunt Seat Equitation. Prereq: 115A or be able to walk, trot, and canter.
D. Intermediate Jumping. Prereq: 115C or jumped a course up to 18".
E. Beginner Western Horsemanship.
F. Intermediate Western Horsemanship. Prereq: 115 E or able to walk, jog and lope.

An S 211. Issues Facing Animal Science. (0-2) Cr. 1. F.S. *Prereq: 114, sophomore classification.* Overview of the factors that define contemporary ethical and scientifically based issues facing animal agriculture. Life skill development (including interactive skills, communication ability, organization, information gathering, and leadership skills) emphasized in the context of issues study. Satisfactory-fail only.

An S 214. Domestic Animal Physiology. (3-0) Cr. 3. F.S. *Prereq: Biol 212, Chem 163 or 177.* Introduction to anatomy and physiology of the neural, circulatory, respiratory, immune, endocrine, reproductive, and digestive systems of domestic animals.

An S 214L. Domestic Animal Anatomy and Physiology Lab. (0-2) Cr. 1. F.S. *Prereq: Concurrent enrollment in An S 214.* Basic anatomy of domestic animals.

An S 216. Equine Science. (2-2) Cr. 3. F. *Prereq: 101 or 114; one course in biology.* Introduction to contemporary concepts, and basic practices and decisions necessary when managing horses through stages of their lives.

An S 217. Equine Farm Practicum. (2-2) Cr. 2. F. *Prereq: Student majoring in Animal Science, An S 115 or riding experience, An S 216 or concurrent.* Intensified management of the equine farm. Provide students with experiential learning in all phases of horse production and management. Students assist with general farm management, preparing horses for sale, marketing techniques and web design.

An S 223. Poultry Science. (2-2) Cr. 3. F.S. *Prereq: 101, 114.* Introduction to principles, practices and decisions necessary when raising poultry through their production cycle.

An S 224. Companion Animal Science. (2-2) Cr. 3. S. *Prereq: Course in biology.* Introduction of students to contemporary concepts, and basic practices and decisions necessary when caring for the companion animal through stages of its life.

An S 225. Swine Science. (2-2) Cr. 3. F.S. *Prereq: 101, 114.* Introduction to principles, practices and decisions necessary when raising swine through the vertically integrated production cycle.

An S 226. Beef Cattle Science. (2-2) Cr. 3. F.S. *Prereq: 101, 114.* Introduction to principles, practices and decisions necessary when raising beef cattle through the vertically integrated production cycle.

An S 229. Sheep Science. (2-2) Cr. 3. F.S. *Prereq: 101, 114.* Introduction to principles, practices and decisions necessary when raising sheep through the vertically integrated production cycle.

An S 235. Dairy Cattle Science. (2-2) Cr. 3. F. *Prereq: 101, 114.* Introduction to principles, practices and decisions necessary when raising dairy cattle through the vertically integrated production cycle.

An S 270. Foods of Animal Origin. (2-2) Cr. 3. F. *Prereq: Biol 212, Chem 163 or 177.* Principles, practices and issues impacting the production, processing and preservation of safe, wholesome, nutritious, and palatable meat, dairy, and egg products. Product evaluation, classification, value, and utilization.

An S 305. Livestock Evaluation. (0-6) Cr. 3. F. *Prereq: Junior classification; An S 270 recommended.* Fall semester leads to 475A or D. Breeding animal and market animal evaluation of beef, swine and sheep using contemporary techniques and tools. Communication and decision-making skills are practiced in the context of making selection decisions.

An S 306. Equine Evaluation. (0-6) Cr. 3. S. *Prereq: sophomore classification or permission of instructor.* Detailed visual evaluation of conformation and performance of the equine athlete. Decision-making skills are practiced in the context of making selection choices. Development of written and oral communication skills as students defend their judgments. Industry trends will be addressed.

An S 311. Career Preparation in Animal Science. (0-2) Cr. 1. F.S. *Prereq: Junior classification in An S.* Life skill development emphasized in the context of career preparation. Assist students with career goal clarification, interview skills, resume preparation. Internship development, job shadowing, and exploration of career option. Satisfactory-fail only.

An S 316. Training the Horse. (0-6) Cr. 3. F. *Prereq: 115, or ability to walk, trot and canter.* Modifying the behavior of the horse for performance objectives through bitting, longeing, saddling, and riding.

An S 319. Animal Nutrition. (2-2) Cr. 3. F.S.SS. *Prereq: 214, course in organic chemistry or biochemistry.* Fundamentals of nutrition. Essential nutritive requirements of domestic animals, sources of nutrients, composition and identification of feeds, diet formulation and feeding recommendations. Nonmajor graduate credit.

An S 320. Livestock Feeding Program Design. (0-4) Cr. 2. F.S. *Prereq: 319.* Advanced diet formulation and feeding recommendations. Evaluation of alternate feeding programs and diets in the context of case studies.

An S 325. Biorenewable Systems. (Cross-listed with A E, Agron, BusAd, Econ, TSM). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing.

An S 331. Domestic Animal Reproduction. (3-0) Cr. 3. F.S. *Prereq: Course in physiology.* Comparative anatomy, physiology, and endocrinology of domestic mammalian animal reproduction. Techniques for the control and manipulation of reproductive processes. Nonmajor graduate credit.

An S 332. Laboratory Methods in Animal Reproduction. (0-4) Cr. 2. F.S. *Prereq: Credit or enrollment in 331.* Comparative reproductive anatomy with emphasis on the physiology of normal reproductive function; ways to control and improve reproduction; principles of artificial insemination in farm animals; and selected laboratory exercises with written report.

An S 333. Embryo Transfer and Related Technologies. (2-0) Cr. 2. F.S. *Prereq: 331 or 332.* Application of embryo transfer and related technologies to genetic improvement of mammalian livestock. Techniques for control of female reproduction, embryo collection and transfer, embryo cryopreservation, and embryo manipulation. Gender selection. Economic and genetic aspects of embryo transfer. Nonmajor graduate credit.

An S 334. Embryo Transfer Laboratory. (0-3) Cr. 1. F. *Prereq: Credit or concurrent enrollment in An S 333; An S 332 or VDPAM 416; permission of instructor.* Selected laboratory exercises related to embryo transfer such as synchronization of estrus, superovulation, detection of estrus, artificial insemination, embryo collection, embryo evaluation, microscopy, embryo cryopreservation, in vitro fertilization, and embryo sexing will be demonstrated and/or performed. Nonmajor graduate credit.

An S 335. Dairy Cattle Evaluation. (0-6) Cr. 3. S. *Prereq: Sophomore classification.* Evaluation of breeding animals for dairy herds. Comparative terminology, decision making, and presentation of oral reasons. Trips to dairy cattle farms. Livestock handling.

An S 336. Domestic Animal Behavior and Well-Being. (2-2) Cr. 3. F. *Prereq: One course in physiology.* Principles of behavior relative to animal care, management and environmental design to ensure animal well-being. Examination of basic neural-endocrine mechanisms involved in the animal's response to its environment. Awareness of animal protection, law and legislation. Methods to objectively assess animal well-being.

An S 337. Lactation. (2-0) Cr. 2. S. *Prereq: 214.* The structure, development and evolution of the mammary gland. Mammary metabolism, milk synthesis; neural and endocrine regulation of mammary function. Immune function and health of the mammary gland.

An S 345. Growth and Development of Domestic Animals. (3-0) Cr. 3. S. *Prereq: An S 214; Biol 313 or Gen 320.* Basic principles of animal growth and development covered at the tissue, cellular and molecular level. Emphasis placed on skeletal muscle, adipose, bone, and immune system growth and development. The effects of genetics, nutrition, and pharmaceuticals on growth.

An S 352. Genetic Improvement of Domestic Animals. (2-2) Cr. 3. F.S. *Prereq: One course in statistics, Biol 211, course in genetics.* Principles of qualitative and quantitative genetics applied to creating change in domestic animals. Impact of selection and mating schemes in achieving breeding program goals. Applications and impacts of biotechnological advancements in genetic manipulation. Nonmajor graduate credit.

An S 353. Animal Breeding Programs Design. (0-4) Cr. 2. S. *Prereq: 352.* Evaluation of alternate breeding programs and genetic improvement techniques in the context of case study. Experiential and cooperative learning techniques employed. Nonmajor graduate credit.

An S 360. Fresh Meats. (2-2) Cr. 3. F. *Prereq: 270; a course in organic or biochemistry.* Impact of muscle structure, composition, rigor mortis, inspection, fabrication, handling, packaging and cooking on the palatability, nutritional value, yields, market value, and safety of fresh meat. Nonmajor graduate credit.

An S 399. Animal Science Internship. Cr. arr. Repeatable. F.S.SS.

A. Graded Internship Experience. Cr. 2 to 6. Prereq: Permission of the instructor. Learning experience focused on professional development for a career related to animal science. Journal, presentation, and creative component.
B. Supervised Internship Experience. Cr.
R. Prereq: Permission of internship coordinator. Supervised learning activity consisting of work period in production agriculture or the agriculture-related industry.

An S 411. Addressing Issues in Animal Science. (0-2) Cr. 1. F.S. *Prereq: Senior classification in An S.* Life skill development emphasized in the context of exploring one's perspective of the most pressing moral and scientific issues facing animal agriculture. Clarification and communication of personal conclusions in small and large group settings expected.

An S 415. Equine Systems Management. (2-2) Cr. 3. S. *Prereq: 216, 319, 331.* Application of advanced horse management - nutrition, reproduction, exercise physiology and business. Computer-aided management. Explore topics of current concern in the horse industry. Computer aided study. Nonmajor graduate credit.

An S 417. Equine Reproductive Management. (2-2) Cr. 3. S. *Prereq: 216, 331, 415 or concurrent and permission of instructor.* Practical application of managing a breeding farm including servicing the mare, handling stallions, breeding problems, foaling mares, and marketing techniques.

An S 419. Advanced Animal Nutrition. (2-0) Cr. 2. F. *Prereq: 214, 319.* Detailed consideration of digestion, metabolism, and assimilation of nutrients. Recent advances and developments in basic nutrition. Nonmajor graduate credit.

An S 423. Poultry Systems Management. (2-2) Cr. 3. F. *Prereq: 223, 319, 331, 352.* Decisions facing the administrator of a poultry enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the poultry enterprise. Computer aided study. Nonmajor graduate credit.

An S 424. Companion Animal Systems Management. (2-2) Cr. 3. S. *Prereq: 224, 319, 331, 352.* Decisions facing the administrator of a companion animal enterprise. Financial and business goal identification, problem clarification, and resource allocation to manage the companion animal system. Nonmajor graduate credit.

An S 425. Swine Systems Management. (2-2) Cr. 3. F.S. *Prereq: 225, 270, 319, 331, 352; Econ 330 or equivalent recommended.* Decisions facing the administrator of a swine enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the swine enterprise. Computer aided study. Nonmajor graduate credit.

An S 426. Beef Cattle Systems Management. (2-2) Cr. 3. F.S. *Prereq: 226, 270, 319, 331, 352; Econ 330 or equivalent recommended.* Decisions facing the administrator of a beef cow-calf or feedlot enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the beef enterprise. Computer aided study. Nonmajor graduate credit.

An S 429. Sheep Systems Management. (2-2) Cr. 3. S. *Prereq: 229, 319, 331, 352; Agron 334 recommended; Econ 330 or equivalent recommended.* Decisions facing the administrator of a sheep enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the sheep enterprise. Computer aided study. Nonmajor graduate credit.

An S 434. Dairy Systems Management. (2-2) Cr. 3. F.S. *Prereq: 235, 319, 331, 337, 352; Econ 330 or equivalent recommended.* Decisions facing the administrator of a dairy enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the dairy enterprise. Computer aided study. Nonmajor graduate credit.

An S 435. Applied Dairy Farm Evaluation. (2-2) Cr. 3. S. *Prereq: An S 434; Econ 330.* Evaluate nutrition, reproduction, milk quality, breeding, and related management practices of commercial dairy herds in a case study format. Students will apply knowledge gained in the classroom to commercial dairy farm situations and develop skills in information gathering, decision making, problem solving, and interpersonal communications. Nonmajor graduate credit.

An S 460. Processed Meats. (Dual-listed with 560). (2-2) Cr. 3. S. *Prereq: 270.* Physical, chemical and biological properties of meat important to processed meat product characteristics. Ingredients, technology and equipment used for cured meats, loaf products and fresh, cooked, dry and semi-dry sausages products. Nonmajor graduate credit.

An S 475. Intercollegiate Judging Training and Competition. (0-4) Cr. arr. Repeatable. F.S. *Prereq: permission of instructor.* Specialized training in evaluation and grading of livestock, livestock products, and livestock production management plans. Maximum of 6 credits may be applied toward graduation.
A. Meat Animals
B. Dairy Cattle
C. Meats
D. Meat Animal Evaluation.
E. Horses
F. Management Systems

An S 480. Animal Industry Leadership Fellows. Cr. 1. Repeatable. F.S. *Prereq: A. An S 226; permission of instructor C. An S 225; permission of instructor.* Students broaden their perspective of the livestock industry through site visits, case-study (Fellows) projects, and cooperative learning experiences that capitalize on interaction skills in the context of studying the structure of the U.S. livestock industry. This for-credit offering represents the central academic focus of the Iowa State University Animal Industry Leadership Fellows Program. Study is species specific, and enrollment is limited. Satisfactory-fail only.
A. Beef
C. Pork

An S 489. Issues in Food Safety. (Cross-listed with FS HN, HRI, VDPAM). (1-0) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in FS HN 101 or 272 or HRI 233; FS HN 419 or 420; FS HN 403.* Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

An S 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the instructor.* Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.
A. Animal Science
B. Dairy Science
C. Meat Science
D. Companion Animal Science
E. Equine Science
G. Poultry Science
H. Honors
I. Entrepreneurship

An S 493. Workshop in Animal Science. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Workshop in livestock production. Includes current concepts in breeding, nutrition, reproduction, meats, and technologies that impact the animal industry. Nonmajor graduate credit.

An S 495. Agricultural Travel Course Preparation. Cr. R. Repeatable. F.S. *Prereq: Permission of instructor.* Limited enrollment. Students enrolled in this course will also register for Agron 495 and intend to register in Agron 496 and An S 496 the following term. Topics will include the agricultural industries, climate, crops, culture, history, livestock, marketing, soils, and preparation for travel to locations to be visited. Information normally available 9 months before departure.

An S 496. Agricultural Travel Course. Cr. arr. Repeatable. *Prereq: Permission of instructor, 30 college credits.* Limited enrollment. Students enroll in both An S 496 and Agron 496. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on livestock and crop production. Locations and duration of tours will vary. Summer tour will usually visit a northern location and winter tour will usually visit a southern location. Information usually available 9 months before departure. Tour expenses paid by students.
A. International tour
B. Domestic tour

An S 497. Undergraduate Teaching Experiences in Animal Science. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Development of oral and written communication skills of technical concepts in animal science. Emphasis on organizational skills, conducting activities and interpersonal communication skills. Responsibilities in a class under direct supervision of a faculty member. A maximum of 4 credits of An S 497 may be applied toward graduation.

Courses primarily for graduate students, open to qualified undergraduate students

An S 500. Computer Techniques for Biological Research. (2-0) Cr. 1. F. Introduction to UNIX and SAS for solving research problems, including organization of data files, transfer of files between workstations, developing models, and techniques for analysis of designed experiments. Introduction to matrix algebra for solving animal breeding problems using MATLAB and computer simulation.
A. (1st half of semester) UNIX and SAS
B. (2nd half of semester) Problem solving using matrix algebra

An S 501. Survey of Animal Disciplines. (1-0) Cr. 1. F. Required for Animal Science graduate students. Orientation to departmental and graduate school policies and procedures. Discussion of programs of research and outreach in Animal Science. Issues impacting the animal industry. Satisfactory-fail only.

An S 503. Seminar in Animal Production. (1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor.* Discussion and evaluation of current topics in animal production and management.

An S 511. Applied Ruminant Nutrition. (2-0) Cr. 2. *Prereq: 319.* Procedures and theories in beef, dairy, and sheep nutrition. Feeding programs and requirements for lactation, growth, and reproduction. Designed for master of agriculture program.

An S 515. Integrated Crop and Livestock Production Systems. (Cross-listed with A E, Agron, SusAg). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: SusAg 509.* Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

An S 518. Digestive Physiology and Metabolism of Non Ruminants. (Cross-listed with NutrS). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: An S 419 or NutrS 501.* Digestion and metabolism of nutrients. Nutritional requirements and current research and feeding programs for poultry and swine.

An S 520. Digestive Physiology and Metabolism of Ruminants. (Cross-listed with NutrS). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: An S 419 or NutrS 501.* Digestive physiology and nutrient metabolism in ruminant and preruminant animals.

An S 533. Physiology and Endocrinology of Animal Reproduction. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: General physiology course.* Development of structure and function of the reproductive system. Physiologic and endocrine aspects including puberty, gametogenesis, estrous cycle, pregnancy, parturition, interaction of environment, thyroid and adrenal function, and nutrition with these processes.

An S 536. Perinatology. (2-0) Cr. 2. S. *Prereq: One course in physiology; one course in biochemistry.* Regulation of metabolism and development in the mammalian fetus and neonate is explored in a comparative manner. Emphasis will be on the dynamic changes in these relationships occurring at birth.

An S 537. Topics in Farm Animal Environmental Physiology, Behavior, Stress, and Welfare. (3-0) Cr. 3. Repeatable. F.S. *Prereq: permission of instructor; M.S. or Ph.D. student.* Each semester students focus on different topics related to farm animal environmental physiology, behavior, stress, and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line cooperative course involving instructors at Iowa State University, Texas Tech University, and the University of Illinois. Each topic may be taken only one time.

A. Animal rights and Philosophies
B. Brain mechanisms of stress
C. Measuring behavior and welfare
D. Environmental stressors
E. Stress and the immune system
F. Other related topics

An S 540. Livestock Immunogenetics. (Cross-listed with Micro, V MPM). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: An S 561 or Micro 575 or V MPM 520.* Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

An S 549. Advanced Vertebrate Physiology I. (Cross-listed with B M S, Kin). (3-0) Cr. 3. F. *Prereq: Biol 335; credit or enrollment in BBMB 404 or 420.* Neurophysiology, sensory systems, muscle, neuroendocrinology, endocrinology.

An S 552. Advanced Vertebrate Physiology II. (Cross-listed with B M S, Kin, NutrS). (3-0) Cr. 3. S. *Prereq: Biol 335; credit or enrollment in BBMB 404 or 420.* Cardiovascular, renal, respiratory, and digestive physiology.

An S 552L. Advanced Vertebrate Physiology Laboratory. (Cross-listed with BMS). (0-3) Cr. 1. *Prereq: Credit or enrollment in B M S 552.* Laboratory for cardiovascular, renal, respiratory, and digestive physiology.

An S 556. Current Topics in Genome Analysis. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: BBMB 405 or GDCB 510.* Introduction to principles and methodology of molecular genetics useful in analyzing and modifying large genomes. Survey of Statistical methods and computer programs for bioinformatics, linkage mapping, radiation hybrid mapping, and mapping quantitative trait loci.

An S 560. Processed Meats. (Dual-listed with 460). (2-2) Cr. 3. S. *Prereq: 270.* Physical, chemical and biological properties of meat important to processed meat product characteristics. Ingredients, technology and equipment used for cured meats, loaf products and fresh, cooked, dry and semi-dry sausage products.

An S 561. Population and Quantitative Genetics for Breeding. (Cross-listed with Agron). (4-0) Cr. 4. F. *Prereq: Stat 401.* Population and quantitative genetics for plant and animal genetics. Study of the genetic basis and analysis of variation in quantitative traits in domestic or experimental populations using phenotypic and molecular marker data, including estimation of heritability and other genetic parameters, linkage analysis and mapping of quantitative trait loci, and the impact of inbreeding, heterosis, and genotype-by-environment interaction.

An S 562. Methodologies for Population/Quantitative Genetics. (2-0) Cr. 2. S. *Prereq: 561, Stat 402.* Basic theory for genetic analysis of animal breeding data. Course A (1st half semester) covers linear models, selection index methods, and basic theory for best linear unbiased prediction. Course B (2nd half semester) best linear unbiased prediction, including genetic groups, environmental adjustment, repeated records, multiple trait models, maternal effects models, and theory for maximum likelihood estimation of genetic parameters.
A. Linear Models and Genetic Prediction.
B. Advanced Genetic Prediction and Paramater Estimation.

An S 565. Professional Practice in the Life Sciences. (Cross-listed with PI P, Agron, BCB, Hort, Micro, V MPM). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.

A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

An S 570. Advanced Meat Science and Applied Muscle Biology. (2-2) Cr. 3. S. *Prereq: 470.* Ante and postmortem factors impacting composition, structure, and chemistry of red meat and poultry muscle/meat, the conversion of muscle to meat, and the sensory and nutritional attributes of fresh meats. Oral research reports and a research proposal.

An S 571. Advanced Meat Processing Principles and Technology. (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: An S 470 or 570.* Physical/chemical relationships during processing. Effects of modern technology, nonmeat additives and preservation techniques on quality and safety of processed meat. Laboratory demonstration of principles and technology.

An S 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

A. Animal Breeding
B. Animal Nutrition
C. Meat Animal Production
D. Dairy Production
E. Meat Science
F. Physiology of Reproduction
G. Muscle Biology
H. Poultry Nutrition
I. Poultry Products
J. Experimental Surgery
K. Professional Topics
L. Teaching
M. Molecular Biology
N. Ethology

An S 599. Creative Component. Cr. arr. F.S.SS. *Prereq: Nonthesis M.S.* A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.
A. Animal Breeding and Genetics
B. Animal Nutrition
C. Animal Physiology
D. Animal Science
E. Meat Science

Courses for graduate students

An S 603. Seminar in Animal Nutrition. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.* Discussion of current literature; preparation and submission of abstracts.

An S 619. Advanced Nutrition and Metabolism - Protein. (Cross-listed with NutrS). (2-0) Cr. 2. F. *Prereq: BBMB 405.* Digestion, absorption, and intermediary metabolism of amino acids and protein. Regulation of protein synthesis and degradation. Integration of cellular biochemistry and physiology of mammalian protein metabolism.

An S 620. Advanced Nutrition and Metabolism - Energy. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: BBMB 405.* Energy constituents of feedstuffs and energy needs of animals as related to cellular biochemistry and physiology. Interpretations of classical and current research.

An S 633. Seminar in Animal Reproduction. (1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor.* Discussion of current literature and preparation of reports on selected topics concerning physiology of reproduction.

An S 652. Animal Breeding Strategies. (2-0) Cr. 2. *Prereq: An S 561.* Basic concepts and methods for design and evaluation of genetic improvement programs for livestock. Topic A. (1st half semester) Prediction of response to selection, selection index theory, multiple trait selection, inbreeding, cross-breeding, and marker-assisted selection. Topic B. (2nd half semester) Advanced concepts in design and evaluation of animal breeding programs, including modeling and optimization, derivation of economic values, gene-flow, and predicting rates of inbreeding. Each topic may be taken only one time for academic credit.
A. Breeding Goals and Response to Selection (S.)
B. Design and Evaluation of Animal Breeding Programs (Alt. S., offered 2011)

An S 653. Applied Animal Breeding Strategies. (2-0) Cr. 2. F. *Prereq: 561 recommended.* Industrial applications of breeding systems, selection methods, and new genetic technologies. One or more field trips to an industry breeding company to define a class project.
A. Swine and Poultry (Alt. F., offered 2010)
B. Beef and Dairy (Alt. F., offered 2009)

An S 655. Advanced Computational Methods in Animal Breeding and Genetics. (3-1) Cr. 2. Alt. F., offered 2009. *Prereq: 500, 562, Com S 207.* Computational methods and strategies for analysis of large data sets with animal breeding data for use in research and industry applications. Course A (1st half semester) Strategies for handling large sets and for prediction using best linear unbiased prediction using a formal language and utility programs. Course B (2nd

half semester) Strategies for estimation of genetic parameters and for use of non-linear models for genetic analysis of categorical and survival type data.
A. Computational Strategies for Predicting Breeding Values
B. Computational Strategies for Genetic Parameter Estimation

An S 656. Statistical Methods for Mapping Quantitative Trait Loci. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 562, Stat 447.* Statistical methods for mapping quantitative trait loci in out-bred populations. Methods based on modeling covariances between relatives. Likelihood based methods using half-sib and full-sib families and extended pedigrees. Bayesian methods applied.

An S 658. Seminar in Animal Breeding and Genetics. (1-0) Cr. 1. Repeatable. F.S. Presentation of current research related to animal breeding and genetics.

An S 670. Molecular Biology of Muscle. (Cross-listed with BBMB). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: BBMB 405, 420, or 502.* Ultrastructure of muscle; chemistry, structure, function, and molecular biology of muscle proteins. Molecular aspects of muscle contraction, development and turnover. Cytoskeletal proteins and dynamics.

An S 684. Seminar in Meat Science. (1-0) Cr. 1. Repeatable. S. *Prereq: Permission of instructor.* Discussion and evaluation of current topics in research publications in meat science.

An S 685. Seminar in Muscle Biology. (1-0) Cr. 1. Repeatable. S. *Prereq: Permission of instructor.* Reports and discussion of recent literature and current investigations.

An S 695. Seminar in Animal Science. (1-0) Cr. 1. Repeatable. S. Reports and discussion of current issues and research in animal science. One credit is required for all M.S. degree candidates with graduate majors in the Department of Animal Science, and two credits are required for all Ph.D. candidates with graduate majors in the Department of Animal Science. Satisfactory-fail only.

An S 699. Research. Cr. arr. Repeatable.
A. Animal Breeding
B. Animal Nutrition
C. Meat Animal Production
D. Dairy Production
E. Meat Science F. Physiology of Reproduction
G. Muscle Biology
H. Poultry Nutrition
I. Poultry Products
J. Animal Ethology

Anthropology

http://www.Anthr.iastate.edu/

R. Paul Lasley, Chair of Department

Professors: Lasley, Whiteford

Professors (Emeritus): Bower, Butler, Gradwohl, Huang

Associate Professors: Coinman, Ilahiane, Pruetz

Associate Professors (Emeritus): Wolff

Assistant Professors: Arndt, Dusselier, Hill, Moutsatsos, Viatori

Lecturers: Folinsbee, Johnsen

Undergraduate Study

An undergraduate major in Anthropology can Serve as the nucleus for a general liberal education, or as the prerequisite for graduate training qualifying a person for positions in (1) college and university teaching, (2) research, and (3) administrative and applied positions in government, development organizations, museums, and private businesses or corporations.

Anthropology graduates develop a well-rounded professional education in four fields of anthropology: cultural anthropology, linguistic anthropology, archaeology, and biological anthropology. They learn what it means to be human through the study of culture and social relations, human biology and evolution, languages, music, art, architecture, and through the study of past human communities. Graduates learn the important historical and contemporary issues of our subdisciplines, and they learn what it means to be a "modern" Anthropologist and a citizen in an international and global community. Graduates develop an appreciation of the value of cultural diversity at the local, national and international level. They acquire a particular holistic vision that requires using a repertoire of methods in order to forge a deeper understanding of cultural contexts, both past and present. Undergraduate students may obtain experience in archaeological, ethnological and biological research.

Anthropology majors may choose either a bachelor of arts or a bachelor of science degree, both of which require 33 credits in anthropology. A bachelor of arts degree is obtained by fulfilling the college general education requirements plus 6 additional credits in Groups I, II, and/or IV. A bachelor of science degree is obtained by fulfilling the college general education requirements plus 6 additional credits in Group III.

Undergraduate students with majors in anthropology are required to take the following anthropology core courses: 306, 307, 308, 309 and 450. One course in statistics is required.

Undergraduates majoring in anthropology are required to have a minor or a second major. A minor usually consists of 15 credits minimum. A minor in anthropology consists of at least 15 credits and must include 306 or 309 and 307 or 308, and at least 3 other credits in courses numbered 300 or above.

Communication Proficiency requirement: The department requires that a student earn a grade of C or better in Engl 250 and either English 302 or 309 or 314.

The principal subdisciplines of anthropology are represented by the following:

1. General cultural anthropology and ethnology: 201, 230, 250, 257, 306, 313, 322, 323, 325, 326, 327, 335, 340, 411, 412, 418, 431, 432, 434B, 436, 439, 444, 450, 451B, 490B, 491.

2. Archaeology: 202, 308, 315, 321, 337, 414, 416, 420, 428, 429, 434A, 450, 451A, 427I, 490A.

3. Linguistic Anthropology: 309, 451D, 490D.

4. Biological Anthropology: 202, 307, 319, 424, 434C, 438, 445, 451C, 490C.

Graduate Study

The department offers work for the degree master of arts with a major in anthropology. Graduate courses are offered in the areas of biological anthropology, archaeology, cultural anthropology, linguistic anthropology, history and theory, and methodology. Competence in one foreign language and in statistics must be demonstrated. A thesis, generally based on original fieldwork, is required.

Courses primarily for undergraduate students

Anthr 201. Introduction to Cultural Anthropology. (3-0) Cr. 3. F.S.SS. Comparative study of culture as key to understanding human behaviors in different Societies. Using a global, cross-cultural perspective, patterns of family life, economic and political activities, religious beliefs, and the ways in which cultures change are examined.

Anthr 202. Introduction to Biological Anthropology and Archaeology. (3-0) Cr. 3. F.S. Human biological and cultural evolution; survey of the evidence from fossil forms and archaeology, as well as living primates and traditional cultures; introduction to methods of study in archaeology and biological anthropology.

Anthr 230. Globalization and the Human Condition. (3-0) Cr. 3. F.S. An introduction to understanding key global issues in the contemporary world. Focuses on social relations, cultural practices and political-economic linkages among Africa, the Americas, Asia, Europe and the Pacific.

Anthr 250. Contemporary Muslim Societies. (3-0) Cr. 3. S. An introduction to understanding key local and global issues facing Muslim Society. Focus on cultural, social, political, religious, and ecological forces shaping contemporary Muslim Societies and linkages with the non-Muslim world.

Anthr 306. Cultural Anthropology. (2-2) Cr. 3. S. *Prereq: 201.* Survey of the major theoretical, methodological and empirical foundations of cultural anthropology. Participatory lab: focus on ethnographic methods through individual research projects.

Anthr 307. Biological Anthropology. (2-2) Cr. 3. S. *Prereq: 202.* Human evolution as known from fossil evidence, comparative primate studies, and genetic variations in living populations. Laboratory-tutorial sessions include study and discussion of human osteology, fossil hominids, simple Mendelian traits, and bio-ethics in applied biological anthropology.

Anthr 308. Archaeology. (2-2) Cr. 3. F. *Prereq: 202.* Methods and techniques for the recovery and interpretation of archaeological evidence, its role in reconstructing human behavior and past environments. Laboratory sessions include experience in the interpretation of archaeological evidence, the use of classification systems, and prehistoric technologies such as ceramics and stone tools. Field trips.

Anthr 309. Linguistic Anthropology. (Cross-listed with Ling). (2-2) Cr. 3. F. *Prereq: 201.* Language as a human attribute; language versus animal communication; human communication in cultural context; paralanguage, kinesics, proxemics, artifacts as communication; language and culture; cross-cultural Sociolinguistics; ethnoscience; and language policies. Participatory lab: focus on analysis of a non-Western language and communication system.

Anthr 313. The Family and Kinship in Cross-Cultural Perspective. (Dual-listed with 513). (3-0) Cr. 3. S. *Prereq: 201 recommended.* Comparative and historical overview of family, marriage and kinship crossculturally; discussion of differences in the structure, cycle, and functioning of family and kin relations through ethnographic readings, including Euro-American examples; current critical and theoretical issues in kinship studies, especially integrating work on gender, sexuality and representation.

Anthr 315. Archaeology of North America. (Dual-listed with 515). (Cross-listed with Am In). (3-0) Cr. 3. S. *Prereq: 202 or 308.* Prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; culture-historical sequences of major culture areas; linkages of archaeological traditions with selected ethnohistorically known Native American groups.

Anthr 319. Skeletal Biology. (Dual-listed with 519). (2-2) Cr. 3. F. *Prereq: 307 or college level biology.* Comprehensive study of the skeletal anatomy, physiology, genetics, growth, development and population variation of the human skeleton. Applications to forensic anthropology, paleopathology and bioarchaeology are introduced.

Anthr 321. World Prehistory. (Dual-listed with 521). (3-0) Cr. 3. S. *Prereq: 202 recommended.* An introduction to archaeological sites from around the world including the Near East, Africa, Europe, Mesoamerica, and North and South America. Emphasis is on the interpretation of material cultural remains in reconstructing past Societies.

Anthr 322. Peoples and Cultures of Native North America. (Dual-listed with 522). (Cross-listed with Am In). (3-0) Cr. 3. F.SS. *Prereq: 201 or Am In 210.* Origin, distribution, and traditional life of native peoples of North America. Survey of culture areas; ecology and subsistence, language, kinship, life cycle, political, economic, and religious systems; impact of European contact.

Anthr 323. Topics in Latin American Anthropology. (Dual-listed with 523). (Cross-listed with Am In). (3-0) Cr. 3. Repeatable. S. *Prereq: Anthr 201 or 306 recommended.* Exploration of contemporary Latin American social dynamics within specific historical, political and economic contexts; discussion of current ethnographic approaches to studying key Sociocultural issues in Latin America. Topics vary each time offered.
A. Violence and Memory
B. Social movements and Democracy
C. Race, Class and Gender
D. Regional Focus

Anthr 325. Peoples and Cultures of Africa. (Dual-listed with 525). (Cross-listed with Af Am). (3-0) Cr. 3. S. *Prereq: 201 or 306 recommended.* Origins and distribution of peoples of Africa; geographical characteristics as related to culture types, including early civilizations; a comparative examination of economic, subsistence, language, social and political organization, and religious systems throughout the continent; change processes, the impact of colonialism, and the nature of contemporary African Societies.

Anthr 335. Peoples and Cultures of the Middle East. (Dual-listed with 535). (3-0) Cr. 3. F. *Prereq: 201 or 306 recommended.* Anthropological approaches to the study of Middle East cultures. Survey of major culture areas, discussion of economic, political, and social and religious issues and systems. Examination of contemporary social movements.

Anthr 337. Andean Archaeology. (Dual-listed with 537). (3-0) Cr. 3. F. *Prereq: 202 or 321 recommended.* Survey of prehistoric Andean cultures of Peru, Bolivia and Ecuador; the archaeology of the Incas and their ancestors. Emphasis on prehistoric economic, religious, and political organization, the rich material culture recovered through archaeological records; and the use of ethnohistoric texts and modern ethnographies to reconstruct the prehistory of Andean Societies.

Anthr 340. Magic, Witchcraft, and Religion. (Dual-listed with 540). (Cross-listed with Relig). (3-0) Cr. 3. S. *Prereq: 201 or 306.* Origin and development of indigenous magico-religious systems; myth and ritual; therapeutic aspects; symbols and meanings; religion and Sociocultural change, including acculturation, nativistic, and revitalization movements.

Anthr 350. Primate Behavior. (Dual-listed with 550). (2-2) Cr. 3. F.S.SS. *Prereq: Anthr 202 and/or basic biology course recommended.*. An introduction to the Order Primates with a focus on their behavior. Biological and social adaptations of monkeys, apes, and prosimians; basic evolutionary concepts, current trends and theories in the field of Primatology and issues related to primate conservation.

Anthr 411. Culture Change and Applied Anthropology. (Dual-listed with 511). (3-0) Cr. 3. F. *Prereq: 201 or 306.* Theoretical and practical considerations of human cultural development. Examination of theories of cultural change, culture contact and acculturation. Dynamics of directed change in contemporary world cultures. Principles, theories, and ethics of international development projects from a sociocultural perspective.

Anthr 412. Psychological Anthropology. (Dual-listed with 512). (3-0) Cr. 3. F. *Prereq: 201 or 306.* Relationship of cultural, social and personality factors in human behavior. Cross-cultural comparisons of child rearing practices, cognitive development, mental health, deviancy, ethno-psychiatry, altered states of consciousness, and psychological dimensions of culture change.

Anthr 414. Southwestern Archaeology. (Dual-listed with 514). (3-0) Cr. 3. F. *Prereq: 308 or 315 or 321.* Prehistoric archaeology of the American Southwest, including the Paleo-indian and Archaic periods; the adoption of agriculture; the emergence of pueblo Societies; relationships with contemporary Southwest cultures.

Anthr 418. Global Culture, Consumption and Modernity. (Dual-listed with 518). (3-0) Cr. 3. F. *Prereq: Anthr 201 or 306 recommended.* Cross-cultural study of the impact of globalization, with an emphasis on economic consumption and the movement of goods, ideas, and peoples across cultural and national boundaries.

Anthr 420. Cultural Continuity and Change in the Prairie-Plains. (Dual-listed with 520). (Cross-listed with Am In). (3-0) Cr. 3. F. *Prereq: 315 or 322.* Ecological adaptations, sociocultural changes, and continuities of traditions among Prairie and Plains Indian groups through time; impacts of Euro-American Society and technology on Indians of the Great Plains; perspectives from ecology, archaeology, ethnology, history, and contemporary literary sources.

Anthr 424. Forensic Anthropology. (Dual-listed with 524). (2-2) Cr. 3. S. *Prereq: 319.* Comprehensive study of forensic anthropology, a specialized subfield of biological anthropology. Emphasis is placed on personal identifications from extremely fragmentary, comingled, burnt, cremated and incomplete skeletal remains. All parameters of forensic study are included as they pertain to anthropology, including human variation, taphonomy, entomology, archaeology, pathology, epidemiology; genetics and the non-biological forensic disciplines. An appreciation for the wide range of medicolegal and bioethical issues will also be gained.

Anthr 427I. Archaeology. (Cross-listed with Ia LL). Cr. 4. SS. Nature of cultural and environmental evidence in archaeology and how they are used to model past human behavior and land use; emphasis on Iowa prehistory; basic reconnaissance surveying and excavation techniques. Nonmajor graduate credit.

Anthr 428. Topics in Archaeological Laboratory Methods and Techniques. (Dual-listed with 528). (2-2) Cr. 3. Repeatable. S. *Prereq: 308.* Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition and organization, and computer applications
A. Lithics
B. Ceramics
C. Faunal remains
D. General.

Anthr 429. Archaeological Field School. (Dual-listed with 529). Cr. arr. SS. *Prereq: 202 or 308.* Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence.

Anthr 431. Ethnographic Field School. (Dual-listed with 531). Cr. arr. SS. 4 or 6 weeks. Summer field school for training in ethnographic field methods; students will carry out research projects in social anthropology, learning a variety of investigative research techniques commonly used in social sciences.

Anthr 432. Current Issues in Native North America. (Dual-listed with 532). (Cross-listed with Am In). (3-0) Cr. 3. S. *Prereq: 201 or 306; 322 or Am In 210 recommended.* Conditions and issues of contemporary Native Americans; historical background of eighteenth and nineteenth century Indian-White relationships; examination of legal Status, the reservation system, treaty violations, Indian militancy, education and urbanization, self-determination, social impact of resource development, and other current concerns.

Anthr 434. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior or senior standing.* Supervised practice in government agencies, museums, and business organizations. Not more than 6 credits of internship experience may count towards the major. No credits in Anthr 434 may be used to satisfy anthropology core courses for majors or for the anthropology minor. Satisfactory-fail only.
A. Archaeology
B. Cultural Anthropology
C. Biological Anthropology
D. Linguistic Anthropology

Anthr 436. Development Anthropology. (Dual-listed with 536). (3-0) Cr. 3. S. *Prereq: Anthr 201 or 306.* Historical and theoretical basis of the practices of development, applied and economic anthropology. Covers a wide range of topics such as the role of aid, institutions of development, indigenous knowledge, rural development projects, organization of production, migration, health and environment.

Anthr 438. Primate Evolutionary Ecology and Behavior. (Dual-listed with 538). Cr. 3. S. *Prereq: 202 or 307.* Primate behavior and ecology in evolutionary perspective: biological and social adaptations of prosimians, monkeys, and apes. Introduction to the Order Primates, basic evolutionary concepts, and techniques of behavioral observation. Focus on theory and methods current in Primatology, including applied conservation biology.

Anthr 439. Medical Anthropology. (Dual-listed with 539). (3-0) Cr. 3. S. *Prereq: 201 or 202 or 306.* Study of human health in cultural and environmental context; comparison of health and disease patterns of western and non-western populations; healing systems; use of epidemiological models in understanding illness and disease etiologies cross-culturally; interrelationship between diet and culture.

Anthr 444. Sex and Gender in Cross-cultural Perspective. (Dual-listed with 544). (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: Anthr 201; Anthr 306 recommended.* Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western Societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

Anthr 445. Biological Field School. (Dual-listed with 545). Cr. arr. SS. *Prereq: 202 or Biol 101.* Summer field school for training in behavioral and ecological methods for primatologists. Proposal, data collection and analyses, and presentation of research topic in primatology.

Anthr 450. Historical and Theoretical Approaches in Anthropology. (3-0) Cr. 3. F. *Prereq: 306.* Survey of the historical foundations of anthropology and its interrelated four sub-fields; key figures in 19th and 20th century anthropology with a focus on major theoretical contributions.

Anthr 451. Practicum in Anthropology. Cr. arr. Repeatable. F.S.SS. *Prereq: 201 or 202 or 308.* Application of methods under actual laboratory and field conditions, including basic data management, synthesis, and analysis.
A. Archaeology
B. Cultural Anthropology
C. Biological Anthropology
D. Linguistic Anthropology

Anthr 482. Topics in Biological Anthropology. (Dual-listed with 582). (3-0) Cr. 3. Repeatable. F. *Prereq: Anthr 307.* In-depth study of current topics in biological Anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.
A. Paleoanthropology
B. Primate Cognition
C. Population Conservation
D. Population Genetics and Human Evolution

Anthr 490. Independent Study. Cr. arr. Repeatable. *Prereq: 9 credits in anthropology.* No more than 9 credits of Anthr 490 may be counted toward graduation.
A. Archaeology
B. Cultural Anthropology
C. Biological Anthropology
D. Linguistic Anthropology (Same as Ling 490D)

H. Honors
I. Undergraduate Independent Study (Same as Ia LL 490I)

Courses primarily for graduate students, open to qualified undergraduate students

Anthr 500. Language and Culture. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: Anthr 309 or 510.* Approaches to the study of the relationship between language structure, world view, and cognition; social and structural linguistic variation; cross-cultural aspects of verbal and non-verbal communication; linguistic change; contemporary applications of linguistic anthropology.

Anthr 503. Biological Anthropology. (3-0) Cr. 3. F. *Prereq: 307.* Survey of the history of biological anthropology, current developments and theoretical issues in evolution, human variation and adaptation, population studies, primates and primate behavior, and Paleoanthropology.

Anthr 509. Agroecosystems Analysis. (Cross-listed with Agron, Soc, SusAg). (3-4) Cr. 3. F. *Prereq: Senior or above classification.* Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (Agronomic, economic, ecologic, social, etc.) and scales of operation.

Anthr 510. Theoretical Dimensions of Cultural Anthropology. (3-0) Cr. 3. F. *Prereq: 6 credits in anthropology.* Survey of historical and current developments in topical and theoretical approaches to sociocultural anthropology. Examination and assessment of controversies; new research directions and theoretical approaches.

Anthr 511. Culture Change and Applied Anthropology. (Dual-listed with 411). (3-0) Cr. 3. F. *Prereq: 6 credits in anthropology, 201 or 306.* Theoretical and practical considerations of cultural development. Examination of theories, cultural change, culture contact and acculturation. Dynamics of directed change in contemporary world cultures. Principles, theories, and ethics of international development projects from a sociocultural perspective.

Anthr 512. Psychological Anthropology. (Dual-listed with 412). (3-0) Cr. 3. F. *Prereq: 201 or 306.* Relationship of cultural, social and personality factors in human behavior. Cross-cultural comparisons of child rearing practices, cognitive development, mental health, deviancy, ethno-psychiatry, altered states of consciousness, and psychological dimensions of culture change.

Anthr 513. The Family and Kinship in Cross-Cultural Perspective. (Dual-listed with 313). (3-0) Cr. 3. S. *Prereq: 6 credits in anthropology, 201 recommended.* Comparative and historical overview of family, marriage and kinship crossculturally; discussion of differences in the structure, cycle, and functioning of family and kin relations through ethnographic readings, including Euro-American examples; current critical and theoretical issues in kinship studies, especially integrating work on gender, sexuality and representation.

Anthr 514. Southwestern Archaeology. (Dual-listed with 414). (3-0) Cr. 3. F. *Prereq: 308 or 315 or 321.* Prehistoric archaeology of the American Southwest, including the Paleo-indian and Archaic periods; the adoption of agriculture; the emergence of pueblo Societies; relationships with contemporary Southwest cultures.

Anthr 515. Archaeology of North America. (Dual-listed with 315). (3-0) Cr. 3. S. *Prereq: 202 or 308.* Prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; culture-historical sequences of major culture areas; linkages of archaeological traditions with selected ethnohistorically known Native American groups.

Anthr 518. Global Culture, Consumption and Modernity. (Dual-listed with 418). (3-0) Cr. 3. F. *Prereq: Anthr 201 or 306 recommended.* Cross-cultural study of the impact of globalization, with an emphasis on economic consumption and the movement of goods, ideas, and peoples across cultural and national boundaries.

Anthr 519. Skeletal Biology. (Dual-listed with 319). (2-2) Cr. 3. F. *Prereq: 307 or college level biology recommended.* Comprehensive study of the skeletal anatomy, physiology, genetics, growth, development and population variation of the human Skeleton. Applications to forensic anthropology, paeopathology, and bioarchaeology are introduced.

Anthr 520. Cultural Continuity and Change in the Prairie-Plains. (Dual-listed with 420). (3-0) Cr. 3. F. *Prereq: 315 or 322.* Ecological adaptations, sociocultural changes, and continuities of traditions among Prairie and Plains Indian groups through time; impacts of Euro-American Society and technology on Indians of the Great Plains; perspectives from ecology, archaeology, ethnology, history, and contemporary literary sources.

Anthr 521. World Prehistory. (Dual-listed with 321). (3-0) Cr. 3. S. *Prereq: 202 recommended.* An introduction to archaeological sites from around the world including the Near East, Africa, Europe, Mesoamerica, and North and South America. Emphasis is on the interpretation of material cultural remains in reconstructing past Societies.

Anthr 522. Peoples and Cultures of Native North America. (Dual-listed with 322). (3-0) Cr. 3. F. *Prereq: 201 or Am In 210.* Origin, distribution, and traditional life of native peoples of North America. Survey of culture areas; ecology and subsistence, language, kinship, life cycle; political, economic and religious systems; impact of European contact.

Anthr 523. Topics in Latin American Anthropology. (Dual-listed with 323). (3-0) Cr. 3. Repeatable. S. *Prereq: 6 credits in anthropology, 201 or 306 recommended.* Exploration of contemporary Latin American social dynamics within specific historical, political and economic contexts; discussion of current ethnographic approaches to studying key Sociocultural issues in Latin America. Topics vary each time offered.
A. Violence and Memory
B. Social Movements and Democracy
C. Race, Class and Gender
D. Regional Focus

Anthr 524. Forensic Anthropology. (Dual-listed with 424). (3-0) Cr. 3. S. *Prereq: 319.* Comprehensive study of forensic anthropology, a specialized subfield of biological anthropology. Emphasis is placed on personal identifications from extremely fragmentary, comingled, burnt, cremated and incomplete skeletal remains. All parameters of forensic study are included as they pertain to anthropology, including human variation, taphonomy, entomology archaeology, pathology, epidemiology; genetics and the non-biological forensic disciplines. An appreciation for the wide range of medicolegal and bioethical issues will also be gained.

Anthr 525. Peoples and Cultures of Africa. (Dual-listed with 325). (3-0) Cr. 3. S. *Prereq: 201 or 306 recommended.* Origins and distribution of peoples of Africa; geographical characteristics as related to culture types, including early civilizations; a comparative examination of economic, subsistence, language, social and political organization, and religious systems throughout the continent; change processes, the impact of colonialism, and the nature of contemporary African Societies.

Anthr 528. Topics in Archaeological Laboratory Methods and Techniques. (Dual-listed with 428). (2-2) Cr. 3. Repeatable. S. *Prereq: 308.* Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition organization, and computer applications
A. Lithics
B. Ceramics
C. Faunal remains
D. General.

Anthr 529. Archaeological Field School. (Dual-listed with 429). Cr. arr. SS. *Prereq: 202 or 308.* Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence.

Anthr 530. Ethnographic Field Methods. Cr. 3. F. *Prereq: 6 credits in anthropology, permission of instructor.* Field training experience in ethnography. Problems emphasizing field studies in the contemporary Societies of the world. Focus on techniques of data gathering and analysis.

Anthr 531. Ethnographic Field School. (Dual-listed with 431). Cr. arr. SS. 4 or 6 weeks. Summer field school for training in ethnographic field methods; students will carry out research projects in social anthropology, learning a variety of investigative research techniques commonly used in social sciences.

Anthr 532. Current Issues in Native North America. (Dual-listed with 432). (3-0) Cr. 3. S. *Prereq: 6 credits in anthropology, 201 or 306; 322 or Am In 210 recommended.* Conditions and issues of contemporary Native Americans; historical background of eighteenth and nineteenth century Indian-White relationships; examination of legal Status, the reservation system, treaty violations, Indian militancy, education and urbanization, self-determination, social impact of resource development, and other current concerns.

Anthr 535. Peoples and Cultures of the Middle East. (Dual-listed with 335). (3-0) Cr. 3. F. *Prereq: 201 or 306 recommended.* Anthropological approaches to the study of Middle East cultures. Survey of major culture areas. Discussion of economic, political, and social and religious issues and systems. Examination of contemporary social movements.

Anthr 536. Development Anthropology. (Dual-listed with 436). (3-0) Cr. 3. S. *Prereq: Anthr 201 or 306.* Historical and theoretical basis of the practices of development, applied and economic anthropology. Covers a wide range of topics such as the role of aid, institutions of development, indigenous knowledge, rural development projects, organization of production, migration, health and environment.

Anthr 537. Andean Archaeology. (Dual-listed with 337). (3-0) Cr. 3. F. *Prereq: 202 or 321 recommended.* Survey of prehistoric Andean cultures of Peru, Bolivia and Ecuador; the archaeology of the Incas and their ancestors. Emphasis on prehistoric economics, religious, and political organization, the rich material culture recovered through archaeological records; and the use of ethnohistoric texts and modern ethnographies to reconstruct the prehistory of Andean societies.

Anthr 538. Primate Evolutionary Ecology and Behavior. (Dual-listed with 438). (3-0) Cr. 3. S. *Prereq: 202 or 307.* Primate behavior and ecology in evolutionary perspective; biological and social adaptations of prosimians, monkeys, and apes. Introduction to the Order Primates, basic evolutionary concepts, and techniques of behavioral observation. Focus on theory and methods current in Primatology, including applied conservation biology.

Anthr 539. Medical Anthropology. (Dual-listed with 439). (3-0) Cr. 3. S. *Prereq: 6 credits in anthropology, 201 or 202 or 306 recommended.* Study of human health in cultural and environmental context; comparison of health and disease patterns of western and non-western populations; healing systems; use of epidemiological models in understanding illness and disease etiologies cross-culturally; interrelationship between diet and culture.

Anthr 540. Magic, Witchcraft, and Religion. (Dual-listed with 340). (3-0) Cr. 3. S. *Prereq: 6 credits in anthropology, 201 or 306 recommended.* Origin and development of indigenous magico-religious systems; myth and ritual; therapeutic aspects; symbols and meanings; religion and Socio-cultural change, including acculturation, nativistic, and revitalization movements.

Anthr 544. Sex and Gender in Cross-cultural Perspective. (Dual-listed with 444). (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: 201; 306 recommended.* Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western Societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

Anthr 545. Biological Field School. (Dual-listed with 445). Cr. arr. SS. *Prereq: Anthr 202 or Biol 101 and permission of instructor.* Summer field school for training in behavioral and ecological methods for primatologists. Proposal, data collection and analyses, and presentation of research topic in primatology.

Anthr 550. Primate Behavior. (Dual-listed with 350). (2-2) Cr. 3. F.S.SS. *Prereq: Anthr 202 and/or basic biology course recommended.*. An introduction to the Order Primates with a focus on their behavior. Biological and social adaptations of monkeys, apes, and prosimians; basic evolutionary concepts, current trends and theories in the field of Primatology and issues related to primate conservation.

Anthr 555. Seminar in Archaeology. (3-0) Cr. 3. S. *Prereq: 308 or 429.* Examination of the history of Anthropological archaeology and current issues and debates concerning methods, theories and the ethics of modern archaeology.

Anthr 582. Topics in Biological Anthropology. (Dual-listed with 482). (3-0) Cr. 3. Repeatable. F. *Prereq: Anthr 307.* In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.
A. Paleoanthropology
B. Primate Cognition
C. Population Conservation
D. Population Genetics and Human Evolution

Anthr 590. Graduate Independent Study. (Cross-listed with Ia LL, A Ecl, EEOB). Cr. arr. Repeatable. SS. *Prereq: Graduate classification and permission of instructor.*
I. Iowa Lakeside Laboratory (Same as Ia LL 590I)

Anthr 591. Orientation to Anthropology. (1-0) Cr. 1. F. *Prereq: Admission to the Anthropology Graduate Program.* Introduction to the Anthropology program, including the requirements for successful degree completion, department administrative procedures, ethics in anthropology and current trends in the four subfields of anthropology. Required of graduate students. Satisfactory-fail only.

Courses for graduate students

Anthr 610. Foundations of Sustainable Agriculture. (Cross-listed with Agron, SusAg, Soc, A E). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging systems of agriculture in terms of core concepts of sustainability and their theoretical contexts.

Anthr 699. Research. Cr. arr. Repeatable.
I. Iowa Lakeside Laboratory (Same as Ia LL 699I.)

Apparel, Educational Studies, and Hospitality Management

www.aeshm.hs.iastate.edu/

Robert Bosselman, Chair of Department

Distinguished Professors (Emeritus): Fanslow, Moyer, Winakor

University Professors (Emeritus): Farrell-Beck

Professors: Bosselman, Damhorst, Fiore, Kadolph

Professors (Emeritus): Anderson, Beavers, Brun, Burnet, Cowan, Crabtree, Gilmore, Smith, Stone, Williams

Associate Professors: Baltzer, Hausafus, Niehm, Parsons

Associate Professors (Emeritus): Amos, Brackelsberg, Brown, Ebert, Huss, Kundel, Kunz, Walsh

Associate Professors (Adjunct): Strohbehn

Assistant Professors: Barker, Hurst, Karpova, Keino, Y. Lee, Marcketti, Rajagopal, Wohlsdorf-Arendt, Zheng

Assistant Professors (Adjunct): Glock

Instructors (Adjunct): Fratzke

Lecturers: Ackerman, Burger, Christensen, Fiihr, Fitzpatrick, Kramer, M. Lee, Sanger, Trost, Wirth, Wise

The department offers courses that provide opportunities for students to learn about interdisciplinary areas including aesthetics, leadership, event planning, entrepreneurship, and multi-channel retailing at both undergraduate and graduate levels. AESHM courses serve to complement the student's major area of study whether it be Apparel Merchandising, Design, and Production; Family and Consumer Sciences Education; Hotel and Institutional Management; agriculture, business, design education, engineering, liberal arts and sciences or minor areas of study including entrepreneurial studies, design studies, or international studies.

Students majoring in Apparel Merchandising, Design, and Production are required to earn a C- or better in all AESHM courses applied to the degree, including transfer courses.

For additional courses of interest, see the listings for Family and Consumer Sciences Education and Studies; Hotel, Restaurant, and Institution Management; and Textiles and Clothing.

Courses primarily for undergraduate students

AESHM 111. Professional Development for AESHM. (2-2) Cr. 3. F.S. Career exploration, presentation and professional skills, teamwork and leadership, creativity, critical thinking, technology, and service learning components. Some WWW lectures.

AESHM 271. Public Relations and Event Management I. (2-2) Cr. arr. Repeatable. S. *Prereq: Permission of instructor.* Overview of public relations and event management in the apparel and hospitality industries. Production of an event including developing budgets, publicity, advertising, fund raising, choreography, staging, lighting, and food. Course must be taken for 3 credits first time, can be repeated for 1 credit.

AESHM 275. Merchandising. (3-0) Cr. 3. F.S. *Prereq: 3 credits in Math*. Principles of merchandising as applied to human science-related businesses, such as retailing, service, hospitality, and manufacturing. Study of planning, development, and presentation of apparel- and hospitality-related product lines.

AESHM 287. Principles of Management in Human Sciences. (3-0) Cr. 3. F.S. Introduction to management concepts and principles with application to the human Sciences organizations. Includes service quality management, professionalism, and social responsibility.

AESHM 311. Seminar on Careers and Internships. (1-0) Cr. 1. F.S. *Prereq: Sophomore classification. Good academic standing.* Internship and career planning, professional expectations and responsibilities. Resume development, cover letters, portfolio planning, interviewing techniques, and business etiquette.

AESHM 340. Hospitality and Apparel Marketing Strategies. (3-0) Cr. 3. F. *Prereq: Econ 101.* Application of marketing principles to the hospitality, apparel and retail industries. Emphasis on development of organizational strategies, marketing plans, service and social marketing principles within human sciences-related businesses.

AESHM 342. Aesthetics of Everyday Experience. (3-0) Cr. 3. F.S. Design principles, aesthetic concepts, and Philosophies applied to multi-sensory consumer environments. Influence of individual differences and cultural patterns on aesthetic preferences.

AESHM 379. Community Leadership: Examination of social Issues. (3-0) Cr. 3. F. Study of family and community social issues from diverse perspectives. Application of critical thinking and reflection to issues with a focus on leadership within the community.

AESHM 421. Developing Global Leadership: Maximizing Human Potential. (3-0) Cr. 3. S. Development of leadership in a global environment. Focus on the contributions of women in enhancing the well-being of others. Strategies for working with individuals, families and communities in other countries and cultures. Taking local action on global issues. Student participation in cultural activities.

AESHM 424. International Study Abroad Seminar. Cr. arr. Repeatable. F.S.SS. Orientation to study abroad program considering topics related to country and location; travel arrangements and preparation for study abroad; on-site fieldwork and academic experiences in an international setting.

AESHM 438. Human Resource Management. (3-0) Cr. 3. S. *Prereq: HRI 193, AESHM 275 or 287; junior classification.* Principles and practices of human resource management relevant to human Science-related organizations. Emphasis on the entry-level manager's role.

AESHM 471. Public Relations and Event Management II. (2-2) Cr. arr. Repeatable. S. *Prereq: Permission of instructor.* Advanced application of public relations and event management in the apparel and hospitality industries. Provide leadership and communicate direction for production of an event including developing budgets, publicity, advertising, fund raising, choreography, staging, lighting, and food. Course must be taken for 3 credits first time, can be repeated for 1 credit.

AESHM 474. Entrepreneurship in Human Sciences. (Dual-listed with 574). (3-0) Cr. 3. S. *Prereq: junior or senior Status.* Entrepreneurship concepts of innovation, creativity, opportunity assessment, business planning. Focus on human Sciences-related businesses: retail, service, hospitality, family, home-based, rural, women and minority-owned businesses. Project applications include market research, feasibility analysis, and new business proposals.

AESHM 477. Multi-channel Retailing. (3-0) Cr. 3. F. *Prereq: 3 credits in marketing or AESHM 275 or 287.* Strategies used by retailers to market products through store formats, e-commerce, catalog, TV, mobile, direct sales. Emphasis on integration of e-commerce with other channels.

Courses primarily for graduate students, open to qualified undergraduate students

AESHM 545. Consumer Aesthetics and Retail Branding. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: One course in design elements and principles, psychology, consumer behavior, or marketing.* Examination of hedonic nature of consumer experience and its application to experiential design and branding of retail/hospitality establishments. Emphasis on consumer behavior, design, environmental psychology, and marketing literature.

AESHM 574. Entrepreneurship in Human Sciences. (Dual-listed with 474). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: One course in marketing or permission of instructor.* Entrepreneurship concepts of innovation, creativity, opportunity assessment, business planning. Focus on human Sciences-related businesses: retail, service, hospitality, family, home-based, rural, women and minority-owned businesses. Project applications include market research, feasibility analysis, and business proposals.

AESHM 577. E-Commerce for Apparel and Hospitality Companies. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: Course in marketing or permission of instructor.* Technology and consumer trends, industry practices, and marketing strategies for e-commerce. Evaluation and development of apparel or hospitality

company websites. Theory application to development of multi-channel business strategies.

Architecture

www.arch.iastate.edu

Calvin Lewis, Chair of Department

Professors: Block, Chan, Engelbrecht, Lewis, Osterberg, Palermo, Schwennsen, Shao

Professors (Emeritus): Findlay, Heemstra, Kitzman, Mckeown, Mukerjea, Shank, Stone

Associate Professors: Alread, Bassler, Bermann, Cardinal-Pett, Ghandour, Horwitz, Leslie, Muecke, Naegele, Paxson, Squire

Associate Professor (Adjunct): Masterson

Assistant Professors: Call, Campbell, Maves, Passe, Sobiech-Munson, Zarecor

Assistant Professor (Collaborator): Schneider

Lecturers: Anderson, Fisher, Goche, Jackson, Julien, Kalaher, Lueth, Whitehead, Zhao

Undergraduate Study

The undergraduate program in architecture is a five-year curriculum leading to the bachelor of architecture degree. The program provides opportunities for general education as well as preparation for professional practice and/or graduate study. An optional one-semester foreign study program is offered to fourth year students.

The undergraduate curriculum includes one year of preprofessional coursework and four years of professional coursework. Admission to the professional degree program is based on the applicant's performance in the completed preprofessional curriculum; previous high school record (or transfer record where applicable); portfolio and essay evaluations; and on available departmental resources.

Objectives of the Bachelor of Architecture program:
The Department is committed to the study of architecture as a cultural discipline in which issues of practice, of the multiplicity of social formations in which buildings exist, and of environmental effect are enfolded with the subject matter of building design - construction, space, material, form and use. Architecture arises from the aspirations that diverse individuals and groups have for their physical environment, and from the social enterprise of designing and fabricating the landscape we inhabit. It involves individual and multiple buildings, the spaces within them, and the exterior landscape.

It is our intent: that our students develop the skills with which to critically assess and research architectural questions and to invent architectural designs that address those questions; that they develop a working method for designing and that they have the communication, graphic, modeling and computational skills to support design exploration and to represent their design ideas to others; that they gain knowledge of architectural technologies through which buildings are given form, of which they are constructed and by which they are environmentally tempered; that they understand architectural history, that they understand the theoretical and diverse cultural underpinnings of the discipline of architecture, that they are able to reference architectural precedents and know how to utilize all of these in the development of their ideas; and that they have grounding in the ethical and practical aspects of the architectural profession in Society.

For students entering the professional program, the department highly recommends purchase or lease of a laptop/notebook computer and appropriate software. See the *Undergraduate Academic Advising Handbook* in the departmental office or the departmental web pages for hardware and software specifications.

For a more complete undergraduate program description, see *College of Design, Curricula*.

Graduate Study

The Department of Architecture offers professional, post-professional and research-oriented degrees for graduate students. The M.Arch. I and M. Arch. II emphasize the relationship between professional education and research. The M.S.A.S. is for students with non-professional degrees who want to pursue graduate-level research on the built environment. All the programs encourage interdisciplinary work within the College of Design and across related fields within the university.

Objectives:
The graduate program assumes the following: the built environment is an active agent in a global ecosystem and the setting for most forms of cultural exchange; the built environment can make positive and negative contributions to the vitality of local and global communities; understanding the dynamics of social production, material consumption and cultural exchange is a prerequisite to meaningful architectural design. For the most part, the built environment is designed by people who do not consider the consequences of their actions broadly. Therefore, our program demands engagement with contemporary issues and a commitment to lifelong learning. We encourage students to examine the relationships between local, regional and global contexts with a particular emphasis on the dynamics of the contemporary American Midwest. The domain of the architect's action is limited, but the range of information needed to make intelligent and responsible design decisions is vast. We expect our graduates to value the necessity of research, interdisciplinary collaboration and teamwork.

The M.Arch. I is an accredited first professional degree in architecture. Students with an undergraduate degree other than architecture enroll in a 100-credit, seven semester program. The curriculum starts with an intensive three-semester course sequence that places equal emphasis on architectural design, science and technology, and social and historical seminars on the built environment. The remaining four semesters have an open structure that allows students to explore architecture within an interdisciplinary context. These four semesters include a series of thematic and option studios, as well as various elective offerings. Students with a B.A. or B.S. in architecture or other affiliated design fields are considered for advanced standing based on a review of their academic record.

The M.Arch. II is a 30-credit post-professional degree in architecture for students with a B.Arch. or equivalent professional degree in architecture. The program is not subject to NAAB accreditation. The M.Arch. II program offers designers with a professional degree an opportunity to pursue advanced research in design. The program of study is expected to explore architectural design within interdisciplinary fields and requires completion of a creative component. As a precondition for acceptance, applicants are required to submit a statement of purpose that defines the research they want to pursue in architectural design. Upon admission, students partner with a faculty member to select courses from across the university to determine their program of study. A minimum of two semesters should be devoted to the program; due to teaching assistantship and research needs, students often take longer to finish.

The M.S.A.S. is a 30-credit interdisciplinary research degree in architectural studies. This degree is for students with bachelor degrees in various fields and interests in graduate-level research on the built environment. The M.S.A.S program is not subject to NAAB accreditation and is not intended, on its own, to lead to a career as a licensed architect. The program of study is expected to explore architecture within interdisciplinary fields and requires completion of a thesis project. As a precondition for acceptance, applicants are required to submit a thesis proposal. Upon admission, students partner with a faculty member to serve as a thesis adviser and to determine their program of study. A minimum of two semesters should be devoted to the program; due to teaching assistantship and research needs, students often take longer to finish. Areas of specialization include, but are not limited to: accessibility, architectural education, architectural history, building technology, energy and sustainability, environmental and social change, globalization and the built environment, historic preservation, housing, light and sound, politics and architecture and professional ethics.

Double-degree programs are currently offered with the Department of Community and Regional Planning (M.Arch./M.C.R.P.) and the College of Business (M.Arch./M.B.A.).

Financial support in the form of teaching and research assistantships is available.

Contact the department office for specific curricula.

Courses primarily for undergraduate students

Arch 102. Pre-Architecture Design. (1-6) Cr. 4. F.S. Three-dimensional design and drawing, with emphasis on creative conceptualization, exploration of materials, and analytical thinking. Includes study of architectural precedents and exercises to develop ability to communicate about form and space.

Arch 132. Two-Dimensional Studio. (0-6) Cr. 2. F.S. *Prereq: Enrollment in the preprofessional program.* Introduction to free-hand drawing concepts and practices. Exploration of the sketch as a means of inquiry, conceptualization and representation of form and space. Exercises focus on acquiring proficiency in the perceptual and experiential aspects of drawing. Various media, subjects and environmental contexts.

Arch 182. An Introduction to Architecture. (3-0) Cr. 3. S. *Prereq: Open to non-majors.* Through the study of architects, buildings, and theories, an introduction to the discipline of architecture, presenting architectural process and architectural works as culturally grounded events and artifacts.

Arch 201. Architectural Design I. (1-15) Cr. 6. F. *Prereq: Completion of the preprofessional program and admission into the professional program.* Introduction to architectural design. Introduction to architectural design, including precedent research, drawing conventions, model making, and diagramming. Studio projects focus on investigating the impact of specific site conditions on design, threshold conditions, and small-scale domestic space. Students will learn skills in problem solving, visualization, and written, oral, and graphic communication. Field trips to relevant architectural sites.

Arch 202. Architectural Design II. (1-15) Cr. 6. S. *Prereq: 201; Math 142; Phys 111.* Continuation of fundamental architectural design exploration. Studio projects focus on the generation of ideas based on experience and an understanding of urban Spaces. Emphasis on systematic analysis of urban culture, scale, materiality, and networks. Students work in

groups and individually. Representational methods expand on architectural conventions through experimentation. Fieldtrips to relevant architectural sites.

Arch 221. History of Western Architecture I. (Cross-listed with Dsn S). (3-0) Cr. 3. F. Introductory survey with emphasis on the cultural, visual, natural, and constructed context. Ancient through Renaissance.

Arch 222. History of Western Architecture II. (Cross-listed with Dsn S). (3-0) Cr. 3. S. Introductory survey with emphasis on the cultural, visual, natural, and constructed context. Renaissance to present.

Arch 230. Design Communications I. (2-2) Cr. 3. F. *Prereq: Admission to the professional program.* Investigations of various design media–including computer graphics and freehand drawing–and their applications to design, specifically to the course work in 201. Exercises to develop manual skill and perceptual sensitivity.

Arch 240. Materials and Assemblies I. (3-0) Cr. 3. F. *Prereq: Completion of the preprofessional program and admission into the professional program.* Introduction to common architectural materials, their physical properties, and integration into light construction subsystems. Model building codes, gravitational and climactic forces, and simplified methods of analysis for the preliminary design of building systems.

Arch 242. Architectural Structures I. (3-1) Cr. 3. S. *Prereq: 240; Math 142; Phys 111.* Structural performance and preliminary design of residential scale wood frame members and systems; principles of equilibrium and material behavior.

Arch 271. Human Behavior and Environmental Theory. (3-0) Cr. 3. F. *Prereq: Completion of the preprofessional program and admission into the professional program.* Exploration of theories that describe social structure and order and the manner in which individuals and Societies organize themselves and structure their environment.

Arch 301. Architectural Design III. (1-15) Cr. 6. F. *Prereq: 202.* Consideration of landscape as a constructed, cultural artifact. Projects address the perceptual aspects and strategies of situation and location; examination of environmental phenomena and patterns of use and settlement as revealed and affected by the architectural artifact. Development of a critical design process is stressed.

Arch 302. Architectural Design IV. (1-15) Cr. 6. S. *Prereq: 301 and minimum 2.0 GPA in previous studio courses.* Continuation of 301, examining housing in the urban Situation; diverse scales of use and occupation within the city as shaped by cultural tendencies. Projects examine collective and individual identities related by the condition of adjacency, the ability to consider varieties of scale within a project, and a further development of critical and technical methods.

Arch 310. Practical Experience. Cr. R. *Prereq: Permission of department chair.* Students must register for this course prior to commencing each term. Available only to students taking course loads of eleven credits or less.

Arch 334. Computer Applications in Architecture. (2-2) Cr. 3. F.S.SS. *Prereq: 201; 230.* Current and potential applications of digital computers in architecture. Projects employing computer graphics and modeling methods. Awareness of programming languages related to applications.

Arch 335. Three-Dimensional Studio. (Cross-listed with ArtIS). (0-5) Cr. 2. Repeatable. F.S. This course deals with three dimensional problems in visual invention, organization, and expression emphasizing creative manipulation of tools, materials, and techniques as means for three dimensional thinking. Projects cover the additive (modeling), subtractive (carving), substitutional (casting) as well as constructive techniques.

Arch 344. Architectural Structures II. (3-0) Cr. 3. F. *Prereq: 242.* Structural performance and preliminary design of low to medium rise steel frame members and systems, long span steel systems, and masonry walls and systems. Principles of equilibrium and material behavior.

Arch 346. Architectural Structures III. (3-0) Cr. 3. S. *Prereq: 344.* Structural performance and preliminary design of low- to medium- rise reinforced concrete and prestressed concrete members and systems. Wind and seismic lateral forces and the principles of equilibrium and material behavior.

Arch 351. Solar Home Design. (Cross-listed with Dsn S). (3-0) Cr. 3. S. *Prereq: 202.* Architectural design and technical analysis of residential structures with emphasis on energy construction and solar energy utilization.

Arch 357. Environmental Forces in Architecture. (3-0) Cr. 3. S. *Prereq: Completion of the preprofessional program and admission into the professional program; Math 142; Phys 111.* Introduction to environmental forces that describe the function of buildings in terms of human comfort and patterns of occupancy. Emphasis on analytical rules of thumb and calculation methods that contribute to design synthesis. A design process is developed utilizing building climatology, control of thermal, luminous, and acoustic environments.

Arch 401. Architectural Design V. (1-15) Cr. 6. F. *Prereq: 302.* A rigorous examination of architecture's relationship with culture and technology. Studio projects stress the interpretation and integration of contextual and historical considerations, as well as structural, environmental, and communication systems, in a comprehensive design proposal.

Arch 402. Architectural Design VI. (1-15) Cr. 6. S. *Prereq: 401 and minimum 2.0 GPA in previous studio courses.* An examination of the relationship between architecture and the city. Studio projects stress analysis and interpretation of the diverse forces and conditions that impact and inform architecture in the urban environment. Urban design project. Study abroad option.

Arch 403. Architectural Design VII. (1-15) Cr. 6. F. *Prereq: 402.* Advanced forum for architectural research and/or design. Choice of thematic studios or student initiated research and design. Experimentation and innovation are encouraged. Dsn S 446/546, for 6 cr. each time taken, can be substituted for this class and be taken up to a maximum of 12 credits.

Arch 404. Architectural Design VIII. (1-15) Cr. 6. S. *Prereq: 403.* Advanced forum for architectural research and/or design. Choice of thematic studios or student initiated research and design. Experimentation and innovation are encouraged. Dsn S 446/546, for 6 cr. each time taken, can be substituted for this class and be taken up to a maximum of 12 credits.

Arch 420. Topics in American Architecture. (3-0) Cr. 3. Repeatable. F.S. *Prereq: Junior classification.* History, theory, and principles of American architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 420 may be applied to degree program. Nonmajor graduate credit.

Arch 422. Topics in Medieval Architecture. (3-0) Cr. 3. Repeatable. S. *Prereq: Junior classification.* History, theory, and principles of medieval architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 422 may be applied to degree program. Nonmajor graduate credit.

Arch 423. Topics in Renaissance to Mid-Eighteenth Century Architecture. (3-0) Cr. 3. Repeatable. S. *Prereq: Junior classification.* History, theory, and principles of renaissance to mid-eighteenth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 423 may be applied to degree program. Nonmajor graduate credit.

Arch 424. Topics in Nineteenth Century Architecture. (3-0) Cr. 3. Repeatable. F. *Prereq: Junior classification.* History, theory, and principles of nineteenth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 424 may be applied to degree program. Nonmajor graduate credit.

Arch 425. Topics in Twentieth Century Architecture. (3-0) Cr. 3. Repeatable. F.S. *Prereq: Junior classification.* History, theory, and principles of twentieth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 425 may be applied to degree program. Nonmajor graduate credit.

Arch 426. Topics in Native American Architecture. (Cross-listed with Am In, Dsn S). (3-0) Cr. 3. Repeatable. F.S. *Prereq: Junior classification.* History, theory, and principles of Native American/American Indian architecture, landscape architecture and planning considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 426 may be applied to degree program. Nonmajor graduate credit.

Arch 427. History, Theory, and Criticism of Chinese Architecture. (Dual-listed with 527). (3-0) Cr. 3. F. *Prereq: Junior classification.* Survey of the history and theoretical concept of Chinese built environment with emphasis on the morphology of built form and its relation to art, landscape design, and urban Structure. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. Nonmajor graduate credit.

Arch 431. Analytical Drawing. (1-6) Cr. 3. Repeatable. F.S. *Prereq: 232, 302.* Exploration of 2- and 3-dimensional representations. Emphasis on on-site freehand sketching, perspective and orthographic drawing, rendering of shadows and textures, and use of diverse media.

Arch 432. Advanced Computer Lighting and Rendering. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 230, 301.* Exploration of the computer as a design and communication tool. Emphasis on lighting and rendering techniques.

Arch 433. File to Fabrication. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 230, 301.* Exploration of the computer as a design and manufacturing tool. Emphasis on fabrication techniques and rapid prototyping including laser-cutting, 3-D printing and CNC routing.

Arch 434. Computer-aided Architectural and Environmental Design. (1-4) Cr. 3. S. *Prereq: 334.* Emphasis on application of the computer as a design tool, topical applications and computer graphic methods, development of computer software for architectural and environmental problem solving. Nonmajor graduate credit.

Arch 436. Advanced Design Media. (2-2) Cr. 3. Repeatable. F.SS. *Prereq: 230.* Special topics in design media applications.

Arch 437. Architectural Photography. (3-0) Cr. 3. F. *Prereq: 202.* Emphasis on use of the camera and lighting in photographing drawings and interior and exterior building environments. Nonmajor graduate credit.

Arch 448. Materials and Assemblies II. (3-0) Cr. 3. S. *Prereq: 346.* Investigation of the materials and integrated systems found in complex construction assemblies. Emphasis on determination and utilization of appropriate forms of material assemblies and structural systems for large scale construction.

Arch 458. Environmental Control Systems. (3-0) Cr. 3. F. *Prereq: 357.* Overview of architectural environmental control systems in response to occupant comfort, patterns of use, health, and safety regulations. Emphasis on the analytical rules of thumb and calculation methods necessary to provide integrated

design synthesis of technical systems within architecture. Understanding the use and design of mechanical, electrical, plumbing, fire safety, transportation, and conveying systems and subsystems.

Arch 482. Professional Practice. (Dual-listed with 582). (3-0) Cr. 3. F. *Prereq: 202.* Emphasis on the circumstances and opportunities of the professional practice of architecture: practice as profession, process, organization, business, and evolving models of practice.

Arch 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on required form.* Independent investigation.
A. Design Communications.
B. Design
C. Technical Systems.
D. Architectural History
E. Behavioral Studies
F. Practice
H. Honors

Courses primarily for graduate students, open to qualified undergraduate students

Arch 505. Architectural Design I. (0-10) Cr. 5. F. *Prereq: Admission to the M Arch program. Concurrent enrollment in 595; 541.* An introduction to comprehensive architectural design projects (individual and collaborative) with coordinated studies in design media, history, theory, culture, science, and technology. Projects establish a framework for designing buildings as aspects of dynamic circumstances such as environmental forces, construction methods, economic and political regulations, social relationships, and cultural values. Course content and assignments coordinated with 506 and 596.

Arch 506. Architectural Design II. (0-10) Cr. 5. S. *Prereq: 505; 583; 541. Coreq: 596; 542.* Continuation of 505. More challenging comprehensive architectural design projects (individual and collaborative) with coordinated studies in design media, history, theory, culture, science and technology. Projects establish a framework for designing buildings as aspects of dynamic circumstances such as environmental forces, construction methods, economic and political regulations, social relationships and cultural values.

Arch 507. Architectural Design and Media III. (0-10) Cr. 5. SS. *Prereq: 506, 596, 542. Coreq: Arch 543.* Design projects that examine the relationship between architectural concepts and the reality of built form. Emphasis is placed on the multi-faceted role of the architectural detail in the design process. Assignments involve the study of contemporary and historic construction documentation, research into architectural materials and the use of representational media appropriate to the scale of the detail. Projects also demand engagement with the cultural and technological issues explored in previous and concurrent courses.

Arch 510. Practical Experience. Cr. R. Repeatable. F.S.SS. *Prereq: Graduate standing and permission of department DOGE.* Students must register for this course prior to commencing each period. Available only to students taking course loads of 8 credits or less.

Arch 519. Middle Eastern Cities. (3-0) Cr. 3. F. *Prereq: Graduate or senior standing.* Middle Eastern cities introduce a particular continuity between history and contemporary life where in some cases the latter is about re-defining the former. Introduction to basic academic writings on Middle Eastern cities in addition to other contemporary cultural productions of the region. Study of various aspects of Middle Eastern life and the built environments that this life produces.

Arch 527. History, Theory, and Criticism of Chinese Architecture. (Dual-listed with 427). (3-0) Cr. 3. F. *Prereq: Senior classification or graduate standing.* The history and theoretical concept of Chinese built environment with emphasis on the morphology of built form and its relationship to art, landscape design, and urban structure. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Arch 528. Topical Studies in Architecture. (Cross-listed with Dsn S). (3-0) Cr. arr. Repeatable. F.S.SS. *Prereq: Arch 221, 222 or senior classification or graduate standing.*
A. Studies in Architecture and Culture
B. Technology
C. Communications
D. Design
E. Practice

Arch 529. Spatial Dialectics in the American Midwest. (3-0) Cr. 3. S. *Prereq: Graduate or senior standing.* The American Midwest has witnessed dramatic transformation during the last two centuries which impacted its physical, environmental, economic and social characteristics. This course is an interdisciplinary study of the evolution and sustainability of Midwestern space in relationship to forces of flow shaped by the mobility of bodies, products, meanings, and symbols that are enforced, incorporated, reproduced or destroyed.

Arch 534. Advanced Computer-aided Architectural Design. (1-4) Cr. 3. Repeatable. F. *Prereq: 434, permission of instructor.* Emphasis on concepts, algorithms, data structures, advanced modeling, rendering, animation, and virtual reality applications in architectural design.

Arch 535. Advanced Three-Dimensional Studio. (0-5) Cr. 2. Repeatable. F.S. *Prereq: 335 or graduate standing.* Advanced investigation of sculptural expression with emphasis on individual projects.

Arch 541. Science and Technology for Architects I. (4-2) Cr. 5. F. *Prereq: Admission to the M.Arch I program. Coreq: 505; 595.* First of a four-course series in building science and technologies. Introduction to Human Factors, Descriptive Geometry, Basic Building Materials, and Small-Scale Building Envelopes. Theory and case studies, stressing the connectivity of technical issues to broader formal, social, and cultural spheres. Course content and assignments coordinated with 505 and 595.

Arch 542. Science and Technology for Architects II. (4-2) Cr. 5. S. *Prereq: 505; 541; 595. Coreq: 506; 596.* Second of a four-course series in building science and technologies. Elementary Statics and Beam Theory, Basic Construction Materials, and Site and Building Circulation. Theory and case studies stressing the connectivity of technical issues to broader formal, social, and cultural spheres. Course content and assignments coordinated with 506 and 596.

Arch 558. Sustainability and Green Architecture. (Cross-listed with Dsn S). (3-0) Cr. 3. F. *Prereq: Graduate standing.* Issues of Sustainability as related to living patterns and city design, population, pollution and use and availability of natural resources for the built environment; Issues of Green Architecture as it relates to building material selection, systems of building materials, the environment of the United States and the World, architects and examples of buildings with green or sustainable designations.

Arch 567. Preservation, Restoration, and Rehabilitation. (Cross-listed with Dsn S). (3-0) Cr. 3. S. *Prereq: Senior classification.* Construction standards and procedures for preserving, restoring, reconstructing, and rehabilitating existing buildings following the guidelines of the National Park Service and the National Trust for Historic Preservation. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Arch 571. Design for All People. (Cross-listed with Dsn S, Geron). (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Principles and procedures of universal design in response to the varying ability level of users. Assessment and analysis of existing buildings and sites with respect to standards and details of accessibility for all people, including visually impaired, mentally impaired, and mobility restricted users. Design is neither a prerequisite nor a required part of the course. Enrollment open to students majoring in related disciplines. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Arch 575. Contemporary Urban Design Theory. (Cross-listed with Dsn S). (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Current urban design theory and its application to urban problems. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Arch 576. Study Abroad Options. (3-0) Cr. 3. Repeatable. SS. Special topics in environmental design, architectural history and contemporary practice. Travel to relevant countries. General cultural and historical studies, topical projects and individual inquiry. Courses may be taught by departmental faculty or faculty from approved Iowa State Study Abroad programs. See current offerings for detailed syllabus.

Arch 581. Service Learning. (1-12) Cr. 5. SS. *Prereq: 506, 596, 542.* Planning and construction of a full-scale project serving a community need. Learning occurs through both theory and active involvement in constructed work. Projects connect previous coursework to practical applications and community involvement.

Arch 582. Professional Practice. (Dual-listed with 482). (3-0) Cr. 3. F. *Prereq: Graduate standing.* Emphasis on the circumstances and opportunities of the professional practice of architecture: practice as profession, process, organization, business, and evolving models of practice.

Arch 583. Research in Practice. (3-0) Cr. 3. S. *Prereq: Senior or graduate standing.* Foundational course in the methods and conceptual tools of design research in the context of practice. Through team and individual guided projects, students generate, analyze and represent knowledge in design-related communications and contexts. Alternative models of practice, client groups and communities are addressed within projects that precede, feed, follow, or overlap with architectural contracts.

Arch 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on approved form.* Investigation of architectural issues having a specialized nature.

Arch 595. Seminar on the Built Environment I: History. (5-0) Cr. 5. F. *Prereq: Admission to the MArch I program. Coreq: 505; 541.* Introduction to architectural history and its role in shaping the contemporary practice of architecture. Students learn skills in critical thinking, visual analysis, and research methods. Course sessions develop thematically with interdisciplinary readings, group discussions, student presentations, and research projects. Course content and assignments coordinated with 505 and 541.

Arch 596. Seminar on the Built Environment II: Landscape and Society. (5-0) Cr. 5. S. *Prereq: 505; 541; 595. Coreq: 506; 542.* Introduction to landscape as artifact and multi-disciplinary knowledge-base for design thinking. Literatures and methods of environmental psychology, cultural geography, landscape and architectural history and theory, site and circulation design as intersection of built infrastructural, natural, and social systems. Emphasis on sensory perception, and human movement; investigations of climate, environmental conditions, and values toward consumption and sustainability in everyday experience of the built environment. Course content and assignments coordinated with 506 and 542.

Arch 597. Seminar on the Built Environment III: Theory. (3-0) Cr. 3. F. *Prereq: Senior classification or graduate standing.* Multidisciplinary overview of contemporary theories concerned with the production of the built environment. Particular attention to urbanism as a discourse that relates social interactions and power structures to material space. Coursework includes readings, seminar discussion and a research paper.

Arch 598. Seminar in the Built Environment IV: Topical Study. (3-0) Cr. 3. S. *Prereq: senior or graduate standing.* A research seminar that takes an in-depth look at a topic within contemporary discourses on architecture and urbanism. The topic will be considered from multiple points of view including its historical, theoretical, behavioral and cultural aspects.

Courses for graduate students

Arch 601. Architecture and Landscape Design. (0-12) Cr. 6. F. *Prereq: 507; 542; 596. Coreq: 643.* Design projects that explore the relationships among architecture, cultural landscapes, and biological issues. Emphasis on regional sites and Socio-economic conditions. Projects stress engagement with local circumstances and stakeholders, and the application of interdisciplinary research, new materials and systems. Course content and assignments coordinated with 643.

Arch 602. Design Studio Options. (0-12) Cr. 6. Repeatable. S. *Prereq: 601.* Design studio electives include, but are not limited to: independent and interdisciplinary projects, study abroad, and design-build. Dsn S 446/546, for 6 cr. each time taken, can be substituted for this class and be taken up to a maximum of 12 credits.

Arch 603. Comprehensive Design. (0-12) Cr. 6. F. *Prereq: 601.* Rigorous examination of architecture's relationship with culture and technology. Studio projects stress the interpretation of contextual and historical considerations, as well as structural, environmental, mechanical, electrical and plumbing systems, in a comprehensive design proposal. This course fulfills the Graduate College Creative Component Requirement.

Arch 643. Science and Technology for Architects III. (2-2) Cr. 3. F. *Prereq: 507, 542, 596, 581 or graduate standing. Coreq: 601.* Third in a four-course series in building science and technologies. Structural Elements and Systems, and Building Services. Theory and case studies stressing the connectivity of technical issues to broader formal, social and cultural spheres. Course content and assignments coordinated with 601.

Arch 644. Science and Technology for Architects IV. (2-2) Cr. 3. S. *Prereq: 643 or graduate standing.* Fourth of a four-course series in building science and technologies. Building Enclosures, Interior Construction and Sensory Qualities, Fabrication and Construction. Theory and case studies stressing the connectivity of technical issues to broader formal, social and cultural spheres. Summative Student Project.

Arch 690. Independent Design Study. (1-15) Cr. 6. Repeatable. F.S.SS. *Prereq: Admission to MSAS or M Arch 30 credit program.* Independent architectural design projects commensurate with student interests requiring approval of Architecture Graduate Advisory Committee.

Arch 698. Graduate Seminar. Cr. R. Repeatable. F.S. *Prereq: Graduate standing.* Special topics and guest speakers.

Arch 699. Research. (1-18) Cr. arr. Repeatable. F.S.SS.

Art and Design

Roger Baer, Chair of Department

Distinguished Professors (Emeritus): Heggen, Miller

Professors: Baer, Herrnstadt, Lilligren

Professors (Emeritus): Allen, Bro, Dake, Evans, Fowles, Held, Pickett, Singer, Smith, Sontag, Stieglitz, Tartakov

Associate Professors: Akkurt, Caldwell, Chidister, Croyle, Cunnally, Curran, Fontaine, Gibbs, Gould, Jones, Kang, Katz, Malven, Martin, Mickelson, Muench, Paschke, Richards, Satterfield, Stout, Walton, Warme

Associate Professors (Emeritus): Bruene, Lehner, Mcilrath, Polster, Sage, Sreenivasam

Associate Professors (Adjunct): Demartino, Pohlman

Associate Professor (Collaborator): Sandor

Assistant Professors: Brunner, Bruski, Call, Campbell, Eisman, Faber, Godbey, Golec, Holland, Iasevoli, Sobiech-Munson, Song

Assistant Professor (Collaborator): Schneider

Senior Lecturers: Boehmer, Harris, Mikovec, Pappenheimer, Ure

Lecturers: Biechler, Morgan

Undergraduate Study

The department offers the degree Bachelor of Fine Arts (B.F.A.) in three curricular areas: Graphic Design, Integrated Studio Arts, and Interior Design. The department also offers the degree Bachelor of Arts (B.A.) in Art and Design. Each of these curricula affords excellent preparation for a variety of career opportunities or as a foundation for graduate study.

B.F.A. Graphic Design. Emphasis is on creative problem solving, design process, and the visual organization of communication media. Graphic design graduates effectively integrate abstract thinking skills; communication design theory, history, and methodology; and technology. Components of visual communication including typography, symbology, and image creation are integrated with an understanding of professional practice.

B.F.A. Integrated Studio Arts. Students select from a variety of studio options in order to build a portfolio and prepare for a professional practice in the visual arts. This concentration emphasizes aesthetics, visual problem solving, critical thinking, and skill development in a variety of media employing contemporary, historical, and cultural theory and practices.

B.F.A. Interior Design. Emphasis is on the student's application of design processes to creatively solve problems of the interior environment based on knowledge of human Safety, functional utility, physical, psychological, and contextual fit. Graduates in interior design are competent in visual communication (sketching, drafting and computer aided design), design problem solving, space planning, lighting and color specification for interiors, finish and furniture selection, detailing interior construction and application of human factors. The curriculum is accredited by the Foundation for Interior Design Education Research (FIDER) as providing professional level education.

Students entering the Graphic Design, Interior Design, or Integrated Studio Arts programs involving computeraided design or animation are strongly encouraged to purchase or lease of a laptop/notebook computer and appropriate software. Contact the department or see the College of Design web site for hardware and software specification.

B.A. Art and Design. This curriculum offers two concentrations: Art and Culture, and Visual Cultural

Culture Studies. Art and Culture has a greater emphasis on studio components, and Visual Culture Studies on humanities and liberal arts components.

Both concentrations are combined with an applied career minor or approved program.

Transfer students with studio credits from other colleges and universities must present a portfolio of work done in those courses to determine if these credits can be applied toward specific studio requirements. Students are required to present this portfolio upon admission and prior to registration for classes. Arrangements for this process must be made with department advisers.

The department offers no minor but participates in the undergraduate minor in design studies.

Graduate Study

The department offers the degrees of Master of Fine Arts (M.F.A.) in Graphic Design, Integrated Visual Arts, and Interior Design, and Master of Arts (M.A.) in Art and Design, with degree specialization in interior design, graphic design, and environmental graphic design. Graduates have a broad understanding of visual communication, problem solving, and interdisciplinary studies.

The M.F.A. curricula in Graphic Design and Interior Design require a minimum of 60 credits. The M.F.A curriculum in Integrated Visual Arts requires a minimum of 61. These programs include an art and design seminar, a studio concentration, history and criticism courses, a teaching seminar, elective courses outside the department or area of study, and the completion of a thesis-exhibition or thesis.

M.F.A. graduates in Graphic Design are skilled in communication design, problem solving, and are adept in the use of visual language and symbology. Graduates are proficient in the design of communications and the use of technologies that incorporate human interaction with environments, objects, and electronic and traditional publications. The M.F.A. is recognized as the terminal degree in the graphic design field. The degree requires completion of a written thesis integrating theory, research, and design problem solving.

M.F.A graduates in Interior Design are proficient in visual communication skills, design theory, human factors, and space planning. The M.F.A. degree is considered a terminal degree in the interior design field. The degree requires completion of a written thesis comprised of original research.

M.F.A. graduates in Integrated Visual Arts have skills that link traditional studio disciplines with emerging technologies. Graduates are prepared as visual artists to enter studio research, business, higher education or new interdisciplinary fields. The MFA is recognized as the terminal degree. A required thesis-exhibition is composed of two parts, a substantial exhibition and a written statement that describes the development of the work in the exhibition, its objectives, and its historical and cultural points of reference. A thesis may be an appropriate alternative, but some portion of the work should entail an element of design problem-solving in the form of a visual product.

The M.A. in Art and Design with specialization in interior design requires a minimum of 34 credits including a studio concentration and work in research methods and human factors. Candidates focus on research in an area of specialization culminating in a written thesis comprised of original research. Graduates have a broad understanding of current interior design issues and design research, preparing them for special analytical aspects of design practice and further studies leading to the PhD. Applicants without a degree in interior design may be required to complete up to 40 additional credits of course work.

The M.A. in Art and Design with a specialization in graphic design requires a minimum of 30 credits including seminar courses in art and design, a studio concentration, a history course, a business practice course, courses outside of graphic design, and the completion of a capstone course in graphic design. Graduate students selecting the M.A. in graphic design will focus on a first professional degree. Applicants without a degree in graphic design may be required to complete up to 17 additional credits of coursework.

The M.A. in Art and Design with a specialization in environmental graphic design requires a minimum of 34 credits including a seminar course in art and

design, a studio concentration, a history courses, courses in design methods, and the completion of a capstone course in environmental graphic design.

Graduate students selecting the M.A. in environmental graphic design will focus on a first professional degree. Applicants without a degree in background in environmental graphic design may be required to complete up to 15 additional credits of coursework.

Credit earned at Iowa State University or other institution for the Master of Arts degree may be applied toward the master of fine arts degree at the discretion of the program of study committee.

Applicants to the graduate program should have an undergraduate major in an art or design area and demonstrate the ability to do technically competent and original work through the presentation of a slide or digital portfolio for faculty review. Past academic performance and the quality of studio work are critical in the admission process. A minimum 3.0 GPA in the student's undergraduate major is the standard for full admission to the graduate program. Admission is also determined by studio space available within the program area, which changes yearly due to graduate students' progress in their programs of study.

Graduate students who have not completed an undergraduate program of study substantially equivalent to that required of undergraduates in the department can expect that additional supporting coursework, determined by the graduate faculty, will be required.

Prospective students are advised to contact the graduate coordinator with specific questions about admission procedures and portfolio review. Application and additional program information may be obtained from the Department of Art and Design, College of Design, Iowa State University, Ames, Iowa 50011-3092.

Art (Art)

Courses primarily for undergraduate students

Art 108. Visual Foundations I. (0-6) Cr. 3. F.S.SS. Exploring visual order, creative process, and interaction of two- and three-dimensional design. Introduction to color.

Art 109. Visual Foundations II. (0-6) Cr. 3. F.S.SS. *Prereq: 108.* Continued exploration of visual order, creative process, and interaction of two- and three-dimensional design and color.

Art 110. Orientation to Artand Design. Cr. R. F.S. Overview of the department and university with special emphasis on curricula, program planning, and study skills. Advising, policy and procedures, student services.

Art 130. Drawing I. (1-6) Cr. 3. F.S.SS. The introductory course in drawing, focusing on the fundamentals of drawing from observation. Subject matter may include working from the still life, architectural settings, landscape and the human figure. Line, shape, perspective and value studies are explored through a variety of drawing media.

Art 230. Drawing II. (0-6) Cr. 3. F.S. *Prereq: Art 108 or Dsn S 102, 183, and 131.* A continuation of Dsn S 131 (Design Representation). Further development of perceptual drawing skills from a variety of subject matter. Continued practice with drawing materials and techniques with emphasis on tonal and color media.

Art 292. Introduction to Visual Culture Studies. (Cross-listed with Dsn S). (3-0) Cr. 3. F.S. *Prereq: Open to all majors.* An introduction to various topics in visual culture studies. The lecture course will provide students with a creative and intellectual context in which to study historical and contemporary instances of the visual in culture. Individual lectures examine significant trends in the visual arts, mass media, scientific imagery, visual communications, and other areas related to visual literacy and visual representation in local and global contexts. Cross cultural viewpoints and issues of diversity will be presented in relation to visual culture and related fields.

Art 494. Art and Design in Europe Seminar. (1-0) Cr. 1. *Prereq: Permission of instructor and planned enrollment in 495.* Cultural and historical aspects of art and design in Western Europe in preparation for study abroad. Area of study varies each time offered. Satisfactory-fail only.
A. Fine Arts
G. Graphic Design
I. Interior Design
N. Art History

Art 495. Art and Design in Europe. (Dual-listed with 595). Cr. 3. F.S.SS. *Prereq: 494, permission of instructor.* International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities. Related activities depending on specific area of study which may vary each time offered. Travel and tour expenses to be paid by the student.
A. Fine Arts
G. Graphic Design
I. Interior Design
N. Art History

Art 496. Art and Design Field Study. Cr. R. Repeatable. *Prereq: Enrollment in an art and design studio or art history course, permission of instructor.* Study and tours of museums, galleries, artist and/or designer studios and other areas of interest within art and design. Satisfactory-fail only.

Art 497. Studio Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Advanced classification in a department curriculum.* Written approval of supervising instructor and department chair on required form in advance of semester of enrollment. Supervised experience with a cooperating artist or studio. Satisfactory-fail only.

Art 498. Museum/Gallery Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Advanced classification in a department curriculum.* Written approval of supervising instructor on required form in advance of semester of enrollment. Supervised experience with a cooperating museum or gallery or art center. Satisfactory-fail only.

Art 501. Issues in Visual and Material Culture Seminar. (3-0) Cr. 3. *Prereq: Permission of instructor.* Issues and debates that pertain to the study of visual objects and material artifacts in their cultural context. Examination of the role of visual and material culture studies as both relate to allied disciplines including, but not limited to: anthropology, art history, design history, design studies, and new media studies.

Art 511. Seminar in Teaching. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Readings and discussion of university level design education issues, studio/classroom observation, development of a teaching Philosophy, lesson planning and presentation.

Art 595. Art and Design in Europe. (Dual-listed with 495). Cr. 3. *Prereq: Graduate classification, 494 or equivalent, permission of instructor.* International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities. Related activities depending on specific area of study which may vary each time offered. Tour and travel expenses to be paid by the student.
A. Fine Arts
G. Graphic Design
I. Interior Design
N. Art History

Art 598. Museum/Gallery Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification and permission of instructor.* Written approval in advance of semester of enrollment. Supervised experience with a cooperating museum or gallery or art center. Satisfactory-fail only.

Courses for graduate students

Art 605. Research Methods. (3-0) Cr. 3. *Prereq: Permission of instructor.* Research strategies related to fine art and technology. Application of selected methods to specific issues.

Art 697. Studio Internship. Cr. arr. F.S.SS. *Prereq: Graduate classification and approval of POS committee.* Supervised off-campus learning experience with a prominent artist, designer, or firm.

Art 699. Research. Cr. arr. Repeatable.
A. Thesis
B. Thesis-exhibition museum or gallery or art center.
Satisfactory-fail only.

Art Education (ArtEd)

Courses primarily for undergraduate students

ArtEd 211. Introduction to Art Education. (0-6) Cr. 3. F.S. Design experiences for the K-12 classroom. Hands-on discipline-specific and integrated art activities; emphasis on creativity and thinking skills.

Graphic Design (ArtGr)

Courses primarily for undergraduate students

ArtGr 270. Graphic Design Studio I. (0-6) Cr. 3. F. *Prereq: Dsn S 102 and Dsn S 131, enrollment in 275; admission to the graphic design program through department review.* Basic design concepts and color principles used for visual communication.

ArtGr 271. Graphic Design Studio II. (0-6) Cr. 3. S. *Prereq: Art 230, ArtGr 270, 275, enrollment in 276.* Principles of typographic composition, structure and hierarchy. Formal and conceptual principles of symbology.

ArtGr 275. GraphicTechnology I. (0-4) Cr. 2. F. *Prereq: enrollment in 270.* Basic computer skills for graphic design.

ArtGr 276. GraphicTechnology II. (1-2) Cr. 2. S. *Prereq: 275, enrollment in 271.* Color management, color theory and applications skills for graphic design.

ArtGr 291. Theories and Principles of Graphic Design. (1-0) Cr. 1. F. *Prereq: Enrollment in 270.* Historical, cultural, and social issues related to the practice of visual communication.

ArtGr 370. Graphic Design Studio III. (0-6) Cr. 3. F. *Prereq: 271, 276, enrollment in a 2-credit option; credit or enrollment in 387.* Creation and design of images and symbols for communication. Application and integration of typography with images and symbols.

ArtGr 371. Graphic Design Studio IV. (0-6) Cr. 3. S. *Prereq: 370, 387, enrollment in a 2-credit option.* Development and preparation of design concepts for application to the printing and electronic publishing process. Creative problem-solving skills, introduction to systems design.

ArtGr 372. Graphic Design Materials and Processes. (2-0) Cr. 2. S. *Prereq: Credit or enrollment in 371.* Lecture about the processes and materials involved in graphic design arts reproduction. Course covers prepress, paper selection and specification, ink systems, type systems and fonts, output technology, printing presses and bindery operations.

ArtGr 377. Graphic Design Internship Seminar. (1-0) Cr. 1. F. *Prereq: Credit or enrollment in 370 or 371.* Procedural and ethical concerns related to the graphic design internship. Personal goals, preparation of resume and plans for internship. Study and tours of areas of interest within the graphic design profession.

ArtGr 378. Critical Issues in Graphic Design. (2-0) Cr. 2. *Prereq: Credit or enrollment in 370.* Lecture, discussion and writing about the critical issues facing the communications field today and in the future.

ArtGr 387. Graphic Design History/Theory/ Criticism I. (Dual-listed with 587). (3-0) Cr. 3. F. *Prereq: Art H 280, 281, Dsn S 183.* Late nineteenth century to the 1990s. This course will explore the cultural, social,

political, industrial, and technological forces that have influenced the practice of graphic design in Britain, Europe, and the United States. Students will study the historical issues and problems facing designers, their clients, and their publics. Nonmajor graduate credit.

ArtGr 388. Graphic Design History/Theory/ Criticism II. (Dual-listed with 588). (3-0) Cr. 3. S. *Prereq: Art H 281, Dsn S 183, or ArtGr 387.* Critical issues that affect the contemporary practice of graphic design as it relates to the United States. Students will study a variety of issues that include, but are not exclusive to, new media, gender, class, design and the public sphere, design as social action, postmodern design theory, sustainability, and ethical practice. Nonmajor graduate credit.

ArtGr 391. Graphic Design Field Study. (0-1) Cr. 1. Repeatable. *Prereq: Enrollment in 300 or 400 level graphic design studio course.* Travel, study, and tours of areas of interest within the graphic design profession such as print production companies, design studios, and museums. Satisfactory-fail only.

ArtGr 470. Graphic Design Studio V. (0-6) Cr. 3. F. *Prereq: 371, enrollment in a 2-credit option.* Advanced design systems as applied to corporate identity and environmental graphic design. Symbology as an integrated component of communication systems.

ArtGr 472. Photographic Art Direction. (Dual-listed with 572). (0-6) Cr. 3. *Prereq: 471, 482, enrollment in 370 or 371, or 470 or 471.* Photography as a graphic design component. Compositional and conceptual elements in photographic images. Must have a camera with adjustable shutter speeds and lens openings.

ArtGr 473. Time Based Multi-Media. (Dual-listed with 573). (0-6) Cr. 3. *Prereq: Enrollment in 370 or 371, or 470 or 482.* The design of visual, aural and written communication for electronic media.

ArtGr 474. Exhibition Design. (Dual-listed with 574). (0-6) Cr. 3. F.S. *Prereq: Enrollment in 370 or 371 or 470 or 482.* Visual communication applied to exhibition design focusing on educational or interactive museum exhibitions, trade show booth design, and modular unit design for traveling exhibitions. Translation of graphic information to a three-dimensional space.

ArtGr 475. Advanced Typography. (Dual-listed with 575). (0-6) Cr. 3. F.S. *Prereq: Enrollment in 370 or 371 or 470 or 482.* Typographic theory exploring traditional and non-traditional forms, both historical and contemporary typographic achievements.

ArtGr 476. Graphic Design Methodology. (Dual-listed with 576). (0-6) Cr. 3. F.S. *Prereq: Enrollment in 370 or 371 or 470 or 482.* Analysis and application of scientific, systematic, and non-traditional problem-solving and problem-seeking techniques.

ArtGr 477. Graphic Design Practicum. (0-6) Cr. 3. F.S. *Prereq: Enrollment in 370 or 371 or 470 or 482, portfolio review and permission of instructor.* Graphic design outreach and problem solving. Individual and group projects for non-profit clients selected by the instructor.

ArtGr 478. Web Design for E-Commerce/Graphic Applications. (Dual-listed with 578). (0-6) Cr. 3. S. *Prereq: Enrollment in 370 or 371 or 470 or 482.* The development of advanced and experimental web design for the applications of e-commerce, education and the communication of visual information.

ArtGr 479. Wayfinding Design. (Dual-listed with 579). (0-6) Cr. 3. *Prereq: Enrollment in 370 or 371 or 470 or 482.* Study of the navigational challenges of built environments and outdoor spaces, including site analysis, development of navigational plans, and design of wayfinding sign systems. Issues of function, accessibility, legibility, and fabrication are considered.

ArtGr 480. Graphic Design Internship. (3-0) Cr. 3. SS. *Prereq: 377, 12 credits in graphic design; permission of instructor, registration in advance of enrollment.* Graphic design experience in an off-campus professional environment.

ArtGr 481. Graphic Design Professional Practices. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 470.* Professional design management: ethics, setting up a new business, client/designer relationships, contractual options, billing practices, and effective operating procedures.

ArtGr 482. Professional Presentation. (0-6) Cr. 3. S. *Prereq: 470, enrollment in a 2-credit option.* Exploration and development of the graphic design portfolio and resume in electronic, print, and photographic form.

ArtGr 484. Selected Studies in Graphic Design. (Dual-listed with 584). Cr. arr. Repeatable. *Prereq: Permission of instructor.* Special issues related to graphic design. Topics vary each time offered.

ArtGr 490. Independent Study. Cr. arr. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed related graphic design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.
A. Theory, Criticism, and Methodology
B. Two-Dimensional Design
C. Three-Dimensional Design
H. Honors
I. Internship/Cooperative (in-depth experience other than ArtGr 480)

ArtGr 491. Publication Design: Magazines. (Dual-listed with 591). (0-6) Cr. 3. F. *Prereq: Credit or enrollment in 370.* The Philosophy, concepts and structures of magazine design.

ArtGr 492. Publication Design: Books. (Dual-listed with 592). (0-6) Cr. 3. S. *Prereq: Credit or enrollment in 370 or 371.* The Philosophy, concepts and structures of book design.

ArtGr 493. Workshop. Cr. arr. Repeatable. *Prereq: Evidence of satisfactory experience in area of specialization.* Intensive 2 to 4 week studio exploration. Topics vary each time offered.

Courses primarily for graduate students, open to qualified undergraduate students

ArtGr 570. Advanced Studies in Visual Communication. (0-6) Cr. 3. F. *Prereq: Graduate classification in College of Design.* Theory and investigation of systems, structures, principles of visual organization, and typography for communication. Studio problems will be influenced by social, cultural, environmental, or technological factors.

ArtGr 571. Signs, Symbols, Images. (0-6) Cr. 3. S. *Prereq: Graduate Classification in College of Design.* Investigation and application of signs, symbols and semiotic theory for communication. Studio problems influenced by social, cultural, environmental, or technological factors.

ArtGr 572. Photographic Art Direction. (Dual-listed with 472). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* Photography as a graphic design component. Compositional and conceptual elements in photographic images. Must have a camera with adjustable shutter speeds and lens openings.

ArtGr 573. Time Based Multi-Media. (Dual-listed with 473). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* The design of visual, aural and written communication for electronic media.

ArtGr 574. Exhibition Design. (Dual-listed with 474). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* Visual communication applied to exhibition design focusing on educational or interactive museum exhibitions, trade show booth design, and modular unit design for traveling exhibitions. Translation of graphic information to a three-dimensional space.

ArtGr 575. Advanced Typography. (Dual-listed with 475). (0-6) Cr. 3. *Prereq: Graduate classification in College of Design.* Typographic theory exploring traditional and non-traditional forms.

ArtGr 576. Graphic Design Methodology. (Dual-listed with 476). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* Analysis and application of scientific, systematic, and non-traditional problem-solving and problem-seeking techniques.

ArtGr 578. Design for E-Commerce/Graphic Applications. (Dual-listed with 478). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* The development of advanced and experimental web design for the applications of e-commerce, education and the communication of visual information.

ArtGr 579. Wayfinding Design. (Dual-listed with 479). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* Study of the navigational challenges of built environments and outdoor spaces, including site analysis, development of navigational plans, and design of wayfinding sign systems. Issues of function, accessibility, legibility, and fabrication are considered.

ArtGr 584. Selected Studies in Graphic Design. (Dual-listed with 484). Cr. arr. Repeatable. *Prereq: Graduate classification in the College of Design.* Special issues related to graphic design. Topics vary each time offered.

ArtGr 587. Graphic Design History/Theory/ Criticism I. (Dual-listed with 387). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Late nineteenth century to the 1990's, this course will explore the cultural social, political, industrial, and technological forces that have influenced the practice of graphic design in Britain, Europe, and the United States. Students will study the historical issues and problems facing designers, their clients, and their publics.

ArtGr 588. Graphic Design History/Theory/ Criticism II. (Dual-listed with 388). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Critical issues that affect the contemporary practice of graphic design as it relates to the United States. Students will study a variety of issues that include, but are not exclusive to, new media, gender, class, design and the public sphere, design as social action, postmodern design theory, sustainability, and ethical practice.

ArtGr 590. Special Topics. Cr. arr. *Prereq: Bachelor's degree in graphic design, or evidence of satisfactory equivalency in specialized area.* Written approval of instructor and department chair on required form in advance of semester of enrollment.
A. Theory, Criticism, and Methodology
B. Two-Dimensional Design
C. Three-Dimensional Design

ArtGr 591. Publication Design: Magazines. (Dual-listed with 491). (0-6) Cr. 3. F. *Prereq: Graduate enrollment in College of Design.* The Philosophy, concepts and structures of magazine design.

ArtGr 592. Publication Design: Books. (Dual-listed with 492). (0-6) Cr. 3. S. *Prereq: Graduate enrollment in College of Design.* The Philosophy, concepts and structures of book design.

ArtGr 593. Workshop. Cr. arr. Repeatable. *Prereq: Graduate classification; evidence of satisfactory experience in area of specialization.* Intensive 2 to 4 week studio exploration. Topics vary each time offered.

ArtGr 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

ArtGr 672. Graphic Design and Human Interaction. (0-6) Cr. 3. F.S. *Prereq: 570, 571, and graduate enrollment in College of Design or permission of instructor.* The theory and investigation of experience design as it applies to human interactions in contemporary society and culture. Studio problems may involve such areas as: exhibition design, electronic interface design, wayfinding, package design, and publication design.
A) Usability. The exploration and design of interface/interaction with products, systems, and technologies
B) Design for Behavioral Change. The exploration and design of educational experiences and artifacts as they relate to the social, emotional, and behavioral aspects of society.
C) Consumer Experience Design and Branding. The exploration and design of identity systems and consumer brand experiences..

ArtGr 690. Advanced Topics. Cr. arr. Repeatable.

ArtGr 698. Current Issues in Graphic Design. Cr. arr. Repeatable. *Prereq: Graduate enrollment in College of Design or permission of instructor.* Selected issues in contemporary graphic design. Topics and readings vary each time offered.

ArtGr 699. Research-Thesis. Cr. arr. Repeatable.

Art History (Art H)

Courses primarily for undergraduate students

Art H 181. Origins and Evolution of Modern Design. (Cross-listed with Dsn S). (3-0) Cr. 3. F.S. History of designed artifacts, their creators, and their cultural environments in Western Europe and America from the beginning of the Industrial Revolution to the present.

Art H 280. History of Art I. (Cross-listed with Dsn S). (3-0) Cr. 3. F. Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts; from prehistoric through Gothic. H. Honors. Cr. 4.

Art H 281. History of Art II. (Cross-listed with Dsn S). (3-0) Cr. 3. S. Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts; from the Renaissance to the twentieth century.
H. Honors. Cr. 4

Art H 378. Popes and Caesars: 2000 Years of Art History in Rome. (3-0) Cr. 3. SS. *Prereq: Permission of instructor.* Survey of Italian art and architecture from the Etruscans to Bernini, including lectures and tours of museums and historical sites. Study abroad course taught in Rome, with travel to other Italian cities. Tour and travel expenses to be paid by student.

Art H 382. Art and Architecture of Asia. (Dual-listed with 582). (Cross-listed with Dsn S). (3-0) Cr. 3. Introduction to the history of art and architecture in China, Korea, and Japan before the modern era. Visual materials selected based on important themes that are critical in understanding Asian culture and art tradition. Museum field trip expenses to be paid by students. Nonmajor graduate credit.

Art H 383. Greek and Roman Art. (Dual-listed with 583). (Cross-listed with Dsn S, Cl St). (3-0) Cr. 3. Greek art from Neolithic and Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West. Nonmajor graduate credit.

Art H 384. Art of Islam. (3-0) Cr. 3. Historical survey of the painting, sculpture, crafts, and architecture of the various civilizations of the Islamic world.

Art H 385. Renaissance Art. (Dual-listed with 585). (Cross-listed with Dsn S). (3-0) Cr. 3. European art including painting, sculpture, architecture, and crafts; thirteenth through sixteenth centuries. Nonmajor graduate credit.

Art H 394. Women/Gender in Art. (Dual-listed with 594). (Cross-listed with Dsn S). (3-0) Cr. 3. Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture. Nonmajor graduate credit.

Art H 481. Art and Architecture of India. (Dual-listed with 581). (Cross-listed with Dsn S). (3-0) Cr. 3. Survey of Indian-style art and architecture through history. Examine how art and architecture developed in the Indian world has come to define the Indian identity religiously, culturally, socially, and politically. Nonmajor graduate credit.

Art H 487. Nineteenth Century Art. (Dual-listed with 587). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. European and American art and architecture from 1780 to 1900 focusing on the major movements of western Europe: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism. Nonmajor graduate credit.

Art H 488. Modern and Contemporary Art and Theory I. (Dual-listed with 588). (Cross-listed with Dsn S). (3-0) Cr. 3. F. Visual arts and critical theory from Impressionism to Abstract Expressionism Nonmajor graduate credit.

Art H 489. Sequential Art. (Dual-listed with 589). (Cross-listed with Dsn S). Cr. 3. An art-historical survey of comic strips, comic books, and graphic novels from their origins in the 19th century to present. Nonmajor graduate credit.

Art H 490. Independent Study. Cr. arr. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed Art History coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.
H. Honors

Art H 495. Modern and Contemporary Art and Theory II. (Dual-listed with 595). (Cross-listed with Dsn S). (3-0) Cr. 3. Visual arts and critical theory from Abstract Expressionism to the present. Nonmajor graduate credit.

Art H 496. History of Photography. (Dual-listed with 596). (Cross-listed with Dsn S). (3-0) Cr. 3. Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an Art Historical perspective, emphasizing causative factors, cultural influences, and major masters and schools. Nonmajor graduate credit.

Art H 498. Selected Topics in Art History. (Dual-listed with 598). (Cross-listed with Dsn S). (3-0) Cr. 3. Repeatable. Specialized study in the history or criticism of art and design. Course primarily for graduate students open to qualified undergraduate students.

Courses primarily for graduate students, open to qualified undergraduate students

Art H 581. Art and Architecture of India. (Dual-listed with 481). (Cross-listed with Dsn S). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Survey of Indian-style art and architecture through history. Examine how art and architecture developed in the Indian world has come to define the Indian identity religiously, culturally, socially, and politically.

Art H 582. Art and Architecture of Asia. (Dual-listed with 382). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Introduction to the history of art and architecture in China, Korea, and Japan before the modern era. Visual materials selected based on important themes that are critical in understanding Asian culture and art tradition. Museum field trip expenses to be paid by students.

Art H 583. Greek and Roman Art. (Dual-listed with 383). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Greek art from Neolithic and Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West.

Art H 585. Renaissance Art. (Dual-listed with 385). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* European art including painting, sculpture, architecture, and crafts; thirteenth through sixteenth centuries.

Art H 587. Nineteenth Century Art. (Dual-listed with 487). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* European and American art and architecture from 1780 to 1900, focusing on the major movements of western Europe: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism.

Art H 588. Modern and Contemporary Art and Theory I. (Dual-listed with 488). (Cross-listed with Dsn S). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Visual arts and critical theory from Impressionism to Abstract Expressionism.

Art H 589. Sequential Art. (Dual-listed with 489). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* An Art History survey of comic strips, comic books, and graphic novels from their origins in the 19th century to the present.

Art H 590. Special Topics. Cr. arr. *Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area.* Written approval of instructor and department chair on required form in advance of semester of enrollment.

Art H 594. Women/Gender in Art. (Dual-listed with 394). (Cross-listed with Dsn S, W S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture.

Art H 595. Modern and Contemporary Art and Theory II. (Dual-listed with 495). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Visual arts and critical theory from Abstract Expressionism to the present.

Art H 596. History of Photography. (Dual-listed with 496). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an Art Historical perspective, emphasizing causative factors, cultural influences, and major masters and schools.

Art H 598. Selected Topics in Art History. (Dual-listed with 498). (Cross-listed with Dsn S). (3-0) Cr. 3. Repeatable. *Prereq: Graduate classification, permission of instructor.* Specialized study in the history or criticism of art and/or design.

Interior Design (ArtID)

Courses primarily for undergraduate students

ArtID 250. Fundamentals of Interior Design. (2-0) Cr. 2. F. The profession, issues, and the role of interior design.

ArtID 251. Human Factors in Interior Design. (2-0) Cr. 2. S. Overview of issues related to health and safety, ergonomics, Anthropometrics, perception, psycho-behavioral response, physiology, physical ability and universal design. Emphasis on application of human factors to analysis and solution of interior design problems.

ArtID 255. Forces That Shape Interior Space. (3-0) Cr. 3. F. *Prereq: Open to non-majors.* A survey of variables influencing the form and function of interior environments. Review of professional, geo-political, utilitarian, social-cultural, economic, humanistic, historical, technological, and other factors as generators of form.

ArtID 259. Sophomore Field Study. Cr. R. *Prereq: Enrollment in interior design studio course.* Study and tours of areas of interest within the interior design profession such as manufacturers, design studios, showrooms and museums. Satisfactory-fail only.

ArtID 261. Graphic Communication for Interior Design I. (0-4) Cr. 2. F. *Prereq: Admission to the interior design program through program review and enrollment in 265.* Proficiency in the development of technical conventions, and design drawing with drafting instruments. Emphasis on drawing layout, line quality, and lettering. Site and structure measurements, dimensioning, single and multi-view drawings, sections and axonometrics.

ArtID 262. Graphic Communication for Interior Design II. (0-4) Cr. 2. F. *Prereq: Admission to the interior design program through program review and enrollment in 265.* Perspective drawing, design sketching, presentation drawings, shades, shadows, and reflections. Use of various rendering media and techniques.

ArtID 263. Graphic Communication for Interior Design III. (0-4) Cr. 2. S. *Prereq: 261, enrollment in 267.* Computer visualization techniques and applications; projects employing computer graphic methods.

ArtID 265. Interior Design Studio I. (1-6) Cr. 4. F. *Prereq: Credit or enrollment in 250, 261, 262, and 350; admission to the interior design program through program review.* Enhanced creative interior design problem solving. Emphasis on research, spatial composition theories and graphic ideation and communication as applied to the interior design of small scale environments. Modeling and manual visualization techniques.

ArtID 267. Interior Design Studio II. (1-6) Cr. 4. S. *Prereq: 250, 261, 262, 265, 350, enrollment in 251, 259, and 351.* Human factors issues including ergonomics, human behavior and the requirements of special groups. Color theories related to interior spaces. Residential interior design and medium scale projects. Detail drawings, and expansion of visualization techniques.

ArtID 350. Interior Materials Systems and Details I. (2-2) Cr. 3. F. *Prereq: Admission to the interior design program through program review.* Exploration of concepts, materials, and assemblies associated with development of planar interior elements including floors, walls, ceiling, windows, and finishes. Fiber, plastic, sheet metal, and other materials. Emphasis on human factors, testing, codes, detailing, specifications, and other issues related to design and end use.

ArtID 351. Interior Materials Systems and Details II. (2-2) Cr. 3. S. *Prereq: 265, 350 and enrollment in 267.* Exploration of concepts, materials, and assemblies associated with development of furnishings, furniture-scale interior elements. Discussion of materials and fabrication, focusing on wood and metal. Emphasis on human factors, testing, codes, detailing, specifications and other issues related to design and end use.

ArtID 352. Interior Materials Systems and Details III. (2-2) Cr. 3. S. *Prereq: 267, 351 and enrollment in 367.* Exploration of concepts, materials, and components associated with the use of light as an element in interior spaces. Lighting principles, and techniques. Emphasis on human factors, testing, codes, detailing, specifications, and other issues related to design and end use. Teamwork.

ArtID 353. Interior Materials Systems and Details IV. (2-2) Cr. 3. F. *Prereq: 351 and enrollment in 365.* Exploration of concepts, materials, and assemblies associated with development of building construction. Discussion of common building materials and methods. Overview of electrical, mechanical, acoustical, and other building systems. Emphasis on human factors, codes, detailing, and other interior design issues related to buildings.

ArtID 355. Interior Design History/Theory/Criticism I. (3-0) Cr. 3. F. Theoretical approaches to evaluation of interior finishes, furnishings, and decorative arts in relation to parallel developments in art and architecture, from a critical, historical and multicultural perspective. Focus on pre-1850. Nonmajor graduate credit.

ArtID 356. Interior Design History/Theory/Criticism II. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 355 or permission of instructor.* Advanced theoretical approaches to evaluation of interior finishes, furnishings, and decorative arts in relation to parallel developments in art and architecture from a critical, historical, and multicultural perspective. Focus on mid-nineteenth and twentieth century. Nonmajor graduate credit.

ArtID 357. Made in Italy. (2-0) Cr. 2. F. *Prereq: Participation in Study Abroad Rome program.* An investigation of the 20th century roots of modern Italian design and its contemporary form. Lectures and seminar presentations highlight major Italian designers and internationally significant design in the 20th century. Focus is on innovative design that exhibits a synthesis of formal and social functions.

ArtID 359. Junior Field Study. Cr. R. F. *Prereq: Enrollment in third year interior design studio course.* Study and tours of areas of interest within the interior design profession such as manufacturers, design studios, showrooms, and museums. Satisfactory-fail only.

ArtID 360. Interior Design Internship Seminar. (0-1) Cr. 0.5. Repeatable. F.S. *Prereq: Enrollment in third year studio course.* Procedural and ethical concerns relating to interior design internship. Preparation of placement credentials and formulation of personal goals. Internship plans and agreements. Satisfactory-fail only.

ArtID 365. Interior Design Studio III. (1-6) Cr. 4. F. *Prereq: 263, 267, 351 credit or enrollment in 353.* Refined methods of problem identification design programming and problem solving, including theoretically-based concept development and refinement. Emphasis on optimized design work environments and compliance with codes and standards. Produce small and large scale projects. Alternative manual and computer-based visualization methods. Teamwork.

ArtID 367. Interior Design Studio IV. (1-6) Cr. 4. S. *Prereq: 365, credit or enrollment in 352 and 369.* Emphasis on three-dimensional spatial development in large scale, multiple scale unit institutional projects. Inclusion of extensive design documentation. Expansion of alternative manual and computer-based visualization methods. Teamwork.

ArtID 368. International Study Orientation Seminar. (1-0) Cr. 1. *Prereq: 365, permission of instructor and planned enrollment in Rome study option.* Historic and contemporary architecture and interior design, customs and traditions of Rome and related travel itinerary locations. Required of students participating in the interior design international study option.

ArtID 459. Senior Field Study. Cr. R. *Prereq: Enrollment in fourth year interior design studio course.* Study and tours of areas of interest within the interior design profession such as manufacturers, design studios, showrooms and museums. Satisfactory-fail only.

ArtID 460. Interior Design Internship. Cr. 3. SS. *Prereq: Completion of 350, 365.* Professional interior design off-campus experience.

ArtID 461. Interior Design Professional Practices. (3-0) Cr. 3. S. *Prereq: 460.* Organization and general management of the interior design office: agreements, business procedures, and professional ethics. Professional interior design issues and concerns.

ArtID 463. Environments for the Aging. (Cross-listed with HD FS, Geron). (3-0) Cr. 3. S. *Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies.* Emphasis on independent living within residential settings including specialized shelter, supportive services, and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities.

ArtID 465. Interior Design Studio V. (Dual-listed with 565). (1-6) Cr. 4. F. *Prereq: 460.* Design research and refined problem solving methods including functional analysis, programming and detailing. Multi-cultural, study abroad option. Nonmajor graduate credit.

ArtID 467. Interior Design Studio VI. (Dual-listed with 567). (1-6) Cr. 4. S. *Prereq: 465, credit in 469 and all required interior systems and history/theory/criticism courses or permission of instructor.* Refinement of technical, analytical and theoretical problem-solving methods and comprehensive design documentation. In-depth development of interior design projects. Current issues in interior design. Nonmajor graduate credit.

ArtID 468. Interior Design in an Urban Setting. (1-4) Cr. 3. S. *Prereq: Enrollment or credit in third year studio courses.* Study of selected interior design projects and designers practicing in an urban Setting. Studio project examining issues related to interior design in an urban context.

ArtID 469. Advanced Studies in Interior Design. (Dual-listed with 569). Cr. 3. Repeatable. *Prereq: 12 credits in interior design related courses or permission of instructor.* Examination of special issues with emphasis on their translation into design application. Topics vary each time offered. Nonmajor graduate credit.

ArtID 490. Independent Study. Cr. arr. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed related interior design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.
H. Honors

ArtID 493. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: Evidence of satisfactory experience in area of specialization.* Intensive 2 to 4 week studio exploration. Topics vary each time offered.

Courses primarily for graduate students, open to qualified undergraduate students

ArtID 550. Creative Integration. (1-2) Cr. 2. Repeatable. F.S. *Prereq: Permission of instructor.* Analysis and expansion of technical, theoretical and procedural sources of design insight and their application to design problem-solving. Emphasis on the refinement and communication of clear, logical bases for design decisions.

ArtID 551. Design Humanics. (3-0) Cr. 3. Repeatable. F.S. *Prereq: Instructor permission.* An exploration of human nature as broadly defined and as applied to design of the built environment. Consideration of human characteristics, responses and performance, at varying scales, as sources of design insight. Topics vary each time offered.
A: Micro-Scale Humanics- Issues related to the nature, performance and accommodation of the individual organism, including sensation and perception, physical requirement, individual Anthropometrics, personal safety and other issues connecting human needs and built environmental responses.
B: Meso-Scale Humanics- Issues related to human performance in small to moderate scale settings, including psychological and behavioral dimensions, social factors, interpersonal safety, etc. C: Macro-Scale Humanics- Cultural and Societal influences on human performance and well being in the moderate to large scale built environment, including the impact of political, economic, cultural, geographic, design cultural and other Societal factors.

ArtID 552. Design Methods. (2-0) Cr. 2. Repeatable. F.S. *Prereq: Permission of instructor.* Survey of methodologies and methodological tools for varied end uses and drawn from wide ranging sources. Emphasis on their organization and application to design of the human environment. Topics vary each time offered.
A. Investigation & Analysis - Methods of design research, analysis, programming and theory formulation.
B. Synthesis - Methods of synthesizing design concepts and solutions
C. Communication - Methods of managing, translating, communicating and otherwise utilizing text, image, abstract and other forms of information.
D. Procedural Alternatives - New and specialized methodological trends, including subject or setting-specific methods.

ArtID 554. Interior Design Teaching Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Completion of ArtId 667 or permission of instructor.* Supervised practical application of interior design theory, materials, and practice to the educational process.

ArtID 559. Graduate Interior Design Field Study. Cr. R. Repeatable. *Prereq: Graduate enrollment or permission of instructor.* Study and tours of places of interior design-related interest such as manufacturers, design studios, related professional offices, showrooms, museums, and historical sites.

ArtID 560. Interior Design Internship. (3-0) Cr. 3. *Prereq: Completion of a graduate interior design studio or permission of instructor.* Applied, off campus, professional interior design-related experience

ArtID 565. Interior Design Studio V. (Dual-listed with 465). (1-6) Cr. 4. F. *Prereq: Graduate classification and concurrent enrollment in 598.* Design research and refined problem-solving methods including functional analysis, programming and detailing. Multi-cultural, hospitality and retail. Study abroad option.

ArtID 567. Interior Design Studio VI. (Dual-listed with 467). (1-6) Cr. 4. S. *Prereq: Graduate classification and concurrent enrollment in 598 or permission of instructor.* Refinement of technical, analytical and theoretical problem-solving methods and comprehensive design documentation. In-depth development of interior design projects. Current issues in interior design. Nonmajor graduate credit.

ArtID 569. Advanced Studies in Interior Design. (Dual-listed with 469). Cr. 3. Repeatable. *Prereq: Graduate classification, permission of instructor.* Examination of special issues with emphasis on their translation into design application. Topics vary each time offered.

ArtID 590. Special Topics. Cr. arr. *Prereq: Bachelor's degree in interior design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment.*

ArtID 593. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification; evidence of satisfactory experience in area of specialization.* Intensive 2 to 4 week studio exploration. Topics vary each time offered.

ArtID 598. Research Forum. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Concurrent enrollment in 565, 567, 665, or 667, or permission of instructor.* Presentation and discussion of cross-disciplinary design research theory, methods, and application. Focus on the investigation, application, and communication of types of design research.

Courses for graduate students

ArtID 660. Research Methods. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Research strategies related to design. Application of selected methods to specific issues.

ArtID 665. Advanced Interior Design Studio. (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification, concurrent enrollment in 598.* Interior design problem-solving with emphasis on special issues. Project types will include but not be restricted to hospitality, health care, institutional, industrial, residential, historic preservation and commercial environments.

ArtID 667. Experimental Interior Design. (0-6) Cr. 3. Repeatable. F.S. *Prereq: Concurrent enrollment in 598, permission of instructor.* Application of alternative design methods and sources of insight to the solution of human environmental design problems. Focus on the identification, formulation, refinement and application of theory to the design process. Emphasis on the pursuit of new discovery and innovative problem solving. Approaches, settings and scales vary each time offered.

ArtID 690. Advanced Topics. Cr. arr. Repeatable. *Prereq: M.F.A classification, permission of instructor.*

ArtID 697. Design Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Approval of POS committee.* Supervised off-campus learning experience with a prominent designer or firm. (Credit not to be applied to MA degree program of study).

ArtID 698. Current Issues in Interior Design. Cr. 3. Repeatable. *Prereq: Graduate classification.* Selected issues in contemporary design. Topics and readings vary each time offered.

ArtID 699. Research. Cr. arr. Repeatable.
A. Thesis
B. Thesis-Exhibition

Integrated Studio Arts (ArtIS)

Courses primarily for undergraduate students

ArtIS 201. Foundations of Visual Literacy. (0-6) Cr. 3. F.S. *Prereq: Dsn S 102 and 131.* Exploration through the World Wide Web of the nature of visual perception in relation to issues of visual communication and problem solving, envisioning information, scientific visualization and visual thinking. Studio assignments to be digitized and sent to instructor electronically for evaluation and critique.

ArtIS 205. Studio Fundamentals I. (0-6) Cr. 3. F.S. *Prereq: Acceptance into the BFA ISA program..* Introduction to studio fundamentals and crossover between media. Emphasis on ceramics and fibers as tools of expression and communication. Required of all ISA BFA students. Must register for both sections.

ArtIS 207. Studio Fundamentals II. (0-6) Cr. 3. F.S. *Prereq: Acceptance into the BFA ISA program.* Introduction to studio fundamentals and crossover between media. Emphasis on metals and wet darkroom photography as tools of expression and communication. Required of all ISA BFA students. Must register for both sections.

ArtIS 208. Color. (0-6) Cr. 3. F.S. *Prereq: Dsn S 102, 131, and 183.* Required of all ISA BFA students. The impact of changing visual relationships emphasizing physical and psychological color concepts. Additive and subtractive mixing and color interaction exercises using various color media.

ArtIS 209. Studio Fundamentals III. (0-6) Cr. 3. F.S. *Prereq: Acceptance into the ISA BFA program.* Introduction to studio fundamentals and crossover between media. Emphasis on printmaking and wood as tools of expression and communication. Required of all ISA BFA students. Must register for both sections.

ArtIS 211. Studio Fundamentals IV. (0-6) Cr. 3. F.S. *Prereq: Acceptance into the ISA BFA program..* Introduction to studio fundamentals and crossover between media. Emphasis on computers and painting as tools of expression and communication. Required of all ISA BFA students. Must register for both sections.

ArtIS 227. Introduction to Creative Digital Photography. (0-6) Cr. 3. F.S. *Prereq: Dsn S 102, 131, and 183.* The course will include camera operation, scanning, image manipulation, color management and printing. Must have access to 35 mm camera or 4 megapixel (minimum resolution) digital camera. Cameras must have manual override. Digital photography as a medium of design, expression and communication.

ArtIS 229. Introduction to Darkroom Photography. (0-6) Cr. 3. F.S. *Prereq: Dsn S 102, 131 and 183.* Photography as a creative medium of design, expression and communication. Camera techniques and black and white wet lab processing taught. Alternative processes explored as time permits. 35 mm camera with manual exposure controls is required.

ArtIS 233. Watercolor Painting. (0-6) Cr. 3. F.S. *Prereq: Art 230.* Fundamentals of painting using water-based media applied to observation-based painting. Subject matter may include working from actual or two-dimensional references of still life, landscape, architectural space, and the human form.

ArtIS 238. Painting I. (0-6) Cr. 3. F.S. *Prereq: Art 230.* Fundamentals of painting using acrylic and oil media applied to observation-based painting. Subject matter may include working from actual or two-dimensional references of still life, landscape, and the human form.

ArtIS 305. Integrative Media. (Dual-listed with 505). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Dsn S 102, 131 and 183 and 6 credits of additional ISA studio at 200+ level.* Exploration and application of materials and methods that combine and integrate traditional approaches, alternative/new materials and alternative approaches, and new media.

ArtIS 308. Computer Modeling, Rendering and Virtual Photography. (0-6) Cr. 3. F.S. *Prereq: Art 230 or permission of instructor.* Introduction to 3D modeling using computer and available software. Modeling, texturing, lighting, and rendering with respect to 3D object and still scene creation.

ArtIS 310. Sources of Visual Design. (0-6) Cr. 3. F.S. *Prereq: Art 230.* Required of all ISA BFA students. Studio exercises to develop awareness of external and internal sources for design.

ArtIS 311. Contemporary Issues in Studio Art. (0-6) Cr. 3. F.S. *Prereq: 310.* Studio based exploration of issues and directions in current art. Readings, discussions, and studio research projects to build an experimental and applied knowledge base for understanding each student's place in the contemporary art world.

ArtIS 320. Introduction to Furniture Design. (0-6) Cr. 3. F.S. *Prereq: ArtIS 209 or permission of instructor.* Design and creation of basic furniture forms in wood. Introduction to power tools. Develop an individual design process including an understanding of scale and proportion. Develop sensitivity to wood and the social and environmental implications of materials used for furniture design and production.

ArtIS 322. Ceramics II. (0-6) Cr. 3. F.S. *Prereq: 222 or 205.* Further investigation of concepts and techniques in ceramics; introduction to glaze research and kiln firing.

ArtIS 323. Scientific Illustration Principles and Techniques. (Cross-listed with BPM I). (0-6) Cr. 3. Repeatable. F. *Prereq: 6 credits in art and design and 3 credits in biological sciences.* Studio basics and professional techniques in black & white, continuous tone, and color. Emphasis on tools, materials, and rendering.

ArtIS 324. Jewelry/Metalsmithing II. (0-6) Cr. 3. F.S. *Prereq: 207 or permission of instructor.* Continued study of traditional and contemporary metal fabrication techniques applicable to jewelry and object construction, including container forms. Emphasis on design, modeling and rendering techniques and progressive skill development. Basic stone setting and lost wax casting introduced.

ArtIS 325. Integrated Studio Arts Seminar. (2-0) Cr. 2. Repeatable. *Prereq: Any 3-D studio.* Contemporary issues in studio arts explored through lectures and presentations.

ArtIS 326. Illustration and Illustration Software. (Cross-listed with BPM I). (0-6) Cr. 3. Repeatable. S. *Prereq: 323.* Application of painting, drawing, and image making techniques to communication. Development of technical abilities using illustration software. Digital and print production techniques.

ArtIS 327. Illustration as Communication. (Cross-listed with BPM I). (0-6) Cr. 3. F. *Prereq: 326.* Studio problems in illustration emphasizing composition and communication. Problem solving methodologies.

ArtIS 329. Creative Photography. (0-6) Cr. 3. Repeatable. F.S. *Prereq: 207 or 229.* Continuation and expansion of concepts and processes covered in ArtIS 207 and ArtIS 229. Individual thematic expression further enhanced through photographic history and criticism.

ArtIS 330. Drawing III: Life Drawing. (0-6) Cr. 3. Repeatable. F.S. *Prereq: Art 230.* Drawing from the human figure.

ArtIS 335. Three-Dimensional Studio. (Cross-listed with Arch). (0-5) Cr. 2. Repeatable. F.S. This course deals with three dimensional problems in visual invention, organization, and expression emphasizing creative manipulation of tools, materials, and techniques as means for three dimensional thinking. Projects cover the additive (modeling), subtractive (carving), substitutional (casting) as well as constructive techniques.

ArtIS 337. Application of Scientific Illustration Techniques. (Cross-listed with BPM I). (0-6) Cr. 3. S. *Prereq: 323.* Rendering techniques applied to different types of biological and scientific subjects emphasizing communication. The use of traditional and digital media. Term project required.

ArtIS 338. Painting II. (0-6) Cr. 3. Repeatable. F.S. *Prereq: 238.* Painting using acrylic and oil media; composition and expression.

ArtIS 345. Woven Structures. (0-6) Cr. 3. Repeatable. *Prereq: DsnS 102, 131, 183, and ArtIS 205 or equivalent.* Introduction to a variety of textile techniques including on-loom and off-loom woven construction using both traditional and non-traditional materials and approaches. Techniques may include basketry, tapestry weaving, papermaking, and 4-harness

weaving. Emphasis placed on technical development, exploration and experimentation with a variety of fiber media, development of problem solving and critical thinking skills.

ArtIS 346. Textile Surface Design. (0-6) Cr. 3. Repeatable. *Prereq: Dsn S 102, 131, 183 and ArtIS 205, or equivalent.* Introduction to surface design using dyes and discharging agents, as well as mechanical and liquid resists to create complex surfaces. Other surface embellishment techniques, such as direct application of pigments and stitching, will be explored. Emphasis on technical skill development and research, as well as conceptual exploration and visual problem solving.

ArtIS 347. Printed Textile Design. (0-6) Cr. 3. Repeatable. *Prereq: Dsn S 102,131, 183, and ArtIS 205 or equivalent, or permission of instructor.* Textile printing methods; block, stencil, screen-printing using dyes, discharging agents, and pigments. Digital printing on fabric will be introduced. Experimental printing methods will also be explored. Research and development of surface design techniques as a means for personal expression.

ArtIS 356. Relief Printmaking. (Dual-listed with 556). (0-6) Cr. 3. Repeatable. F. *Prereq: Art 230.* Examine the techniques and aesthetic qualities of black and white and color relief printmaking primarily through woodcuts and photopolymer plates. Emphasis is on experimental and creative use of printmaking for artistic expression.

ArtIS 357. Intaglio and Monotype Printmaking. (Dual-listed with 557). (0-6) Cr. 3. Repeatable. F. *Prereq: Art 230.* Examine the techniques and aesthetic qualities of black and white and color intaglio printmaking primarily through etching, aquatint, photographic intaglio and collagraph processes. Unique, one-of-a-kind black and white and color prints from Plexiglas will also be introduced. Emphasis is on experimental and creative use of printmaking for artistic expression.

ArtIS 358. Lithography. (Dual-listed with 558). (0-6) Cr. 3. Repeatable. S. *Prereq: Credit or enrollment in Art 230.* Examine the techniques and aesthetic qualities of lithography primarily through hand-drawn and photographic plates. Emphasis is on experimental and creative use of printmaking for artistic expression. For those taking the course for a second semester, focus is on stone lithography and increased work with color.

ArtIS 399. BFA Professional Practice. (2-0) Cr. 2. S. *Prereq: Junior classification in Art and Design BFA curriculum. Required of all ISA BFA students.* Introduction to professional practices including development of portfolio (visual and written components). Lecture and presentation topics include applying to graduate school, grants/funding opportunities, professional networking, exhibition opportunities, and best practices for studio artists. Half semester course.

ArtIS 407. Principles of 3D Character Animation. (Dual-listed with 507). (Cross-listed with HCI). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 308.* Animation techniques using the computer and available software. Principles of character animation. Prior knowledge of modeling, lighting, texturing and rendering with available software is assumed. Nonmajor graduate credit.

ArtIS 408. Principles of 3D Animation. (0-6) Cr. 3. Repeatable. F.S. *Prereq: 308.* Animation techniques using the computer and available software. Principles of animation. Prior knowledge of modeling, lighting, texturing, animation and rendering with computer and available software is assumed. Nonmajor graduate credit.

ArtIS 409. Computer/Video Game Design and Development. (Dual-listed with 509). (Cross-listed with HCI). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Permission of instructor. Programming emphasis: Com S 227, 228, 229 or equivalent in Engineering; art or graphics emphasis: Art 230 and ArtIS 308; writing emphasis: an English course in creative writing or writing screen plays; business or marketing students: junior classification.* Independent project based creation and development of "frivolous and non-frivolous" computer games in a cross-disciplinary team. Projects require cross-disciplinary teams. Aspects of Indie development and computer/video game history will be discussed. Nonmajor graduate credit.

ArtIS 420. Advanced Furniture Design. (Dual-listed with 520). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 320.* Design and creation of advanced furniture forms in wood with consideration of precedents and innovative approaches. Develop a unique personal approach to the design and making of furniture. Refine sensitivity to wood and the social and environmental implications of materials used for furniture design and production. Nonmajor graduate credit.

ArtIS 422. Ceramics Studio. (Dual-listed with 522). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 322.* In-depth investigation of ceramic forms and surfaces with an emphasis on personal art expression in the medium of ceramics. Kiln firings, research into contemporary artists and development of a body of work are emphasized. Nonmajor graduate credit.

ArtIS 424. Jewelry/Metalsmithing III. (Dual-listed with 524). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 324 or permission of instructor.* Emphasis on metal fabrication and hollow construction techniques applicable to jewelry, functional objects and sculpural art forms. As students advance, they learn sheet metal processes including raising, forming, and anticlastic shell forming techniques. Introduction to mechanisms and tool making. Advanced students are encouraged to integrate these topics with alternative materials and technologies. A focus is placed on independent research, professional engagement and portfolio development. Nonmajor graduate credit.

ArtIS 429. Advanced Photography. (Dual-listed with 529). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 329.* Independent, advanced work in traditional alternative and/or digital photographic processes. Emphasis is on development of a unified body of work and research into contemporary photographers and aesthetic concerns. Nonmajor graduate credit.

ArtIS 430. Drawing IV. (Dual-listed with 530). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Art 330.* Figurative and/or non-figurative drawing with advanced work in media, composition, and theory. Nonmajor graduate credit.

ArtIS 438. Painting III. (Dual-listed with 538). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 338.* Figurative and non-figurative painting with advanced work in media, composition, and theory. Nonmajor graduate credit.

ArtIS 447. Advanced Printed Textile Design. (Dual-listed with 547). (0-6) Cr. 3. Repeatable. *Prereq: 346 or 347.* Advanced textile printing techniques that include screen-printing with dyes, discharging agents, and pigments, and digital printing on fabric. Experimental printing methods will also be explored. Emphasis is on research and development of surface design techniques as a means for personal expression. Nonmajor graduate credit.

ArtIS 458. Advanced Printmaking. (0-6) Cr. 3. Repeatable. F.S. *Prereq: 356, 357, or 358, and permission of instructor.* Independent, advanced work in printmaking processes. Emphasis is on development of a unified body of work and research into contemporary artists.

ArtIS 482. Selected Topics in Studio Art. (Dual-listed with 582). Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Special issues related to studio art. Topics vary each time offered.

ArtIS 490. Independent Study. Cr. arr. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed craft design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.
B. Ceramics
C. Computer Art and Design
D. Drawing
E. Textiles
F. Illustration
G. Metals
H. Honors
I. Painting
J. Photography
K. Printmaking
L. Furniture
M. Mixed Media

ArtIS 493. Workshop. Cr. arr. Repeatable. SS. *Prereq: Permission of instructor.* Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.
B. Ceramics
C. Computer Art and Design
D. Drawing
E. Textiles
F. Illustration
G. Metals
H. Honors
I. Painting
J. Photography
K. Printmaking
L. Furniture
M. Mixed Media

ArtIS 499. BFA Exhibition. (1-0) Cr. 1. S. *Prereq: 399 and senior classification in the Art and Design BFA Curriculum.* Capstone experience for the BFA degree; includes the creation and refinement of a final portfolio both visual and written components. Students give a portfolio presentation to the ISA faculty. Course culminates in the planning and installation of the BFA group exhibition in a formal gallery setting. Required of all ISA BFA students. Half semester course.

Courses primarily for graduate students, open to qualified undergraduate students

ArtIS 505. Integrative Media. (Dual-listed with 305). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.* Exploration and application of materials and methods that combine and integrate traditional approaches, alternative/new materials, alternative approaches and new media.

ArtIS 507. Principles of 3D Character Animation. (Dual-listed with 407). (Cross-listed with HCI). (0-6) Cr. 3. F.S. *Prereq: 308.* Advanced, 3D computer-generated animation concepts and techniques.

ArtIS 508. Computer Aided Animation and Visualization. (0-6) Cr. 3. Repeatable. S. *Prereq: 408 or graduate Status and permission of instructor.* Further investigations begun in ArtIS 408. Attention given to the workflow and management of creating animation and visualizations.

ArtIS 509. Computer/Video Game Design and Development. (Dual-listed with 409). (Cross-listed with HCI). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Permission of instructor..* Independent project based creation and development of "frivolous and non-frivolous" computer games in a cross-disciplinary team. Projects require cross-disciplinary teams. Aspects of Indie development and computer/video game history will be discussed.

ArtIS 520. Advanced Furniture Design. (Dual-listed with 420). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor..* Design and creation of advanced furniture forms in wood with consideration of precedents and innovative approaches. Develop a unique personal approach to the design and making of furniture. Refine sensitivity to wood and the social and environmental implications of materials used for furniture design and production.

ArtIS 522. Ceramics Studio. (Dual-listed with 422). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.* In-depth investigation of ceramic forms and surfaces with an emphasis on personal art expression in the medium of ceramics, kiln firings, research into contemporary artists and development of a body of work are emphasized.

ArtIS 524. Jewelry and Decorative Metalsmithing III. (Dual-listed with 424). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.* Emphasis on metal fabrication and hollow construction techniques applicable to jewelry, functional objects and sculptural art forms. As students advance, they learn sheet metal processes including

raising, forming, and anticlastic shell forming techniques. Introduction to mechanisms and tool making. Advanced students are encouraged to integrate these topics with alternative materials and technologies. A focus is placed on independent research, professional engagement and portfolio development.

ArtIS 529. Advanced Photography. (Dual-listed with 429). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.* Independent, advanced work in traditional, alternative and/or digital photographic processes. Emphasis is on development of a unified body of work and research into contemporary photographers and aesthetic concerns.

ArtIS 530. Drawing. (Dual-listed with 430). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.* Figurative and non-figurative drawing with advanced work in media, composition, and theory.

ArtIS 538. Advanced Painting. (Dual-listed with 438). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.*. Figurative and non-figurative painting with advanced work in media, composition, and theory.

ArtIS 547. Advanced Printed Textile Design. (Dual-listed with 447). (0-6) Cr. 3. Repeatable. *Prereq: Graduate classification.* Advanced textile printing techniques that include screen-printing with dyes, discharging agents, and pigments, and digital printing on fabric. Experimental printing methods will also be explored. Emphasis is on research and development of surface design techniques as a means for personal expression.

ArtIS 556. Relief Printmaking. (Dual-listed with 356). (0-6) Cr. 3. Repeatable. F. *Prereq: Graduate classification and permission of instructor.* Examine the techniques and aesthetic qualities of black and white and color relief printmaking primarily through woodcuts and photopolymer plates. Emphasis is on experimental and creative use of printmaking for artistic expression.

ArtIS 557. Intaglio and Monotype Printmaking. (Dual-listed with 357). (0-6) Cr. 3. Repeatable. F. *Prereq: Graduate classification and permission of instructor.* Examine the techniques and aesthetic qualities of black and white and color intaglio printmaking primarily through etching, aquatint, photographic intaglio and collagraph processes. Unique, one-of-a-kind black and white and color prints from Plexiglas will also be introduced. Emphasis is on experimental and creative use of printmaking for artistic expression.

ArtIS 558. Lithography. (Dual-listed with 358). (0-6) Cr. 3. Repeatable. F. *Prereq: Graduate classification and permission of instructor.* Examine the techniques and aesthetic qualities of lithography primarily through hand-drawn and photographic plates. Emphasis is on experimental and creative use of printmaking for artistic expression. Experienced lithography students may focus on stone lithography and increased work with color.

ArtIS 582. Selected Topics in Studio Art. (Dual-listed with 482). Cr. arr. Repeatable. F.S. *Prereq: Permission of Instructor.* Special issues related to studio art. Topics vary each time offered.

ArtIS 590. Special Topics. Cr. arr. *Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area.* Written approval of instructor and department chair on required form in advance of semester of enrollment.
B. Ceramics
C. Computer Art and Design
D. Drawing
E. Textiles
F. Illustration
G. Metals
I. Painting
J. Photography
K. Printmaking
L. Furniture
M. Mixed Media

ArtIS 593. Workshop. Cr. arr. Repeatable. SS. *Prereq: Graduate classification and permission of instructor.* Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.
B. Ceramics
C. Computer Art and Design
D. Drawing
E. Textiles
F. Illustration
G. Metals
I. Painting
J. Photography
K. Printmaking
L. Furniture
M. Mixed Media

Courses for graduate students

ArtIS 607. Intermedia. (0-6) Cr. 3. Exploration and application of media with various materials, methods and ideas.

ArtIS 698. Current Issues in Studio Arts. Cr. arr. Repeatable. *Prereq: Graduate classification.* Selected issues in contemporary studio arts. Topics and readings vary each time offered.

Astronomy and Astrophysics

See *Physics*.

Biochemistry, Biophysics, and Molecular Biology

http://www.bbmb.iastate.edu

Aragula Gururaj Rao, Chair of Department

Distinguished Professors: Beitz, Fromm

Distinguished Professors (Emeritus): Graves, Metzler

University Professor: Girton

University Professors (Emeritus): Hammond, Horowitz, White

Professors: Andreotti, Honzatko, Jernigan, R. Johansen, K. Johansen, Miller, Myers, Nikolau, Nilsen-Hamilton, Rao, Robson, Robyt, Shin, Thornburg

Professors (Emeritus): Applequist, Atherly, Buss, Stromer, Thomas, Tipton

Professor (Collaborator): Meyer, Tabatabai

Associate Professors: Ambrosio, Bobik, Dispirito, Hargrove, Huiatt, Peters

Associate Professors (Adjunct): James

Assistant Professors: Amarasinghe, Macintosh, Shogren-Knaak, Yu, Zabotina

Lecturer: Fulton, Girton

Undergraduate Study

The department offers majors in biochemistry or biophysics in the College of Liberal Arts and Sciences and a major in agricultural biochemistry in the College of Agriculture.

Biochemists and biophysicists seek to understand life processes in terms of chemical and physical principles. They conduct research in the frontiers of biology such as metabolic networking; structure and function of enzymes, membranes, and hormones; computational approaches; genomic and proteomic technology; protein engineering; plant biotechnology; muscle structure and function; and the design and evaluation of drugs for the treatment of disease. Biochemistry, biophysics and molecular biology provide the basis for much of modern biotechnology. Graduates have opportunities in industry, especially the biotechnology sector, in universities, veterinary medical, and medical schools, and government laboratories. Students who meet the necessary high scholastic standards have the opportunity to continue their studies in graduate school, medical school, or veterinary medical school.

Graduates of biochemistry, agricultural biochemistry and biophysics understand the chemical principles of biological systems including molecular biology. They have developed laboratory expertise in modern biochemical techniques, including the ability to analyze data and prepare scientific reports. Most have participated in undergraduate research and have developed the skills necessary for both written and oral presentations at a level that will serve the student both within the university and in postgraduate professional life. Graduates have the experience of interacting with persons of different disciplines and cultures. Students have the training in mathematics and physics to solve problems of broad scope in biological, biomedical and environmental sciences and to provide leadership in diverse scientific and technological arenas.

Agricultural Biochemistry Major in the College of Agriculture

For the undergraduate curriculum leading to the degree bachelor of science, see *College of Agriculture, Curricula*. Agricultural biochemistry is recommended to students interested in the areas of agriculture requiring strong preparation in biochemistry, chemistry, physics, and mathematics, or in preparation for the study of veterinary medicine. Employment opportunities exist in agrochemical industries, and animal and plant biotechnology.

Biochemistry or Biophysics Majors in the College of Liberal Arts and Sciences

For the undergraduate curriculum leading to the degree of bachelor of science, see Liberal Arts and Sciences, Curriculum. Biochemistry and biophysics are recommended to students whose career interests involve advanced study or employment in biochemistry or biophysics, or in related areas of the biological or medical sciences.

Undergraduate majors in the College of Liberal Arts and Sciences in biochemistry usually have the following basic courses or their equivalents in their programs: BBMB 101, 102, 201, 404 (or 501), 405 (or 502), 411, 461 (or 551); Chem 201 (or 177, 178), 201L (or 177N or 177L), 211, 211L, 322L, 324, 325, 331, 332, 333L (or 331L), 334L (or 332L); Math 165, 166, 265 (or 266 or 267); Phys 221, 222; Biol 211, 211L (or 212L or 313L or 314), 212, 313, 314, and a minimum of 4 additional credits of biological science courses from biology, genetics, and microbiology. Undergraduate research, BBMB 499, is strongly recommended.

Undergraduate majors in biophysics usually include the following basic courses in their programs: BBMB 101, 102, 404, 411, 461 (or 551); Chem 201 (or 177, 178), 177N (or 177L), 322L, 324, 325, 331, 332; Math 165, 166, 265, 266, 307 (or 317), 471; Phys 221, 222; Com S 207; Stat 305 or 231; Biol 211, 211L (or 212L), 212; Chem 211 and 211L; and 9 additional credits in 300 or higher level courses in biochemistry, biophysics, biological sciences, chemistry, or physics.

These lists of courses should not be regarded as statements of fixed requirements or as complete outlines of the work necessary for the major. They are given solely for the convenience of students or advisers who wish to estimate the amount of basic study that may be needed.

Biochemistry and biophysics majors are advised to meet the College of Liberal Arts and Sciences foreign language requirement with courses in French, German, or Russian.

See also the B.S./M.S. program under Graduate Study.

The department offers minors in biochemistry in both the College of Agriculture and the College of Liberal Arts and Sciences, which may be earned by credit in BBMB 404, 405, 311 (or 411), and 451 (or Chem 325), plus additional supporting 300 level courses in chemistry or biochemistry for a total of 15 credits.

Communication Proficiency requirement: Majors in agricultural biochemistry must complete Engl 150 and 250 and one course in speech fundamentals with a grade of C or better in each of these courses. Majors in the College of Liberal Arts and Sciences must complete Engl 150 and 250 and one of the following with a grade of C- or better: (a) Engl 305, 309, or 314; (b) a written report in BBMB 411, or 499.

Interdepartmental Majors

The department participates along with other biological science departments including GDCB and EEOB in offering interdepartmental majors in Biology and Genetics. Biology courses that are staffed in part by department faculty members include Biol 101, 313, 314, and 313L (See Biology).

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in biochemistry and biophysics and with interdepartmental majors in genetics, immunobiology, MCDB (molecular, cellular, and developmental biology), plant physiology, and toxicology. Minor work is offered to students taking major work in other departments.

Prerequisite to graduate work is a sound undergraduate background in biology, chemistry, mathematics, and physics.

All graduate students are required by the department to teach as part of their training for an advanced degree.

The department offers a B.S./M.S. program in biochemistry that allows students to obtain both the B.S. and M.S. degrees in five years. The program is open to students in the College of Liberal Arts and Sciences and in the College of Agriculture. Students interested in this program should contact the department office for details. Application for admission to the Graduate College should be made near the end of the junior undergraduate (third) year. Students would begin research for the M.S. thesis during the summer semester after their junior year and are eligible for research assistantships.

Courses primarily for undergraduate students

BBMB 101. Introduction to Biochemistry. (1-0) Cr. 1. F. Research activities, career opportunities in biochemistry and biophysics, and an introduction to the structure of biologically important compounds. For students majoring in biochemistry, agricultural biochemistry or biophysics or considering one of these majors.

BBMB 102. Introduction to Biochemistry Laboratory. (0-2) Cr. 1. S. *Prereq: Credit or enrollment in Chem 177 and 177L*. Topics in the scientific background of biochemistry, such as macromolecules, metabolism, and catalysis. May include laboratory experiments as well as literature readings and discussion. A significant component is practice in scientific communication. For students majoring in biochemistry, agricultural biochemistry or biophysics or considering one of these majors.

BBMB 201. Chemical Principles in Biological Systems. (2-0) Cr. 2. S. *Prereq: Credit or enrollment in Chem 331.* Survey of chemical principles as they apply in biological systems including: water, organic chemistry of functional groups in biomolecules and biochemical cofactors, weak bonds and their contribution to biomolecular structure, oxidation-reduction reactions and redox potential, thermodynamic laws and bioenergetics, chemical equilibria and kinetics, inorganic chemistry in biological systems, data presentation. The subjects will be taught using molecules from biological systems as examples. Intended for majors in biochemistry, biophysics, or agricultural biochemistry.

BBMB 221. Structure and Reactions in Biochemical Processes. (3-0) Cr. 3. F. *Prereq: Chem 163, 167, or 177.* Fundamentals necessary for an understanding of biochemical processes. Primarily for students in agriculture. Not acceptable for credit toward a major in biochemistry or biophysics. Credit for both BBMB 221 and Chem 231 may not be applied toward graduation.

BBMB 301. Survey of Biochemistry. (3-0) Cr. 3. F.S.SS. *Prereq: Chem 231 or 331.* A survey of biochemistry: structure and function of amino acids, proteins, carbohydrates, lipids, and nucleic acids; enzymology; metabolism; biosynthesis; and selected topics. Not acceptable for credit toward a major in biochemistry, biophysics, or agricultural biochemistry.

BBMB 311. Biochemistry Laboratory. (1-3) Cr. 2. S. *Prereq: Credit or enrollment in 301 or Biol 314.* Emphasis on isolation, characterization, and quantification of biological substances. Only one of BBMB 311 or Biol 314L can be counted toward graduation. Not acceptable for credit toward a major in biochemistry, biophysics, or agricultural biochemistry.

BBMB 403. Microbial Biochemistry and Biotechnology. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Chem 332, BBMB 301.* Fundamental principles of microbial biochemistry, physiology, and genetics, and their application to microbial biotechnology. Topics will include biorenewable resources, metabolic pathway engineering, enzyme engineering, bioremediation, microbial diversity genomics, metagenomics. Nonmajor graduate credit.

BBMB 404. Biochemistry I. (3-0) Cr. 3. F. *Prereq: Chem 332*. A general overview for graduate and advanced undergraduate students in agricultural, biological, chemical and nutritional sciences. Chemistry of amino acids, proteins, carbohydrates, and lipids, vitamins; protein structure; enzymology; carbohydrate metabolism. Credit for both BBMB 420 and the 404, 405 sequence may not be applied toward graduation. Nonmajor graduate credit.

BBMB 405. Biochemistry II. (3-0) Cr. 3. S. *Prereq: 404.* A general overview for graduate and advanced undergraduate students in agricultural, biological, chemical, and nutritional sciences. Metabolism of carbohydrates, amino acids, nucleotides and lipids; formation, turnover, and molecular relationships among DNA, RNA, and proteins; genetic code; regulation of gene expression; selected topics in the molecular physiology of plants and animals. Credit for both BBMB 420 and the 404, 405 sequence may not be applied toward graduation. Nonmajor graduate credit.

BBMB 411. Techniques in Biochemical Research. (1-8) Cr. 3. F. *Prereq: Credit or enrollment in 404 or 501, Chem 210 or 211.* Introduction to laboratory techniques for studying biochemistry, including: chromatographic methods; electrophoresis; spectrophotometry; enzyme purification; enzyme kinetics; and characterization of carbohydrates, proteins, lipids, and nucleic acids. Nonmajor graduate credit.

BBMB 420. Physiological Chemistry. (3-0) Cr. 3. F. *Prereq: Chem 332, BBMB 301 or Biol 314.* Structure and function of proteins; enzymology; biological oxidation; chemistry and metabolism of carbohydrates, lipids, amino acids and nucleic acids; protein synthesis and the genetic code; relationship of biochemistry to selected animal diseases. Biochemistry of higher animals emphasized. Not acceptable for credit toward a major in agricultural biochemistry, biochemistry or biophysics. Credit for both BBMB 420 and the 404, 405 sequence may not be applied toward graduation. Nonmajor graduate credit.

BBMB 430. Procaryotic Diversity and Ecology. (Dual-listed with 530). (Cross-listed with Micro). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Micro 302, Micro 302L*. Survey of the diverse groups of procaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

BBMB 440. Laboratory in Microbial Physiology, Diversity, and Genetics. (Cross-listed with Micro). (1-7) Cr. 3. F. *Prereq: Micro 302, 302L, Chem 332, Biol 313L*. Study of the fundamental techniques and theory of studying the diversity of microbial life. Experimental techniques will include isolation and physiological characterization of bacteria that inhabit different environments. Also included are techniques for the phylogenetic characterization, and genetic manipulation of diverse species of bacteria.

BBMB 451. Physical Biochemistry. (2-0) Cr. 2. F. *Prereq: Chem 331, Phys 112 or 222; a previous course in calculus is helpful but not required.* Selected topics in physical chemistry in the context of applications to problems in biology, biochemistry and food sciences. Not acceptable for credit toward a major in biochemistry or biophysics. Nonmajor graduate credit.

BBMB 461. Topics in Biophysics. (2-0) Cr. 2. S. *Prereq: 451 or Chem 321 or Phys 304.* Biological phenomena viewed as problems in physics, with a focus on structure determinations and macromolecular characterization. Nonmajor graduate credit.

BBMB 490. Independent Study. Cr. arr. F.S.SS. *Prereq: College of Agriculture: junior or senior classification and permission of instructor; College of Liberal Arts and Sciences: permission of instructor.* College of Agriculture: a maximum of 9 credits of 490 may be applied toward graduation.
H. Honors

BBMB 499. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of staff member with whom student proposes to work.* Research under senior staff guidance.

Courses primarily for graduate students, open to qualified undergraduate students

BBMB 501. Comprehensive Biochemistry I. (4-0) Cr. 4. F. *Prereq: Chem 210 or 211, 322, and 332; a previous course in biochemistry is strongly recommended.* Chemical composition of living matter and the chemistry of life processes. Chemical characterization of amino acids, proteins, carbohydrates and lipids; enzymology and co-enzymes; metabolism of carbohydrates; biological oxidations.

BBMB 502. Comprehensive Biochemistry II. (4-0) Cr. 4. S. *Prereq: 501.* Chemical composition of living matter and the chemistry of life processes. Metabolism of lipids, amino acids, and nucleotides; membrane biochemistry; biosynthesis of DNA, RNA, and proteins; gene regulation; selected topics.

BBMB 503. Bioinorganic Chemistry. (Cross-listed with Chem). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Chem 402 or BBMB 405.* Essential elements: transport and storage of ions and of oxygen; metalloenzymes and metallocoenzymes; electron-transfer processes in respiration and photosynthesis; metabolism of nonmetals and redox processes involved in it; medicinal aspects of inorganic chemistry.

BBMB 520. Genetic Engineering. (Cross-listed with GDCB, MCDB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Gen 411 or BBMB 405.* Strategies and methods of gene cloning, restriction endonuclease mapping, southern hybridization, isolation and manipulation of plasmid DNA, and detection of specific genes in bacteria.

BBMB 530. Procaryotic Diversity and Ecology. (Dual-listed with 430). (Cross-listed with Micro). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Micro 302, Micro 302L*. Survey of the diverse groups of procaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

BBMB 531. Structure and Reactivity of Biomolecules. (3-0) Cr. 1. F. *Prereq: Chem 332.* Five weeks. Special properties of reactive groups prevalent in biomolecules and reactions commonly encountered in biochemical studies. A study of reaction types and mechanisms in biochemistry.

BBMB 541. Computational Biochemistry. (1-0) Cr. 1. F. *Prereq: A previous course in biochemistry is recommended.* Computer applications in biochemical research.

BBMB 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BCB, B M S, FS HN, Hort, NutrS, VDPAM, EEOB, NREM, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

BBMB 551. Molecular Biophysics. (3-0) Cr. 3. F. *Prereq: Chem 322.* An examination of physical methods for the study of molecular structure and organization of biological materials, with emphasis on applications. Spectroscopy, hydrodynamic methods, nuclear magnetic resonance, and X-ray diffraction.

BBMB 552. Biomolecular NMR Spectroscopy. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Chem 325 or permission of instructor.* Advanced solution state Nuclear Magnetic Resonance spectroscopy as applied to biological systems. Topics include theoretical principles of NMR, practical aspects of experimental NMR, methodologies for protein structure determination, NMR relaxation, recent advances in NMR spectroscopy.

BBMB 569. Bioinformatics III (Structural Genome Informatics). (Cross-listed with BCB, Com S, Cpr E, Math). (3-0) Cr. 3. F. *Prereq: BCB 567, Gen 411, Stat 430.* Algorithmic and Statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

BBMB 581. Seminar. (1-0) Cr. 1. F. *Prereq: Permission of instructor.* Short presentations by students and discussion on assigned topics. For entering graduate students.

BBMB 590. Special Topics. Cr. arr.

BBMB 593. Workshop in Biochemistry and Biophysics. Cr. 1. Repeatable. *Prereq: Permission of instructor.* Graduate workshops in selected topics in biochemistry and biophysics. Credit in this course does not meet the requirement for advanced graduate electives in Biochemistry.

Courses for graduate students

BBMB 607. Plant Biochemistry. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: 405 or 502.* Description of unique aspects of plant biochemistry including lipid metabolism, cell wall structure, secondary metabolism, phytoalexin biosynthesis, and plant defenses.

BBMB 615. Molecular Immunology. (Cross-listed with Micro, V MPM). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: BBMB 405 or 502.* Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signalling pathways leading to expression of genes that control and activate immune function.

BBMB 622. Carbohydrate Chemistry. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 404 or 501.* Structure, occurrence, properties, function, and chemical and enzymatic modifications of monosaccharides, oligosaccharides, polysaccharides, and glycoproteins.

BBMB 632. Kinetics of Enzyme Action. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 501.* Fundamental and advanced enzyme kinetics. Topics include integrated rate equations, methods for deriving initial-rate equations, inhibition, product effects, methods for verifying kinetic mechanisms, allostery, hysteresis, isotope effects, and complex kinetic mechanisms.

BBMB 640. Signal Transduction. (Cross-listed with GDCB, MCDB). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: GDCB 528, BBMB 404.* Mechanisms and components of cellular signal transduction including receptors, G-proteins, second messengers, protein phosphorylation, other post-translational protein modications, and transcriptional regulation.

BBMB 642. Mechanisms of Enzymatic Catalysis. (2-0) Cr. 1. Alt. F., offered 2010. *Prereq: 404, 420, or 501.* First 8 weeks. The chemical basis of enzymatic catalysis with emphasis on mechanisms of substrate recognition, general acid-base catalysis and stereoelectronic factors.

BBMB 645. Molecular Signaling. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 405, 420, or 502.* Molecular mechanisms of cellular signaling including receptor activation, desensitization and cross talk, signal transduction pathways, and nuclear receptors. Discussion includes a variety of cell surface receptors and their hormone; growth factor and extracellular matrix activators; protein kinases; caspase and transcription factor downstream signals; lipids, gases and cyclic nucleotides as regulators of cell signaling. Course content includes current literature, student and instructor presentations and research proposal writing.

BBMB 652. Protein Chemistry - Chemical Methods. (2-0) Cr. 1. Alt. S., offered 2010. *Prereq: 404 or 501.* First 8 weeks. Chemical reactions as a means of determining protein structure and biological function.

BBMB 653. Protein Chemistry - Physical Methods. (2-0) Cr. 1. Alt. S., offered 2010. *Prereq: 404 or 501.* Second 8 weeks. Protein structure determination as a means of understanding biological function.

BBMB 660. Membrane Biochemistry. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: 405 or 502.* Protein and lipid constituents of biological membranes. Structure and topography of membrane proteins. Selected topics concerning the membrane proteins involved in diverse biochemical processes, such as energy transduction transport across membranes, neurotransmission and signal transduction.

BBMB 661. Current Topics in Neurobiology. (Cross-listed with Neuro, GDCB). Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics may include communication, hormones and behavior, neural integration, membrane biophysics, molecular and cellular neuroscience, developmental neurobiology, neuroanatomy and ultrastructure, sensory biology, social behavior, techniques in neurobiology and behavior.

BBMB 670. Molecular Biology of Muscle. (Cross-listed with An S). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: BBMB 405, 420, or 502.* Ultrastructure of muscle; chemistry, structure, function, and molecular biology of muscle proteins. Molecular aspects of muscle contraction, development, and turnover. Cytoskeletal proteins and dynamics.

BBMB 675. Nucleic Acid Structure and Function. (2-0) Cr. 2. F. *Prereq: 405 or 502.* In-depth discussion of nucleic acid properties, structures and structure/function relationships. Interactions between nucleic acids and proteins will be emphasized.

BBMB 676. Biochemistry of Gene Expression in Eucaryotes. (Cross-listed with MCDB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 404 or 501, 405 or 502 or GDCB 511.* Analysis of the biochemical processes involved in expression of eucaryotic genes and the regulation thereof, including RNA polymerase, transcriptional regulatory proteins, enhancers and silencers, chromosome structure, termination, RNA processing, RNA transport, RNA turnover, small RNAs translational regulation, protein turnover.

BBMB 681. Advanced Seminar. Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.* Student presentations.

BBMB 682. Departmental Seminar. Cr. R. F.S. *Prereq: Permission of instructor.* Staff and visitor research.

BBMB 696. Research Seminar. (Cross-listed with Agron, GDCB, PlBio, Hort, For). Cr. 1. Repeatable. Research seminars by faculty and graduate students. Satisfactory-fail only.

BBMB 698. Seminar in Molecular, Cellular, and Developmental Biology. (Cross-listed with MCDB, GDCB, Micro, V MPM). (2-0) Cr. arr. Repeatable. F.S. Student and faculty presentations.

BBMB 699. Research. Cr. arr. *Prereq: Permission of instructor.*

Bioengineering

http://www.eng.iastate.edu/bioengineering/

Minor administered by the College of Engineering

Supervisory Committee: P. Reilly (Chair), A. Bastawros, T. Kim, H. van Leeuwen, S. Pandey, G. Mirka, L. Genalo, P. Shrotriya

The bioengineering minor at Iowa State University is an interdisciplinary program that complements a student's major discipline by providing additional insight into the interactions between various engineering disciplines and biological systems, emphasizing new ways of solving biological problems. The program provides students with unique educational experiences to apply engineering skills and create new biobased products and devices.

Undergraduate Study

The program is open to all undergraduate engineering students at Iowa State University. This minor will provide students with a foundation of core Bioengineering knowledge, on which tracks will be superimposed to provide in-depth exposure to targeted areas of specialization. In addition to the core courses—BioE 201 and 202—students will complete coursework identified in the following tracks:

Bioinformatics and Systems Biology: BioE 325, BCB 211, 401, 402, and 442.

Biomaterials and Biomechanics: BioE 352, Ch E 440, Ex Sp 355, and Mat E 456.

Biomicrosystems: BioE 341, 341L, 450, 450L, and 428.

Biosystems and Environmental Engineering: A E 216 and 480, BioE 411/511, Ch E 415 and 427, and C E 421/521.

Courses primarily for undergraduate students

Undergraduate engineering students can satisfy the minor in bioengineering by completing a total of 15 credits: 6 from the core curriculum and 9 from the specialized tracks. Students can either choose to specialize in a particular track shown above or use courses from all tracks from which to draw their set of courses. The minor must include at least nine credits which are beyond the total used to meet curriculum requirements for the bachelors of science degree in engineering.

Students are strongly encouraged to consult either their undergraduate academic advisor or a member of the supervisory committee for assistance during the application process.

BioE 201. Introduction to Bioengineering I. (3-0) Cr. 3. *Prereq: Chem 167.* An exploration of cell structure and function, cellular metabolism, types of life forms, energy transport and use, biomolecule structure and function, and enzyme structure, function, and kinetics, with strong Mathematical emphasis.

BioE 202. Introduction to Bioengineering II. (3-0) Cr. 3. *Prereq: BioE 201.* Feedback loops in biological systems, cell and microbial growth patterns, fermentation kinetics. Biotechnology in diseases, wastewater treatment, genetic engineering of bacteria, fungi, plants, and animals, and biosensor operation. Strong Mathematical emphasis.

BioE 325. Systems Biology for Engineering. (3-0) Cr. 3. *Prereq: 202, Math 267.* Review of systems approaches for modeling. Introduction or review of methods for gene regulation in cells and how to model them. Auto regulation of gene networks. Feedforward modeling, timing considerations. Feedback mechanisms. Kinetic and rate-limiting steps.

BioE 341. BioMEMs and Nanotechnology. (3-0) Cr. 3. *Prereq: 202.* Overview of Micro-Electro-Mechanical-System (MEMS) technologies for bioengineering, fundamentals of microfluidic device design, fabrication, and characterization, survey of microfluidic functional building blocks for lab-on-a-chip applications including mixers, valves, channels, and chambers. Topics of nanotechnology in bioengineering, nanoscale building block technologies for bioengineering including self-assembling, surface chemical treatment, nano-imprinting, nano-particles, nano-tubes, nanowires, and stimuli-responsive biomaterials.

BioE 341L. BioMEMS and Nanotechnology Laboratory. (0-3) Cr. 1. *Prereq: 202, concurrent enrollment in 341.* Introductory laboratory course accompanying BioE 341. Design, fabrication, and characterization of BioMEMS lab-on-a-chip devices and nanoscale techniques for bioengineering. Student group projects. BioE341L not a necessary corequisite with BioE341.

BioE 352. Molecular, Cellular and Tissue Biomechanics. (3-0) Cr. 3. *Prereq: 201, E M 324, Mat E 272.* Introduction to the anatomy of the musculoskeletal system and connective tissue. Range of movement, joint dislocation, bone deformity and fracture. Application of continuum mechanics to both living and nonliving systems. Laws of motion, free-body diagrams and simple force analysis of musculoskeletal system. biomechanical response of soft and hard tissues with emphasis on microstructure and mechanical properties. Applications to bioengineering design.

BioE 411. Bioprocessing and Bioproducts. (Cross-listed with A E, BSE, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, Bionergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, Bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

BioE 428. Image Processing with Biomedical Applications. (3-0) Cr. 3. *Prereq: E E 324.* Review of signal processing, linear algebra, probability. Image sampling and quantization. Image transforms, image enhancement, image denoising/restoration. Tomographic reconstruction, segmentation and registration, recognition and shape analysis and applications in Computer Aided disease Detection (CAD).

BioE 450. Biosensing. (3-0) Cr. 3. *Prereq: 202.* Overview of biosensors and bioanalytical challenges; designing for performance including various analytical problems, ion-selective membranes, characteristics of enzymes and basics of bioaffinity sensing; fundamentals of bioselective layers including depositing films and membranes, surfaces for immobilization and bioselective agents; survey of different biosensing technologies including electroanalytical, biomembrane, optical, and acoustic-wave based sensors.

BioE 450L. Biosensing Laboratory. (0-3) Cr. 1. *Prereq: 202, concurrent enrollment in BioE 450.* Laboratory course accompanying BioE 450. Design, fabrication, and characterization of various electrical, chemical, polymer, optical and acoustic sensors. Lab is not a necessary corequisite with BioE 450..

Bioinformatics and Computational Biology – Undergraduate

www.las.iastate.edu/bcb/

Chair: S. Willson

Supervisory Committee: V. Brendel, K. Dorman, D. Fernandez-Baca, F. Honavar, M. Smiley

Undergraduate study

Undergraduate study in BCBio is jointly administered by the Department of Computer Science, the Department of Genetics, Development, and Cell Biology, and the Department of Mathematics. The undergraduate B.S. degree is offered through the College of Liberal Arts and Sciences.

Bioinformatics and Computational Biology is an interdisciplinary science at the interfaces of the biological, informational and computational sciences. The science focuses on a variety of topics. These include gene identification, expression, and evolution; RNA, protein, and genome structure; and molecular and cellular systems and networks. The large group of participating faculty provides students with a multidimensional perspective on bioinformatics and computational biology and presents them with broad range of possibilities to get involved in research.

This major will prepare students for careers at the interfaces of biological, informational and computational sciences. BCBio graduates with a B.S. seeking direct employment will find ready markets for their talents in agricultural and medical biotechnology industries, as well as in academia, national laboratories, and clinics. Although some students find employment directly after their baccalaureate training, many students will continue their education in one of the many excellent graduate programs in bioinformatics and computational biology that now exist.

Participation in this field requires that students achieve a high level of competence not only in biology, but also in mathematics, computer science, and statistics. As a result, the program includes required courses from many different disciplines. Graduates demonstrate an above-average ability to synthesize methods from these different disciplines to solve problems.

In addition to basic degree requirements listed in the Curriculum in Liberal Arts and Sciences (www.las.iastate.edu/academics/generaleducation/), BCBio majors must satisfy the following requirements:

A. Complementary Courses for the BCBio Major (37 cr)
   1. Chem (177, 177L, 178) or (201, 201L); 331.
   2. Phys 221.
   3. Stat 330, 341 and 430.
   4. Biol 211, 211L, 212, 212L and 314.

B. Core Courses Within the BCBio Major (48 cr)
   1. Gen 313, 313L and 411.
   2. Com S 227, 228, 363, and 330 (or Cpr E 310).
   3. Math 165, 166, 265 and (307 or 317).
   4. BCBio 110, 211, 401, 402.
   5. BCBio 490 or 491 (3 cr)

C. Support Electives
3-9 credits to be chosen from the following list:

BCB 495, 539, 542, 548, 549, 550, 551, 593, 594, 596, 597; Phys 222; BBMB 404, 405; Biol 315, 423, 462, 465, 472; Gen 340, 410; Stat 342, 402, 416, 432; Com S and Cpr E courses at the 300 level and above; Math (266 or 267), 304, 314, 385, 471, 481.

D. The communications and English proficiency requirements of the LAS college are met by Engl 150, 250 or 250H, and an additional English writing course chosen from Engl 309 or Engl 314. The lowest grade acceptable in Engl 150, 250 or 250H is C-.

Courses primarily for undergraduate students

BCBio 110. BCBio Orientation. (1-0) Cr. 0.5. F. First 8 weeks. Orientation to the area of bioinformatics and computational biology. For students considering a major in BCBio. Specializations and career opportunities. Satisfactory-fail only.

BCBio 211. Introduction to Bioinformatics and Computational Biology. (3-0) Cr. 3. S. Overview of bioinformatics and computational biology. Database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics.

BCBio 401. Fundamentals of Bioinformatics and Computational Biology I. (3-0) Cr. 3. F. *Prereq: BCBio 211, Com S 228.* Biology as an information science. Generative models for sequences. String algorithms. Sequence alignment. Algorithmic and Statistical aspects of database search. Basic methods in molecular phylogeny/phylogenomics. Genome sequence assembly.

BCBio 402. Fundamentals of Bioinformatics and Computational Biology II. (3-0) Cr. 3. S. *Prereq: BCBio 401.* Genome annotation. DNA and protein motifs. DNA microarrays. Introduction to gene expression studies. Protein, DNA and RNA structure. Structure representation, comparison and visualization. Biological networks and systems.

BCBio 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: BCBio 211, junior or senior classification, permission of instructor.* Students in the College of Liberal Arts and Sciences may use no more than 9 credits of BCBio 490 and 491 toward graduation.

BCBio 491. Team Research Projects.. Cr. arr. Repeatable. *Prereq: BCBio 211, junior or senior classification, permission of instructor.* Research projects in bioinformatics and computational biology done by teams of students. Students in the College of Liberal Arts and Sciences may use no more than 9 credits of BCBio 490 and 491 toward graduation.

Bioinformatics and Computational Biology

www.bcb.iastate.edu

bcb@iastate.edu

Interdepartmental Graduate Major

Chair: C. Tuggle

Associate Chair: V. Brendel

Supervisory Committee: C. Tuggle, V. Brendel, J. Dickerson, D. Dobbs, X. Huang, Z. Wu, R. Jernigan (ex-officio), S. Aluru (former chair)

Participating Faculty: D. Adams, S. Aluru, A. Andreotti, L. Bartholomay, W. Beavis, M. Bhattacharyya, A. Bogdanove, V. Brendel, A. Bronikowski, S. Cannon, H. Chou, D. Cook, J. Dekkers, J. Dickerson, P. Dixon, D. Dobbs, K. Dorman, O. Eulenstein, R. Fernando, H. Greenlee, X. Gu, K. Ho, V. Honavar, R. Honzatko, X. Huang, F. Janzen, R. Jernigan, D. Jones, S. Lamont, D. Lavrov, C. Lawrence, H. Levine, P. Liu, G. Macintosh, A. Miller, L. Miller, C. Minion, K. Moloney, D. Nettleton, B. Nikolau, M. Nilsen-Hamilton,

T. Peterson, G. Phillips, K. Rajan, J. Reecy, P. Reilly, S. Rodermel, M. Rothschild, D. Sakaguchi , P. Schnable, T. Sen, J. Shanks , M. Smiley, J. Smith, G. Song, X. Song, A. Travesset, C. Tuggle, N. Valenzuela, J. Wendel, S. Whitham, S. Willson, R. Wise, Z. Wu, E. Wurtele, E. Yu

Undergraduate Study

Undergraduates seeking a B.S. in Bioinformatics and Computational Biology should enroll in the undergraduate major BCBio, which is described in a separate section of this catalog. *See Index, BCBio.*

Undergraduates wishing to prepare for graduate study in Bioinformatics and Computational Biology should consider the undergraduate major in BCBio. Alternatively, they should obtain solid undergraduate training in at least one of the foundation disciplines: molecular biology, computer science, mathematics, statistics, and physics. They should also elect courses in basic biology, basic transmission and molecular genetics, chemistry, physics, mathematics at least through calculus, statistics, and computer programming.

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in Bioinformatics and Computational Biology (BCB). Faculty are drawn from several departments: Agronomy; Animal Science; Astronomy and Physics; Biochemistry, Biophysics and Molecular Biology; Biomedical Sciences; Chemical and Biological Engineering; Chemistry; Computer Science; Ecology, Evolution, and Organismal Biology; Electrical and Computer Engineering; Genetics, Development and Cell Biology; Industrial Manufacturing and Systems Engineering; Materials Science and Engineering; Mathematics; Plant Pathology; Statistics; Veterinary Microbiology and Preventive Medicine; and Veterinary Pathology.

The BCB program emphasizes interdisciplinary training in nine related areas of focus: Bioinformatics, Computational Molecular Biology, Structural and Functional Genomics, Macromolecular Structure and Function, Metabolic and Developmental Networks, Integrative Systems Biology, information Integration and Data Mining, Biological Statistics, and Mathematical Biology. Additional information about research areas and individual faculty members is available at: www.bcb.iastate.edu.

BCB students are trained to develop an independent and creative approach to science through an integrative curriculum and thesis research projects that include both computational and biological components. First year students are appointed as research assistants and participate in BCB 697 (Graduate Research Rotation), working with three or more different research groups to gain experience in both "wet" (biological) and "dry" (computer) laboratory environments. In the second year, students initiate a thesis research project under the joint mentorship of two BCB faculty mentors, one from the biological sciences and one from the quantitative/computational sciences. The M.S. and Ph.D. degrees are usually completed in two and five years, respectively.

Before entering the graduate BCB program, prospective BCB students should have taken courses in mathematics, statistics, computer science, biology, and chemistry. A well-prepared student will have taken calculus (through multivariable calculus, such as Math 265), a calculus-based introduction to probability and Statistics (like Stat 341), two semesters of computer programming (like Com S 207 and 208), one semester of discrete structures (like Com S 330 or Cpr E 310), some physical and organic chemistry (like Chem 163 and 231), biochemistry (like BBMB 301), genetics (like Biol 313), and evolution (like Biol 315).

During the first year, BCB students are required to address any background deficiencies in calculus, molecular genetics, computer science, statistics and discrete structures, with specific courses determined by prior training. Among the total course requirements for Ph.D. students are four core courses in Bioinformatics (BCB 567, 568, 569, and 570), one core course in Molecular Genetics (GDCB 511), and background courses in statistics and computer science. Students make research presentations (BCB 690), attend faculty research seminars (BCB 691), and participate in workshops/symposia (BCB 593). M.S. students take the above background and core courses, take at least 12 credits of advanced coursework, and may elect to participate in fewer seminars and workshops. Additional coursework may be selected to satisfy individual interests or recommendations of the Program of Study Committee. All graduate students are encouraged to teach as part of their training for an advanced degree. (For curriculum details and sample programs of study, see: www.bcb.iastate.edu.)

Courses primarily for undergraduate students

BCB 444. Introduction to Bioinformatics. (Dual-listed with 544). (Cross-listed with Com S, Cpr E, Gen, Biol). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics. Nonmajor graduate credit.

BCB 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*

BCB 495. Molecular Biology for Computational Scientists. (Cross-listed with Gen). (3-0) Cr. 3. F. Survey of molecular cell biology and molecular genetics for nonbiologists, especially those interested in bioinformatics/computational biology. Basic cell structure and function; principles of molecular genetics; biosynthesis, structure, and function of DNA, RNA, and proteins; regulation of gene expression; selected topics. Provides biological background for BCB 594. Credit for graduation will not be allowed for more than one of Gen 411 and Gen/BCB 495. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students.

BCB 538. Computational Genomics and Evolution. (Cross-listed with GDCB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 313.* Introduction to evolutionary sequence analysis at the genome level. Topics include sequence alignment, phylogenetic inference, molecular clock analysis, ancestral state inference, sequence/structure relation, functional divergence and prediction, evolutionary development, genome duplication, and comparative genomics. Focus will be on data analysis and biological interpretation.

BCB 539. Statistical Methods for Computational Biology. (Cross-listed with GDCB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: BCB 568.* Gu. Advanced discussion about Statistical modeling of DNA and amino acid sequences, microarray expression profiles and other genome-wide data interpretation.

BCB 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BBMB, B M S, FS HN, Hort, NutrS, VDPAM, EEOB, NREM, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

BCB 544. Introduction to Bioinformatics. (Dual-listed with 444). (Cross-listed with Com S, Cpr E, GDCB). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics.

BCB 549. Advanced Algorithms in Computational Biology. (Cross-listed with Cpr E, Com S). (3-0) Cr. 3. S. *Prereq: Com S 311 and either 208 or 228.* Design and analysis of algorithms for applications in computational biology, pairwise and multiple sequence alignments, approximation algorithms, string algorithms including in-depth coverage of suffix trees, seminumerical string algorithms, algorithms for selected problems in fragment assembly, phylogenetic trees and protein folding. No background in biology is assumed. Also useful as an advanced algorithms course in string processing.

BCB 550. Evolutionary Problems for Computational Biologists. (Cross-listed with Com S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Com S 311 and some knowledge of programming.* Discussion and analysis of basic evolutionary principles and the necessary knowledge in computational biology to solve real world problems. Topics include character and distance based methods, phylogenetic tree distances, and consensus methods, and approaches to extract the necessary information from sequence-databases to build phylogenetic trees.

BCB 551. Computational Techniques for Genome Assembly and Analysis. (Cross-listed with Com S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Com S 311 and some knowledge of programming.* Huang. Introduction to practical sequence assembly and comparison techniques. Topics include global alignment, local alignment, overlapping alignment, banded alignment, linear-space alignment, word hashing, DNA-protein alignment, DNA-cDNA alignment, comparison of two sets of sequences, construction of contigs, and generation of consensus sequences. Focus on development of sequence assembly and comparison programs.

BCB 565. Professional Practice in the Life Sciences. (Cross-listed with Pl P, Agron, An S, Hort, Micro, V MPM). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.
A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

BCB 567. Bioinformatics I (Fundamentals of Genome Informatics). (Cross-listed with Com S, Cpr E). (3-0) Cr. 3. F. *Prereq: Com S 208; Com S 330; Stat 341; credit or enrollment in Biol 315, Stat 430.* Biology as an information science. Review of algorithms and information processing. Generative models for sequences. String algorithms. Pairwise sequence alignment. Multiple sequence alignment. Searching sequence databases. Genome sequence assembly.

BCB 568. Bioinformatics II (Advanced Genome Informatics). (Cross-listed with GDCB, Stat, Com S). (3-0) Cr. 3. S. *Prereq: BCB 567, BBMB 301, Biol 315, Stat 430, credit or enrollment in Gen 411.* Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

BCB 569. Bioinformatics III (Structural Genome Informatics). (Cross-listed with BBMB, Com S, Math, Cpr E). (3-0) Cr. 3. F. *Prereq: BCB 567, Gen 411, Stat 430.* Algorithmic and Statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

BCB 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology). (Cross-listed with Com S, GDCB, Stat, Cpr E). (3-0) Cr. 3. S. *Prereq: BCB 567, Biol 315, Com S 311 and either 208 or 228, Gen 411, Stat 430.* Algorithmic and Statistical approaches in computational functional genomics and systems biology. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Ontology-driven, network based, and probabilistic approaches to information integration.

BCB 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

BCB 593. Workshop in Bioinformatics and Computational Biology. (1-0) Cr. 1. Repeatable. F.S. Current topics in bioinformatics and computational biology research. Lectures by off-campus experts. Students read background literature, attend preparatory seminars, attend all lectures, meet with lecturers.

BCB 596. Genomic Data Processing. (Cross-listed with Com S, GDCB). (3-0) Cr. 3. F. *Prereq: Some knowledge of programming.* Study the practical aspects of genomic data processing with an emphasis on hand-on projects. Students will carry out major data processing steps using bioinformatics tools. Topics include base-calling, raw sequence cleaning and contaminant removal; shotgun assembly procedures and EST clustering methods; genome closure strategies and practices; sequence homology search and function prediction; annotation and submission of GenBank reports; and data collection and dissemination through the Internet. Useful post-genomic topics like microarray design and data analysis will also be covered.

BCB 597. Introductory Computational Structural Biology. (Cross-listed with Math). (3-0) Cr. 3. S. *Prereq: Math 561 and 562.* Mathematical and computational approaches to protein structure prediction and determination. Topics include molecular distance geometry, potential energy minimization, and molecular dynamics simulation.

BCB 599. Creative Component. Cr. arr.

Courses for graduate students

BCB 690. Student Seminar in Bioinformatics and Computational Biology. Cr. 1. Repeatable. S. Student research presentations.

BCB 691H. Faculty Seminar in Bioinformatics and Computational Biology. (Cross-listed with GDCB). (1-0) Cr. 1. Repeatable. Faculty research series.

H. Bioinformatics and Computational Biology. (Same as GDCB 691H).

BCB 697. Graduate Research Rotation. Cr. arr. F.S.SS. Graduate research projects performed under the supervision of selected faculty members in the Bioinformatics and Computational Biology major.

BCB 699. Research. Cr. arr. Repeatable.

Biological/ Premedical Illustration

www.bpmi.iastate.edu

(Interdepartmental Undergraduate Program)

Program Committee: Lynn G. Clark, Chair; Dean Biechler, John Dorn, Stanley W. Harpole, Steven M. Herrnstadt, Harry Horner, Don Sakaguchi.

Undergraduate Study

The interdepartmental undergraduate BPM I major is designed for students who want to combine their interests and aptitudes in science and art. Based on the theme of "communicating science through art," the major prepares students for careers in biological illustration or for graduate education in medical illustration elsewhere. Graduates enter fields such as biocommunications, environmental display design, free-lance illustration, museum display design, and various careers in the publishing industry.

Entrance into the BPM I program is by application to the BPM I Advisory Committee. Eligibility is based on an academic standard of at least 2.00 CGPA on 30 credits of university level work and a consideration of artistic ability as demonstrated through submission of a portfolio of representative drawings or other art work. Freshman and transfer students usually declare pre-BPM I as their major while satisfying the conditions for entrance into the major, although other majors can be declared.

To earn the B.A. degree offered by the College of Liberal Arts and Sciences, students must complete the general education requirements in that college and take at least 41 credits in design and 32 credits in the biological sciences. Design courses include: Dsn S 131 and Art 230, ArtIS 233, 308, and 330, BPM I 323, 326, 327, 337, and 497 plus 12 credits chosen from a list of approved upper level courses in art and design. Biological science courses include: LAS 101, Biol 211, 211L, 212, 212L, 255, 256, 351: Biol 356 or 366 or 454, and at least 9 credits chosen from a list of approved biological science courses. Chemistry and Mathematics are also required as supporting courses. Students must earn a grade of C- or better in all art and science courses included in the major and must earn a cumulative GPA of 2.00 in both categories. A brochure is available in 102 Catt Hall that gives a detailed listing of the requirements.

Communication Proficiency Requirement. Students must earn a minimum of C in both English 150 and 250 or equivalent composition courses and in one advanced writing course numbered Engl 302 through 316.

Students in BPM I must complete a senior project or an internship experience (BPM I 497) in which they design and produce artwork that is suitable for publication or public display.

A minor in biological illustration is offered. A minimum of 17 credits must be taken, including 8 credits in biological science courses and 9 credits in art and design courses. The biological sciences must include Biol 211, 211L, 212, and 212L. The art and design courses must include BPM I 323 and 337, and an advanced drawing, illustration, electronic media, or painting course. For more information, contact the BPM I adviser in 102 Catt Hall or view the website listed above.

Courses primarily for undergraduate students

BPM I 323. Scientific Illustration Principles and Techniques. (Cross-listed with ArtIS). (0-6) Cr. 3. Repeatable. F. *Prereq: 6 credits in art and design and 3 credits in biological sciences.* Studio basics and professional techniques in black & white, continuous tone, and color. Emphasis on tools, materials, and rendering.

BPM I 326. Illustration and Illustration Software. (Cross-listed with ArtIS). (0-6) Cr. 3. S. *Prereq: 323.* Application of painting, drawing, and image making techniques to communication. Development of technical abilities using illustration software. Digital and print production techniques.

BPM I 327. Illustration as Communication. (Cross-listed with ArtIS). (0-6) Cr. 3. F. *Prereq: 326.* Studio problems in illustration emphasizing composition and communication. Problem solving methodologies.

BPM I 337. Application of Scientific Illustration Techniques. (Cross-listed with ArtIS). (0-6) Cr. 3. Repeatable. S. *Prereq: 327.* Rendering techniques applied to different types of biological and scientific subjects emphasizing communication. The use of traditional and digital media. Term project required.

BPM I 395. Field Illustration. Cr. arr. Repeatable. S.SS. *Prereq: Permission of instructor.* A combination seminar and field trip course emphasizing nature interpretation, field sketching techniques and preparation of a final illustration based on field experience.

BPM I 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the program cooperative education coordinator, junior classification.* Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

BPM I 435l. Illustrating Nature I Sketching. (Cross-listed with Ia LL). Cr. 2. SS. Sketching plants, animals and terrain. Visual communication, development of a personal style, and integration of typographic and visual elements on a page will be emphasized.

BPM I 436l. Illustrating Nature II Photography. (Cross-listed with Ia LL). Cr. 2. SS. Beginning to intermediate technical and compositional aspects of color photography of natural areas and their plants and animals.

BPM I 490. Independent Study. Cr. arr. Repeatable. *Prereq: Written approval of instructor and advisory committee chair on required form in advance of semester of enrollment.*

BPM I 494. Special Topics in Illustration. Cr. arr. Repeatable. Intensive exploration of illustration techniques in a studio or field setting.

BPM I 497. Illustration Internship. Cr. arr. Repeatable. *Prereq: Junior or senior classification in BPM I, written approval of supervising instructor and advisory committee chair on required form in advance of semester of enrollment.* Satisfactory-fail only.

Biological Systems Engineering

Administered by the Department of Agricultural and Biosystems Engineering

Rameshwar Kanwar, Chair of Department

Distinguished Professor: Brown

Distinguished Professor (Emeritus): H. Johnson

University Professor: Bern

University Professor (Emeritus): Baker

Professors: Chen, Downing, Glanville, Harmon, Hoff, Hurburgh, L. Johnson, Kanwar, Misra, Schwab, Van Leeuwen, Xin

Professors (Emeritus): Beer, Bekkum, Buchele, Bundy, Hazen, Hoerner, Keeney, Lovely, Maney, Mangold, Marley, Melvin, Miller, Pedersen, Riley, R. Smith

Professor (Collaborator): Laflen

Associate Professors: Anex, Bhandari, Birrell, Brumm, Burns, Freeman, Koziel, Mickelson, Raman, Steward, Tim

Associate Professor (Emeritus): Anderson, Greiner, Lorimor

Associate Professor (Collaborators): Han

Assistant Professors: Darr, Grewell, Helmers, Kaleita-Forbes, Keren, Kim, Soupir, Tang, Yu

Assistant Professor (Emeritus): Boyd, Bradshaw

Assistant Professors (Adjunct): Inyang, Shahan, Tong

Assistant Professors (Collaborators): Dunn, Malone

Lecturer: Snell

Courses primarily for undergraduate students

BSE 110. Experiencing Biological Systems Engineering. (0-2) Cr. 1. S. Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of biological systems engineering. Report writing, co-ops, internships, careers, registration planning.

BSE 201. Entrepreneurship and Internship Seminar. (Cross-listed with A E, TSM). (1-0) Cr. 1. F.S. *Prereq: Sophomore classification in AE, AST, BSE, or I Tec.* 8 week course. Overview of the entrepreneurial process and its importance in the economy and the engineering/ technical workplace. Preparation for internship experiences. Relationship of workplace competencies to entrepreneurship, intrapreneurship, and internships; portfolios.

BSE 216. Fundamentals of Agricultural and Biosystems Engineering. (Cross-listed with A E). (2-2) Cr. 3. S. *Prereq: A E 110, Engr 160, credit or enrollment in Math 166.* Application of mathematics and engineering sciences to mass and energy balances in agricultural and biological systems. Emphasis is on solving engineering problems in the areas of heat and mass transfer, air and water vapor systems; animal production systems, grain systems; food systems, hydrologic systems, and bioprocessing.

BSE 301. Leadership and Ethics Seminar. (Cross-listed with A E, TSM). (1-0) Cr. 1. F.S. *Prereq: 201.* 8 week course. Leadership and ethics experiences through case studies and seminar presentations by practitioners. Relationship of workplace competencies to leadership and ethics; portfolios.

BSE 316. Applied Numerical Methods for Agricultural and Biosystems Engineering. (Cross-listed with A E). (2-2) Cr. 3. F. *Prereq: Engr 160, Math 266.* Computer aided solution of agricultural engineering problems by use of numerical techniques and Mathematical models. Systems analysis and optimization applicable to agricultural and biological systems.

BSE 380. Principles of Biological Systems Engineering. (3-0) Cr. 3. S. *Prereq: 216, Ch E 357 or M E 436.* Unit-operation analysis of biological systems, through the study of mass, energy, and information transport in bioresource production and conversion systems. Quantification and modeling of biomass production, ecological interactions, and bioreactor operations.

BSE 401. Professionalism Seminar. (Cross-listed with A E, TSM). (1-0) Cr. 1. F.S. *Prereq: 301.* 8 week course. Examination of professionalism in the context of engineering and technology. Time, project and personnel management. Communications and professional portfolios. Professional licensure. Transition to professional careers.

BSE 411. Bioprocessing and Bioproducts. (Dual-listed with 511). (Cross-listed with A E, BioE, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

BSE 415. Agricultural Engineering Design I. (Cross-listed with A E). (1-2) Cr. 2. F.S. *Prereq: A E 271 or 272, E M 324.* Identification of current design problems in agricultural engineering. Development of alternate solutions using creativity and engineering analysis and synthesis techniques. Nonmajor graduate credit.

BSE 416. Agricultural Engineering Design II. (Cross-listed with A E). (1-2) Cr. 2. F.S. *Prereq: 415.* Selection of promising solutions to design problems identified in 415 for development by design teams. Presentation of designs through oral and written reports and prototypes. Nonmajor graduate credit.

BSE 480. Engineering Analysis of Biological Systems. (Dual-listed with 580). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: 216; Math 266; Biol 211 or 212; M E 330.* Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues.

BSE 511. Bioprocessing and Bioproducts. (Dual-listed with 411). (Cross-listed with A E, BRT, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

BSE 580. Engineering Analysis of Biological Systems. (Dual-listed with 480). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: 216; Math 266; Biol 211 or 212; M E 330.* Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues. Students enrolled in A E 580 will be required to answer additional exam questions and report on two journal articles.

Biology

www.biology.iastate.edu

(Interdepartmental Undergraduate Program)

James T. Colbert, Program Coordinator

Iowa State University is a major center for research and education in the biological sciences. With over 200 faculty in the life sciences, students have the opportunity to learn from some of the nation's leaders in biological research and teaching and to participate in innovative, meaningful research projects that explore frontiers of biology. Few other universities have such a wealth of faculty expertise available to undergraduate students, making Iowa State's Biology Program the logical choice for those who want to participate in a thriving academic community.

The faculties of the Department of Ecology, Evolution and Organismal Biology and the Department of Genetics, Development and Cell Biology jointly offer the undergraduate biology major. This high quality academic program has the flexibility to accommodate a range of career goals while taking advantage of the university's strengths in science and technology. A bachelor's degree in biology provides excellent preparation for graduate study in biological disciplines ranging from the molecular to the ecological levels, and for entrance into various professional schools, such as human medicine, physical therapy, or veterinary medicine. The major is well suited for those who plan to teach biology, who wish to enter government or industrial employment in health or environmental professions, or who prefer educational breadth as an end in itself. By working with our professional and faculty advisers, it is possible to design a unique program of study that will meet student needs and objectives.

Students with special interests and aptitudes should consider combining biology with a minor or a second major in another subject, such as chemistry, environmental studies, journalism, mathematics, music, statistics, or many other subjects offered by the university.

Undergraduate Study

Biology majors, start their studies in the biological sciences by taking a unified biology core curriculum consisting of six integrated courses, five with labs. The first year (Biol 211, 211L, 212, 212L) provides a broad introduction to the nature of life. During the first year, students also take Biol 110 and 111, which are half semester courses designed to introduce the student to the discipline of biology and opportunities for careers in biology. The second year explores concepts in ecology in Biol 312 and the principles of genetics in Biol 313 and 313L. The third year includes courses in cell and molecular biology (Biol 314, 314L) and evolutionary biology (Biol 315). Biology majors must take an additional 20 credits of biological science at the 300 level or above from an approved list of courses. Of these, at least 8 credits must be taken as biology courses, and a minimum of two laboratory or field courses must also be included. Students may earn the B.S. degree in Biology from either the College of Liberal Arts and Sciences or from the College of Agriculture and Life Sciences. Contact the Biology Program Office for details regarding differences in general education and course requirements which are specific to these colleges.

Biology majors should carefully consider their selection of upper-level courses to allow them to emphasize one or more of the sub-disciplines of Biology relevant to their post-baccalaureate objectives. The Biology Program has identified areas of special interest for many disciplines within Biology, with supporting 300-, 400-, and 500-level courses, enabling majors to gain substantial experience in these areas prior to graduation. Faculty advisers with experience in these subject areas work with students to provide advice about preparing for future training in a range of Biology-related professions. Consult the Biology Program advising staff for more information.

Most biology courses numbered 300 or above can be used to satisfy the additional credit requirement. Some courses taught in other departments can also be applied to the biology major; advanced students should consider including 500 level courses in their programs. Check the Biology Program's World Wide Web site for a complete listing of acceptable upper-level life science courses

Biology majors must demonstrate competency in their understanding of the biological sciences. Thus, grades of C- or better in all biological science courses applied to the major are required. Furthermore, in order to graduate, a student must have a cumulative average in the major of at least 2.00.

Courses offered at other locations

In addition to biological science courses taught on campus, students may take courses at various remote locations and arrange to have the credits count toward the advanced courses required in

the biology major. Courses in field and aquatic biology are offered at the Iowa Lakeside Laboratory. Courses in marine biology can be taken at the Gulf Coast Research Laboratory in Mississippi. Iowa State University is a member of the Organization for Tropical Studies, and students may take courses at the organization's field Station in Costa Rica. Courses taught at field Stations associated with other universities throughout the country may also be applied to the degree. Attending a summer field Station adds an important component to an undergraduate program of study.

Courses Offered at Iowa Lakeside Laboratory at Milford, Iowa

Iowa Lakeside Lab is an Iowa Regents facility located at Lake Okoboji in northwest Iowa where various summer courses in field and aquatic biology are offered. Any of the following courses taken at the lab are directly applicable to the degree program in Biology. See the *Iowa Lakeside Laboratory* entry elsewhere in the catalog for a full description of the courses.

Courses offered at Gulf Coast Research Laboratory

The Gulf Coast Research Laboratory is affiliated with the University of Southern Mississippi. Iowa State students may register for marine biology courses and transfer credit to their degree programs under the number Biol 480. Written permission of the Biology Program Director is required for this arrangement. Courses that are available each summer may be viewed at www.coms.usm.edu.

Courses offered at Summer Biological Field Stations

Courses taken at summer field Stations may be transferred to Iowa State University as credit in Biol 481. Such Stations are found throughout the country and often offer courses that emphasize the adaptation of plants and animals to unique environments. See www.biology.iastate.edu for links to field Stations in different biomes, e.g. marine/coastal, Great Lakes, taiga, deciduous forests, deserts, Rocky Mts.

Courses offered by the Organization for Tropical Studies

Iowa State students may register for courses in tropical biology taught in Costa Rica by the Organization for Tropical Studies. Credit is transferred to Iowa State as Biology 482. For further information check www.ots.duke.edu or inquire in the Biology Program Office.

Undergraduate research. Students who have interest in biological research are encouraged to become involved in the research projects of faculty members on campus. Those doing so may receive credit for the experience in Biol 490. Internship experiences are often available at other universities and at industrial or government laboratories. Students participating in such projects may receive internship credit in Biol 494. Making the effort to find a suitable research mentor and engaging in research work can be one of the most valuable experiences of an undergraduate education.

International experience. Because major discoveries in science often result from global efforts, biology majors are encouraged to include an international or study abroad component in their degree programs. This can be done by participating in international field trips originating from the ISU campus in Biol 394 or similar courses in other departments. Many students choose to study abroad, attending a university in another country for up to a year as an exchange student. Minors in Emerging Global Disease, International Studies, or a foreign language can add an international emphasis to a degree in biology. Biology advisers are eager to help plan and arrange such experiences with interested students.

Supporting course requirements. Understanding the modern biological sciences requires an understanding of the physical and Mathematical sciences. Consequently, a minimum number of credits in general chemistry, organic chemistry, biochemistry, and physics are required. See the Biology Program Web Site for specific supporting science requirements.

The Math requirement is competency based. After demonstrating competency in algebra and trigonometry, biology majors must take: two semesters of calculus; or two semesters of Statistics; or one semester of calculus and one semester of Statistics chosen from a list of approved courses available on the Biology Program Web Site and in the Biology Program Office.

Students in the College of Liberal Arts and Sciences, must fulfill the foreign language and general education requirements listed elsewhere in this catalog for that college. Students in the College of Agriculture and Life Sciences must meet the general education requirements for that college as listed elsewhere in the catalog.

Given the important role of writing in the modern sciences, biology majors must demonstrate English competency by earning a minimum of C in both English 150 and 250 or equivalent composition courses and in one advanced writing course numbered English 302 through 316, or JI MC 347.

Customizing a degree

The advantage of choosing a biology major is the flexibility it allows in customizing a program of study to individual goals. That said, the faculty recognizes that many students studying biology have common goals. Consequently, the faculty has developed specific recommendations for students interested in pursuing the following areas of study:

Teacher Licensure. Biology majors seeking licensure to teach biology in secondary schools must meet requirements of the Teacher Education Program as well as those of the Biology Program. In addition they must apply formally for admission to the teacher education program. See the section on Teacher Education for a list of licensure areas, degree requirements, and other information about this program.

Premedical and Prehealth Professions Studies. Biology majors who will go on to medical or health professional schools are urged to determine the entrance requirements for the institutions where they might study. A list of courses recommended for those who wish to pursue a pre-med curriculum is available in the Biology Program office.

Preveterinary Studies. Many students whose goal is to attend veterinary school choose Biology as their major. The requirements for entrance to the Iowa State Veterinary College are listed elsewhere in this bulletin and should be consulted as programs of study are planned.

Preparation for Graduate Studies. Students who are considering graduate school to further their education in a biological sciences should identify a faculty member who has similar interests. Faculty can mentor students as undergraduates providing a smooth transition to graduate school.

Minor

A minor in Biology is offered by the Biology Program. The minor requires 15 credits in Biology, and includes the completion of the specific courses listed below: Biol 211 and 211L, 212 and 212L, and 7 credits in biology courses numbered 300 or above. Nine (9) credits of the required courses must only apply to the minor. For more information, see the Biology Program Web Site, or contact the Biology, Environmental Science, and Genetics Student Services Office in 103 Bessey Hall.

Graduate Study

Biology is an undergraduate major only. Persons interested in graduate study in the biological sciences should apply directly to one of the life science graduate programs at Iowa State University. Interdepartmental graduate offerings in Bioinformatics and Computational Biology; Ecology and Evolutionary Biology; Genetics; Molecular, Cellular and Developmental Biology; Neuroscience; Plant Physiology; Toxicology; Immunobiology; and Environmental Science are also available. (See *Index*.)

A non-thesis master's degree in Interdisciplinary Graduate Studies (biological sciences) has been established particularly for those who wish to have a more diversified program of advanced study than that generally permitted by specific departments and programs.

Courses primarily for undergraduate students

Biol 101. Introductory Biology. (3-0) Cr. 3. F.S.SS. Life considered at cellular, organism, and population levels. Function and diversity of the living world. Presentation of basic biological principles as well as topics and issues of current human interest. Non-majors only. Only one of Biol 101 or 211 may count toward graduation.

Biol 110. Introduction to Biology. Cr. 0.5. F. Orientation to the scope of the biological sciences, and discussion of professional opportunities. Required of first year biology majors. Satisfactory-fail only.

Biol 111. Opportunities in Biology. (1-0) Cr. 0.5. S. Introduction to biological science disciplines and professional opportunities through faculty presentations which examine a variety of current research topics. Satisfactory-fail only.

Biol 155. Human Biology. (3-0) Cr. 3. F.S. A survey course of human biology, including principal structures and functions of the body systems and the diseases and disorders associated with them. Designed to meet general education requirements in natural science. Not recommended for those seeking a career in the allied health professions or for students majoring in life science.

Biol 165. Field Botany. (2-4) Cr. 2. F.SS. 8 weeks. Field and laboratory studies of plants in various local habitats. Includes trees, shrubs, flowering plants and other green plants, lichens and fungi. Not recommended for students with professional interest in plant science.

Biol 173. Environmental Biology. (Cross-listed with Env S). (3-0) Cr. 3. F.S. An introduction to the structure and function of natural systems at scales from the individual to the biosphere and the complex interactions between humans and their environment. Discussions of human population growth, biodiversity, sustainability, resource use, and pollution. Non-majors only.

Biol 204. Biodiversity. (Cross-listed with Env S). (4-0) Cr. 2. S. *Prereq: One course in life sciences*. Survey of the major groups of organisms and biological systems. Definition, measurements, and patterns of distribution of organisms. Sources of information about biodiversity. Not intended for major credit in the biological sciences. Half semester course.

Biol 211. Principles of Biology I. (3-0) Cr. 3. F.S. *Prereq: High school biology and chemistry or credit or enrollment in Chem 163 or 177.* Introduction to the nature of life, including the cellular basis of life; the nature of heredity; evolution; diversity of microbial, plant, and animal life; and principles of ecology. Intended for life science majors. Only one of Biol 101 or 211 may count toward graduation.

Biol 211L. Principles of Biology Laboratory I. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 211.* Laboratory to accompany 211.

Biol 212. Principles of Biology II. (3-0) Cr. 3. F.S. *Prereq: 211.* Introduction to the nature of life, including the cellular basis of life; energy relationships; the nature of heredity; evolution; form and function of microbial, plant, and animal life.

Biol 212L. Principles of Biology Laboratory II. (0-3) Cr. 1. F.S. *Prereq: credit or enrollment in 212.* Laboratory to accompany 212.

Biol 255. Fundamentals of Human Anatomy. (3-0) Cr. 3. F. *Prereq: high school biology and chemistry, or Biol 101.* An introduction to human anatomy, beginning with cells and tissues, surveying all body systems, relating form to function. Systems covered include: integumentary, bones and joints, muscles, nervous, sensory, endocrine, circulatory, lymphatic, respiratory, digestive, urinary, and reproductive. Pre-Medical students should consider Biol 351 for their anatomy background. Not intended for major credit in biology.

Biol 255L. Fundamentals of Human Anatomy Laboratory. (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 255.* Investigation of human anatomy using models and dissections of preserved organs and model mammals. Pre-Medical students should consider 351 for their anatomy background. Not intended for major credit in biology.

Biol 256. Fundamentals of Human Physiology. (3-0) Cr. 3. S. *Prereq: high school biology and chemistry, or Biol 101, or 255 (recommended).* An introduction to human physiology, studying the function of all body systems. Systems covered include: integumentary, bones and joints, muscles, nervous, sensory, endocrine, circulatory, lymphatic and immune, respiratory, digestive, urinary, and reproductive. Pre-Medical students should consider 335 for their physiology background. Not intended for major credit in biology.

Biol 256L. Fundamentals of Human Physiology Laboratory. (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 256.* Student-conducted experiments investigating concepts of human physiology with computer data acquisition and analysis. Interpretation of experimental results and preparation of lab reports. Pre-Medical students should consider 335 for their anatomy and physiology background. Not intended for major credit in biology.

Biol 258. Human Reproduction. (Cross-listed with W S). (3-0) Cr. 3. F. *Prereq: Biol 101, or 155, or 211.* Anatomy and physiology of human reproductive systems, including fertility, pregnancy, and delivery.

Biol 305. Embryology. (2-0) Cr. 2. S. *Prereq: 212.* Basic principles and processes of development. Course will cover classical as well as current aspects of developmental biology. Emphasis will be on vertebrate model systems. Not acceptable for credit in the major for Biology or Genetics major.

Biol 305L. Embryology Laboratory. (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 305.* Selected experiments demonstrating basic concepts in development. Mixture of live embryo experiments and vertebrate developmental anatomy.

Biol 306. Metabolic Physiology of Mammals. Cr. 3. Prereq: 211, 212. Introduction to physiology of metabolic function in mammals and other animals. Metabolic processes and their interactions with various subsystems, approached form an organismal perspective. Integration of cellular, gastrointestinal, cardiovascular, respiratory, and renal processes, relevant to their control and integration at the nervous and endocrine system levels. Functional aspects of organismal physiology; energy and water balances, physiology of rest exercise, and environmental stress. Students cannot receive credit for both Biol 306 and Biol 335

Biol 307. Women in Science and Engineering. (Cross-listed with W S). (3-0) Cr. 3. F. *Prereq: a 200 level course in science, engineering or women's studies; Engl 250.* The interrelationships of women and science and engineering examined from historical, sociological, philosophical, and biological perspectives. Factors contributing to underrepresentation; feminist critiques of science; examination of successful strategies.

Biol 312. Ecology. (Cross-listed with A Ecl, EnSci). (3-3) Cr. 4. F.SS. *Prereq: 211L and 212L.* Fundamental concepts and principles of ecology dealing with organisms, populations, communities and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats.

Biol 313. Principles of Genetics. (Cross-listed with Gen). (3-0) Cr. 3. F.S. *Prereq: 211, 211L, 212, and 212L.* Introduction to the principles of transmission and molecular genetics of plants, animals, and bacteria. Recombination, structure and replication of DNA, gene expression, cloning, quantitative and population genetics. Students may receive graduation credit for no more than one of the following: Gen 260, Gen 313 and 313L, Gen 320, Biol 313 and 313L, and Agron 320.

Biol 313L. Genetics Laboratory. (Cross-listed with Gen). (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 313.* Laboratory to accompany 313. Students may receive graduation credit for no more than one of the following: Biol 313 and 313L, Gen 260, Gen 313, Gen 320, and Agron 320.

Biol 314. Principles of Molecular Cell Biology. (3-0) Cr. 3. F.S. *Prereq: Biol 313.* Integration of elementary principles of metabolism, bioenergetics, cell structure and function to develop a molecular view of how the cell works.

Biol 314L. Molecular Cell Biology Laboratory. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 314.* Laboratory to accompany Biology 314.

Biol 315. Biological Evolution. (3-0) Cr. 3. F.S. *Prereq: 313.* The mechanisms of evolution. Topics in microevolution: population genetics, natural selection, genetic variation, and adaptation. Macroevolution: speciation, extinction, phylogeny, and major evolutionary patterns.

Biology 328. Cell Physiology of Human Diseases. (3-0) Cr. 3. Prereq: 212. Survey of macromolecular and ultrastructural organization of animal cell and membrane structures, including recent molecular discoveries in areas of genomics and proteomics involved with cell growth and cell interactions. Emphasis on selected topics of cellular functions with known human disease states.

Biol 330. Principles of Plant Physiology. (3-0) Cr. 3. *Prereq: Biol 313 or Gen 320; Biol 314 or BBMB 301; Chem 231 or 332; Phys 106 or 111.* An overview of classical and current concepts, principles and approaches regarding the basic mechanisms of plant function underlying growth, development and survival of plants. Topics covered include environmental and developmental signals, plant hormone action, signal transduction, mineral nutrition, water relations, metabolism and photosynthesis..

Biol 330L. Principles of Plant Physiology Laboratory. (0-3) Cr. 1. *Prereq: Credit or enrollment in 330.* Laboratory to accompany Biol 330. Experiments and explorations illustrating fundamental principles of plant physiology. Nonmajor graduate credit.

Biol 335. Principles of Animal Physiology. (3-3) Cr. 4. F.S. *Prereq: Biol 314.* Introduction to systemic functions with emphasis on mammals. Nonmajor graduate credit.

Biology 336. Ecological and Evolutionary Animal Physiology. (3-0) Cr. 3. *Prereq: 211, 212.* Study of mechanisms by which animals perform life-sustaining functions; the evolution and adaptive significance of physiology traits, the diversity of physiological mechanisms, and how physiology and ecology interact.

Biol 351. Comparative Chordate Anatomy. (3-4) Cr. 5. S. *Prereq: 212, junior classification.* The evolution of chordates as reflected in the anatomy of extinct and living forms. Lecture topics include the history and diversity of chordates; comparisons of anatomic structures among major groups, the adaptive significance of anatomic structures. Laboratory involves dissection of representative species.

Biol 352. Vertebrate Histology. (3-3) Cr. 4. S. *Prereq: 212.* Microscopic structure of vertebrate tissues and organs, with an introduction to histological techniques.

Biol 353. Introductory Parasitology. (Cross-listed with Micro). (3-3) Cr. 4. F. *Prereq: Biol 212.* Biology and host-parasite relationships of major groups of animal parasites, and techniques of diagnosing and studying parasites.

Biol 354. Animal Behavior. (3-0) Cr. 3. F. *Prereq: 212.* Ethological and Sociobiological approaches to animal behavior. Genetic and developmental aspects of behavior, biological rhythms, orientation (including navigation, migration), communication, and social behavior (mating, aggression, parental care).

Biol 354L. Laboratory in Animal Behavior. (0-3) Cr. 1. F. *Prereq: Credit or enrollment in Biol 354.* Laboratory techniques for observation, description and analysis of animal activities; independent projects.

Biol 355. Plants and People. (3-0) Cr. 3. S. *Prereq: Credit in 211 and 211L.* Uses of plants and fungi by humans and the importance of plants in the past, present and future. Discussion of fruits, vegetables, grains, herbs, spices, beverages, oils, fibers, wood, medicines, and drugs, in the context of their agricultural, cultural, and economic roles in modern Societies. Emphasis on origins and worldwide diversity of culturally important plants, their characteristics, and uses.

Biol 356. Dendrology. (Cross-listed with For). (2-4) Cr. 4. F. *Prereq: Biol 211.* Identification and ecology of North American woody plant species. Importance of woody plants in timber production and wildlife habitat. Natural disturbances, human impacts, management and restoration concerns for major North American forest regions will be addressed. Nonmajor graduate credit.

Biol 364. Invertebrate Biology. Cr. arr. F. *Prereq: Biol 212.* Emphasis on diversity, development, physiology and behavior of invertebrate organisms-the "spineless wonders" of the world. Laboratory involves hands-on study and investigation of living invertebrates.

Biol 365. Vertebrate Biology. (Cross-listed with A Ecl). (3-2) Cr. 4. F. *Prereq: 212, 212L.* Evolution, biology, and classification of fish, amphibians, reptiles, birds, and mammals. Emphasis on a comparative analysis of the structure and function of organ Systems. Laboratory exercises concentrate on morphology and identification of orders of vertebrates.

Biol 366. Plant Systematics. (2-4) Cr. 4. S. *Prereq: 211.* Introduction to plant phylogenetic systematics, plant classification, survey of flowering plant families, identification and field study of local plants.

Biol 371. Ecological Methods. (Cross-listed with A Ecl). (2-2) Cr. 3. F. *Prereq: 312; Stat 101 or 104.* Quantitative techniques used in management of natural resources with emphasis on inventory and manipulation of habitat and animal populations. Nonmajor graduate credit.

Biol 381. Environmental Systems I: Introduction to Environmental Systems. (Cross-listed with EnSci, Env S, Micro). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including Biology and chemistry.* Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

Biol 382. Environmental Systems II: Analysis of Environmental Systems. (Cross-listed with EnSci). (2-4) Cr. 4. S. *Prereq: EnSci 381.* Continuation of EnSci 381. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

Biol 393. North American Field Trips in Biology. Cr. arr. Repeatable. *Prereq: Two courses in the biological sciences and by approval of application.* Extended field trips, usually during break periods, to North American locations of interest to biologists. Inquire in the Biology Program Office, 103 Bessey Hall, for trip schedule.
A. Pre-trip Seminar. Cr. 1. Discussion of relevant biological and cultural topics during semester preceding trip.
B. Field trip. Cr. 1 to 3. Trip to North American location under supervision of faculty member. Report required.

Biol 394. International Field Trips in Biology. Cr. arr. Repeatable. *Prereq: Two courses in the biological sciences and by approval of application.* Extended field trips, usually during break periods, to international locations of interest to biologists. Inquire in the Biology Program Office, 103 Bessey Hall, for trip schedule.
A. Pre-trip Seminar. Cr. 1. Discussion of relevant biological and cultural topics during semester preceding trip.
B. Field trip. Cr. 1 to 3. Trip to international location under supervision of faculty member. Report required. Offered on a satisfactory-fail grading basis only.

Biol 423. Developmental Biology. (3-0) Cr. 3. S. *Prereq: Biol 313.* Principles of embryogenesis and animal development. Establishment of body axes, organ and limb development, and specification of cell fates. Emphasis on cell signaling and the control of gene expression within the context of a developing organism. Medically relevant subjects will be discussed, including stem cells, cancer biology, fertilization, and cloning.

Biol 423L. Developmental Biology Laboratory. (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 423.* Experiments and explorations illustrating fundamental principles of multicellular development.

Biol 428. Topics in Cell Biology. (3-0) Cr. 3. S. *Prereq: 314.* Selected topics on biological organization and function at the cellular level. Emphasis on biomembranes. Nonmajor graduate credit.

Biol 434. General Comparative Endocrinology. Cr. arr. S. *Prereq: 314.* Dual-listed with EEOB 534. Chemical integration of vertebrate organisms. The structure, development, and evolution of the endocrine glands and the function and structure of their hormones. Laboratory techniques for studying hormonal phenomena. Nonmajor graduate credit.

Biol 436. Neurobiology. (3-0) Cr. arr. F. *Prereq: Biol 335 or Psych 310; physics recommended; permission of instructor to enroll in lab.* (3-3) for 4 cr. Integration, coding, plasticity, and development in nervous systems. Nonmajor graduate credit.

Biol 436L. Neurobiology Laboratory. (0-3) Cr. 1. F. Prereq: Credit or enrollment in 436; permission of instructor to enroll in lab. Laboratory experimentation and demonstrations on integration, coding plasticity, and development in nervous systems. Nonmajor graduate credit.

Biol 439. Environmental Physiology. Cr. arr. Alt. S., offered 2010. *Prereq: 355 or A Ecl 311; physics recommended.* Dual-listed with EEOB 539. Physiological adaptations to the environment with an emphasis on vertebrates. Nonmajor graduate credit.

Biol 444. Introduction to Bioinformatics. (Cross-listed with BCB, Com S, Cpr E, Gen). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics. Nonmajor graduate credit.

Biol 454. Plant Anatomy. (3-3) Cr. 4. F. *Prereq: Biol 212L; 366 recommended.* Characteristics of cell and tissue types in vascular plants. Anatomy of developing and mature stems, roots, and leaves, including secondary (woody) growth. Introduction to the special anatomy of flowers and seeds. Nonmajor graduate credit.

Biol 455. Bryophyte and Lichen Biodiversity. (Dual-listed with EEOB.) Cr. 3. *Prereq: Biol 212, Biol 212L.* Introduction to the biology and ecology of mosses, liverworts, and lichens. Emphasis on identification and diversity of local representatives of these three groups of organisms. Required field trips and service-learning. Nonmajor graduate credit.

Biol 456. Principles of Mycology. (Cross-listed with Micro). (2-3) Cr. 3. F. *Prereq: 10 credits in biological sciences.* Morphology, diversity and ecology of fungi; their relation to agriculture and industry and human health. Nonmajor graduate credit.

Biol 457. Herpetology. (Cross-listed with A Ecl). (2-3) Cr. 3. F. *Prereq: A Ecl 365 or Biol 351.* Dual-listed with EEOB 557. Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodilians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

Biol 458. Ornithology. (Cross-listed with A Ecl). (2-3) Cr. 3. S. *Prereq: A Ecl 365 or Biol 351.* Dual-listed with EEOB 558. Biology, ecology, evolution, and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation. Laboratory exercises complement lecture topics, emphasize identification and distribution of Midwest birds, and include field trips.

Biol 459. Mammalogy. (Cross-listed with A Ecl). (2-3) Cr. 3. S. *Prereq: 351 or A Ecl 365.* Dual-listed with EEOB 559. Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. Laboratory focus on identification, distribution, habits, and habitats of mammals.

Biol 462. Evolutionary Genetics. (Cross-listed with Gen). (3-0) Cr. 3. S. *Prereq: Biol 315.* The genetic basis of evolutionary processes in higher organisms. The role of genetic variation in adaptation, natural selection, adaptive processes, and the influence of random processes on evolutionary change. Nonmajor graduate credit.

Biol 465. Morphometric Analysis. (3-2) Cr. 4. Alt. S., offered 2010. *Prereq: Stat 401.* Dual-listed with EEOB 565. A comprehensive overview of the theory and methods for the analysis of biological shape with emphasis on data acquisition, standardization, statistical analysis, and visualization of results. Methods for both landmark and outline data will be discussed. Nonmajor graduate credit.

Biol 471. Introductory Conservation Biology. (3-0) Cr. 3. Prereq: Biol 312. Examination of conservation issues from a population and community perspective. The role of genetics, demography, and environment in determining population viability, habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology.

Biol 472. Community Ecology. (2-2) Cr. 3. S. *Prereq: Biol 312.* The effect of interspecific interactions on the structure and dynamics of natural and managed communities; including concepts of guild structure and trophic web dynamics and their importance to the productivity, diversity, stability, and sustainability of communities. The implications of interspecifc interactions in the management of wild species will be emphasized with illustrative case histories of interactions between plants, invertebrates, and vertebrates. Nonmajor graduate credit.

Biol 474. Plant Ecology. (3-0) Cr. 3. S. *Prereq: Biol 312.* Principles of plant population and community ecology. Nonmajor graduate credit.

Biol 476. Functional Ecology. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312.* Dual-listed with EEOB 576. The nature of adaptations to physical and biotic environments. Biophysical, biomechanical, and physiological bases of the structure, form, growth, distribution, and abundance of organisms.

Biol 480. Studies in Marine Biology. Cr. arr. Repeatable. Courses taken at Gulf Coast Research Laboratory and other marine biological Stations are transferred to Iowa State University under this number.

Biol 481. Summer Field Studies. Cr. arr. Repeatable. Courses taken at summer biological field Stations are transferred to Iowa State University under this number. See www.biology.iastate.edu for links to field Stations located in different biomes: coastal, Great Lakes, taiga, deciduous forests, deserts, Rocky Mountains.

Biol 482. Tropical Biology. Cr. arr. Repeatable. *Prereq: One year of college biology; knowledge of Spanish desirable but not required.* Students registering for courses taught by the Organization for Tropical Studies will receive credit for this ISU course when requesting a transfer of credits.

Biol 484. Ecosystem Ecology. (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: Combined 12 credits in biology and chemistry.* Introduction of the study of ecosystems and the factors that influence their properties and dynamics. Conceptual foundations for ecosystem studies. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems.

Biol 486. Aquatic Ecology. (Cross-listed with EnSci, A Ecl). (3-0) Cr. 3. F. *Prereq: Biol 312 or EnSci 381 or EnSci 402 or NREM 301.* Dual-listed with EEOB 586. Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology. Nonmajor graduate credit.

Biol 486L. Aquatic Ecology Laboratory. (Cross-listed with A Ecl, EnSci). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in 486.* Dual-listed with EEOB 586L. Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts. Nonmajor graduate credit.

Biol 487. Microbial Ecology. (Cross-listed with EnSci, Micro). (3-0) Cr. 3. F. *Prereq: Six credits in biology and 6 credits in chemistry.* Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems. Nonmajor graduate credit.

Biol 488. Identification of Aquatic Organisms. (0-3) Cr. 1. F.S. On line taxonomic and identification exercises to accompany 486. Instruction and practice in the identification of algae, aquatic macrophytes, zooplankton, and benthos. Nonmajor graduate credit.

Biol 489. Population Ecology. (2-2) Cr. 3. F. *Prereq: Biol 312, Stat 101 or 104, a course in calculus, or graduate standing.* Dual-listed with EEOB 589. Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

Biol 490. Independent Study. Cr. arr. Repeatable. *Prereq: 8 credits in biology and permission of instructor.* Research opportunities for undergraduate students in the biological sciences. No more than 9 credits in Biol 490 may be counted toward graduation and of those, only 6 credits may be applied to the major.
I. Iowa Lakeside Laboratory. (Same as Ia LL 490I) Cr. 1 to 4 each time taken. See Iowa Lakeside Laboratory.
R. Biological research. Cr. 1 to 6 each time taken. For students registering to work on an independent research project under the direction of a faculty member.

Biol 491. Laboratory Teaching Experience. Cr. arr. Repeatable. *Prereq: Permission of supervising staff. For students* registering to be undergraduate laboratory assistants. Satisfactory-fail only.

Biol 494. Biology Internship. Cr. arr. Repeatable. *Prereq: 8 credits in biology and permission of instructor.* Intended to provide credit for significant professional experiences in biological sciences. A written proposal is required prior to registration. Intended for Biology majors.

Biol 495. Undergraduate Seminar. Cr. arr. Repeatable. F.S. *Prereq: 15 credits in biological science; permission of instructor.* Content varies from year to year and may include detailed discussion of special topics in biology, current issues in biology, or careers in biology.

Biol 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Junior classification and permission of the department cooperative education coordinator.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Biomedical Sciences

James Bloedel, Chair of Department

Distinguished Professors: Anderson, Kanthasamy

Distinguished Professors (Emeritus): Christensen, Dellmann

University Professor: Draper

University Professors (Emeritus): Adams, Reece

Professors: Bloedel, Evans, Franke, Goff, Hsu, King, Lin, Martin, Nara, Riedesel, Sharp, Uemura, Ware

Professors (Emeritus): Ahrens, Bal, Carithers, Dyer, Engen, Ghoshal, Randic

Associate Professors: Bracha, Carlson, Day, Jeftinija, Millman, Sakaguchi, Singh

Associate Professors (Emeritus): Crump, Martin

Associate Professors (Collaborators): Hamouche, Kangas, Richt

Assistant Professors: M. Greenlee, Kanthasamy, Kimber, Palic, Rowe

Assistant Professor (Adjunct): Singh

Assistant Professors (Collaborators): Barton, J. Greenlee, Kesl, Kwon

Senior Lecturer: Bolser

Lecturer: Kibbel

Professional Program of Study

For professional curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see Veterinary Medicine, Curriculum.

A good foundation in anatomy, physiology, and pharmacology of animals is necessary to understand the mechanisms of animal disease processes and their treatment. Study of mammalian anatomy and physiology prepares students with a background in the structural and functional activities of cells, tissues, organs, and body systems relevant to veterinary medicine.

An understanding of drug action is essential for rational drug therapy. The general pharmacology courses provide students with a background in basic pharmacology to include pharmacodynamics, toxicology, and the clinical application of drugs. Special emphasis is placed on chemical agents and therapeutic practices specific to veterinary medicine.

Graduate Programs

The department offers Master of Science and Doctor of Philosophy degrees with a major in Biomedical Sciences and specializations in Anatomy, Physiology, Pharmacology, and Cell Biology. Up to 10 credits of dual-listed veterinary courses may be applied for major graduate credit. Departmental research facilities allow for training in experimental anatomy, pharmacology, and physiology. Graduate studies are supervised by faculty members recognized in their areas of expertise. Current areas of research include: Alzheimer's disease, aquatic animal health, calcium and mineral homeostasis, diabetes mellitus, glia-neuron signaling, neurophysiology of pain, neurotoxicology, physiology and pharmacology of nematode ion-channels, Parkinson's disease, pharmacology of schistosomiasis, pharmacology of salmonellosis, physiology and pharmacology of thalamic neurons, physiology of the retina, Spinal Muscular Atrophy, and study of neural stem cells. The objective of the department is to prepare graduate students for successful careers in biomedical research and professional service. The department is part of interdepartmental programs in neuroscience, toxicology, and molecular, cellular, and developmental biology. The combined Ph.D./DVM program is an option offered by the department.

Courses primarily for undergraduate students

B M S 329. Anatomy and Physiology of Domestic Animals. (3-0) Cr. 3. S. *Prereq: Biol 212, 212L.* Survey of body systems of domestic animals. Provides a medical science orientation particularly useful to students in a preveterinary medicine curriculum.

Courses primarily for professional curriculum students

B M S 330. Principles of Morphology I. (Dual-listed with 530). (3-6) Cr. 5. F. *Prereq: First-year classification in veterinary medicine.* Anatomy of the dog.

B M S 331. Principles of Morphology II. (Dual-listed with 531). (2-6) Cr. 4. S. *Prereq: First-year classification in veterinary medicine.* Comparative and topographic anatomy of horse, ruminants, pig, and chicken.

B M S 333. Biomedical Sciences I. (5-3) Cr. 6. F. *Prereq: First-year classification in veterinary medicine.* Microscopic anatomy and physiology of cells, tissues, cardiovascular system, respiratory system, and urinary system.

B M S 334. Biomedical Sciences II. (5-3) Cr. 6. S. *Prereq: First-year classification in veterinary medicine.* Microscopic anatomy of the immune system and integument. Microscopic anatomy and physiology of the digestive system, endocrine system, and reproductive system.

B M S 337. Neuroanatomy. (Dual-listed with 537). (2-2) Cr. 3. S. *Prereq: First-year classification in veterinary medicine.* Neuroanatomy of domestic animals.

B M S 339. Clinical Foundations I. (Cross-listed with V C S). (0-2) Cr. 1. F. *Prereq: First-year classification in veterinary medicine.* Canine physical examination; basic behavior, animal handling and restraint; medical record keeping.

B M S 345. Case Study I. (0-2) Cr. 1. F. *Prereq: First-year classification in veterinary medicine.* Clinical applications of basic sciences taught concurrently in the fall semester of the first year curriculum in veterinary medicine.

B M S 346. Case Study II. (0-1) Cr. 1. S. *Prereq: First-year classification in veterinary medicine.* Clinical applications of basic sciences taught concurrently in the spring semester of the first year curriculum in veterinary medicine.

B M S 354. General Pharmacology. (Dual-listed with 554). (3-0) Cr. 3. S. *Prereq: 333, 334.* General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems. Nonmajor graduate credit.

B M S 355. Topics in Molecular Veterinary Medicine. (Dual-listed with 555). (1-0) Cr. 1. S. *Prereq: Enrollment in or completion of 354..* Receptor and signal transduction anomalies and their diagnosis in veterinary medicine.

B M S 401. Intro to Aquatic Animal Medicine. (Cross-listed with A Ecl). (1-2) Cr. 1. S. 8 week course. Introductory course with focus on fin fish production, health and medicine. Course content will help define future roles for veterinarians, producers, and service providers. Emphasis will be placed on anatomy, pathology, infectious diseases, nutrition, regulatory constraints in production, food safety, and current research. Field trip to aquaculture facility.

B M S 403. Behavior of Domestic Animals. (1-0) Cr. 1. Alt. S., offered 2010. *Prereq: Classification in veterinary medicine.* Normal and abnormal behavior of domestic animals.

B M S 415. Anatomy of Laboratory Animals. (Dual-listed with 515). (1-2) Cr. 2. Alt. S., offered 2010. *Prereq: One year of college biology.* Gross and microscopic anatomy of laboratory animals.

B M S 416. Avian Anatomy. (Dual-listed with 516). (1-2) Cr. 2. Alt. S., offered 2011. *Prereq: One year college biology.* Gross and microscopic anatomy of domestic, exotic, and pet birds.

B M S 421. Special and Applied Anatomy of the Horse. (1-3) Cr. 2. F. *Prereq: 330 or 331 or An S 316 or 415, classification in veterinary medicine.* Special and applied anatomy of the horse. Nonmajor graduate credit.

B M S 443. Pharmacology and Therapeutics. (Dual-listed with 543). (3-0) Cr. 3. F. *Prereq: 354.* Pharmacology and therapeutic uses of fluids, antimicrobial and antiparasitic drugs, clinical use of veterinary drugs, and adverse drug reactions.

B M S 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*
H. Honors

B M S 496. International Preceptorship. (0-40) Cr. arr. Repeatable. S. *Prereq: Second-year classification in veterinary medicine.* International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduate students

B M S 501. Selected Research Methods in Biomedical Sciences. (0-8) Cr. 3. F.S.SS. *Prereq: Graduate classification, permission of a BMS faculty member.* Experience in biomedical techniques in selected BMS laboratories that include but is not limited to cytochemical methods, molecular biological techniques, extracellular and intracellular unit recording, microiontophoresis, microinjection, spectrophoto-fluorometric analysis of chemicals, use of radioisotopes, radioimmunoassay, Ca2+ imaging, confocal microscopy, fluorescence microscopy, and immunocytochemistry.

B M S 515. Anatomy of Laboratory Animals. (Dual-listed with 415). (1-2) Cr. 2. Alt. S., offered 2010. *Prereq: One year of college biology and graduate classification..* Gross and microscopic anatomy of laboratory animals.

B M S 516. Avian Anatomy. (Dual-listed with 416). (1-2) Cr. 2. Alt. S., offered 2011. *Prereq: One year college biology.* Gross and microscopic anatomy of domestic, exotic, and pet birds.

B M S 530. Principles of Morphology I. (Dual-listed with 330). (3-6) Cr. 5. F. *Prereq: 10 credits in biological science and permission of the instructor.* Anatomy of the dog.

B M S 531. Principles of Morphology II. (Dual-listed with 331). (2-6) Cr. 4. S. *Prereq: B M S 530.* Comparative and topographic anatomy of horse, ruminants, pig, and chicken.

B M S 537. Neuroanatomy. (Dual-listed with 337). (2-2) Cr. 3. S. *Prereq: 10 credits in biological science and permission of the instructor.* Neuroanatomy of domestic animals.

B M S 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BBMB, BCB, FS HN, Hort, NutrS, VDPAM, EEOB, NREM, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

B M S 543. Pharmacology and Therapeutics. (Dual-listed with 443). (3-0) Cr. 3. F. *Prereq: 554.* Pharmacology and therapeutic uses of fluids, antimicrobial and antiparasitic drugs, clinical use of veterinary drugs, and adverse drug reactions.

B M S 549. Advanced Vertebrate Physiology I. (Cross-listed with An S, Kin). (3-0) Cr. 3. F. *Prereq: Biol 335, credit or enrollment in BBMB 404 or 420.* Neurophysiology, sensory systems, muscle, neuroendocrinology, and endocrinology.

B M S 552. Advanced Vertebrate Physiology II. (Cross-listed with An S, Kin, NutrS). (3-0) Cr. 3. S. *Prereq: Biol 335, credit or enrollment in BBMB 404 or 420.* Cardiovascular, renal, respiratory, and digestive physiology.

B M S 554. General Pharmacology. (Dual-listed with 354). (Cross-listed with Tox). (3-0) Cr. 3. S. *Prereq: 549 and 552; BBMB 404, 405.* General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems.

B M S 555. Topics in Molecular Veterinary Medicine. (Dual-listed with 355). (1-0) Cr. 1. S. *Prereq: Enrollment in or completion of 554 and graduate classification.* Receptor and signal transduction anomalies and their diagnosis in veterinary medicine.

B M S 556. Cellular, Molecular and Developmental Neuroscience. (Cross-listed with GDCB, Neuro). Cr. arr. F. *Prereq: Biol 335 or Biol 436; physics recommended.* Fundamental principles of neuroscience including cellular and molecular neuroscience, nervous system development, sensory, motor and regulatory systems.

B M S 575. Cell Biology. (Cross-listed with Tox). (3-0) Cr. 3. F. *Prereq: 10 credits in biological science and permission of instructor.* A multi-instructor course covering major topics in cell structure and function, including: universal features of prokaryotic and eukaryotic cells, types of utilization and conversion of energy, genetic control of cell shape and functionality, internal organization of cells, communication between cells and their environment, development of multicellular systems. Students have to write a term paper.

B M S 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*
A. Anatomy
B. Physiology
C. Pharmacology
D. Cell biology

B M S 599. Creative Component. Cr. arr. F.S.SS. *Prereq: Enrollment in BMS graduate program, and permission of instructor..* Creative component for non-thesis Master of Science degree.

Courses for graduate students

B M S 688. Research Review. Cr. 1. Repeatable. F.S. *Prereq: Enrollment in BMS graduate program.* A forum for B M S students to gain experience in the critical exchange of ideas through oral presentation and discussion of scientific information.

B M S 690. Advanced Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*
A. Anatomy
B. Physiology
C. Pharmacology
D. Cell biology

B M S 698. Seminar. Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in BMS graduate program..*
A. Cr. R each time taken. F.
S. Attendance required. B. Cr. 1 each time taken. F.S.S
S. Attendance and presentation required. Offered on a satisfactory-fail grading basis only.

B M S 699. Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in BMS graduate program..*
A. Anatomy
B. Physiology
C. Pharmacology
D. Cell biology

Biorenewable Resources and Technology

www.biorenew.iastate.edu

(Interdepartmental Graduate Program)

D. R. Raman, Chair

Program Coordinating Committee: R. Anex, R.C. Brown, L. Johnson, G. Kraus, M. Liebman, B. Nikolau, B. Shanks

Over 60 Iowa State University faculty members from 16 academic departments and five colleges are affiliated with the Biorenewable Resources and Technology (BRT) graduate program; a complete and up-to-date listing is maintained at: www.biorenew.iastate.edu.

Graduate Study

The graduate program in Biorenewable Resources and Technology (BRT) offers students advanced study in the use of plant and crop-based resources in the production of biobased products (fuels, chemicals, materials, and energy). The BRT program was the first graduate program in biorenewable resources established in the United States. This multi-disciplinary program offers the degrees of master of science and doctor of philosophy in Biorenewable Resources and Technology, and a minor to students taking major work in other departments. The curriculum is designed to encourage students to obtain co-major degrees in Biorenewable Resources and Technology and a more traditional science or engineering discipline. A thesis is required for the master of science degree.

Prerequisite to major graduate work is a bachelor's degree or prior graduate training in engineering or a physical or biological discipline, including agricultural sciences.

The core required courses in the Biorenewable Resources and Technology graduate program include: a foundation course entitled BRT 501 "Fundamentals of Biorenewable Resources", BRT 506 "Biobased Products Seminar", BRT 590 "Special Topics", and BRT 591L "Biorenewable Resources Laboratory". The elective core courses must come from an approved list of courses from a variety of traditional disciplines encompassing one or more of four areas crucial to the development of biobased products: plant science, production, processing, and utilization. Students must complete elective core courses from at least three of the four topical areas, selected in consultation with the student's Program of Study (POS) committee

Graduates of the program will be equipped with skills to develop and manage cost effective and environmentally attractive technologies for producing fuels, chemicals, materials, foods and energy from renewable plant biomass.

Information on application procedures and specific requirements of the major can be obtained from the following Internet address: www.biorenew.iastate.edu

Courses primarily for graduate students, open to qualified undergraduate students

BRT 501. Fundamentals of Biorenewable Resources. (3-0) Cr. 3. S. *Prereq: Undergraduate training in an engineering or physical or biological discipline or degrees in agriculture or economics.* Introduction to the science and engineering of converting biorenewable resources into bioenergy and biobased products. Survey of biorenewable resource base and properties; description of biobased products; methods of biorenewable resource production; processing technologies for fuels, chemicals, materials, and energy; environmental impacts; economics of biobased products and bioenergy.

BRT 506. Biobased Products Seminar. Cr. arr. F.S. *Prereq: Undergraduate training in an engineering or physical or biological discipline or degrees in agriculture or economics.* Taken one semester for 1 credit and remaining semesters as R credit. Seminars and discussion on current topics in biorenewable resources and technology. Satisfactory-fail only.
A. Cr. 1. Paper required.
B. Cr.
R. Attendance only.

BRT 511. Bioprocessing and Bioproducts. (Cross-listed with A E, BSE, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 101 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofules, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis. Term paper for graduate level only.

BRT 535. Thermochemical Processing of Biomass. (Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: Undergraduate course work in thermodynamics and transport phenomena.* Introduction to thermal and catalytic processes for the conversion of biomass to biofuels and other biobased products. Topics include gasification, fast pyrolysis, hydrothermal processing, syngas to synfuels, and bio-oil upgrading. Application of thermodynamics, heat transfer, and fluid dynamics to bioenergy and biofuels.

BRT 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Investigation of an approved topic on an individual basis. Course content and requirements to be designed and developed in consultation with the student's major professor or instructor, but in all cases a formal report should be written.

BRT 591L. Biorenewable Resources Laboratory. (0-3) Cr. 1. Repeatable. F.S.SS. *Prereq: Permission of student's major professor and instructor.* Special topics laboratory and research experience in biorenewable resources and technology that affords an experience beyond thesis-focused research. To be designed in consultation with the student's major professor and instructor. A laboratory report is required. For student in the BRT program, BRT 591L may be taken twice. For student in the BRT program, BRT 591L may be taken twice.

Courses for graduate students

BRT 699. Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of student's major professor.*

Botany

www.eeob.iastate.edu

Interdepartmental Graduate Major

Robert S. Wallace, Director of Graduate Education

Participating Faculty: D. Bassham, L. Clark, J. Colbert, W. Crumpton, D. Farrar (Emeritus), H. Horner, T. Jurik, K. Moloney, J. Nason, D. Oliver, J. Pritchard (Adjunct), J. Raich, S. Rodermel, L. Tiffany (Emeritus), M. Spalding, A. van der Valk, R. Wallace, J. Wendel, B. Wilsey, E. Wurtele

Undergraduate Study

Students wishing to pursue an undergraduate degree in the basic plant sciences are encouraged to investigate the numerous possibilities available to them at Iowa State University. The undergraduate Biology Program, jointly administered by faculties of the departments of Ecology, Evolution, and Organismal Biology (EEOB) and Genetics, Cell and Developmental Biology (GDCB), includes a wide spectrum of opportunities for students to develop their academic interests through the study of plant biology. Students can major in Biology in the College of Liberal Arts and Sciences or in the College of Agriculture. Contact the Biology Student Services office in 103 Bessey Hall for general information about the Biology Program. For those students interested in applied plant sciences, undergraduate majors in Agronomy, Horticulture, and Forestry are also available through the College of Agriculture.

Graduate Study

The Botany Graduate Program offers work for the degrees Master of Science and Doctor of Philosophy with a graduate major in Botany, and minor work for students majoring in other departments or graduate programs. Within the Botany Graduate Major, one of the following areas of specialization may be designated: aquatic and wetland ecology, cytology, ecology, morphology, mycology, physiology and molecular biology, or systematics and evolution. Relevant graduate courses that may be counted toward completion of these degrees are offered by the Departments of EEOB and GDCB, and by other departments and programs. The specific requirements for each student's course distribution and research activities are set by the Program of Study Committee established for each student individually, and must satisfy all requirements of the Graduate College (See *Index*). GRE (and if necessary, TOEFL) scores are required of all applicants; students are encouraged to contact faculty prior to application.

Related interdepartmental graduate majors in Ecology and Evolutionary Biology (EEOB); Environmental Science (EnSci); Genetics (IG); Molecular, Cellular and Developmental Biology (MCDB); Plant Physiology (IPPM); and Toxicology should also be investigated as possible graduate programs with specific disciplinary focus.

At present, the Botany Graduate Program is under review and may change Status in the near future. Before applying for admission to the Botany Graduate Major, prospective students should contact the Botany Graduate Program Director of Graduate Education Dr. Robert Wallace (rwallace@iastate.edu) for specific details about the program's Status and application procedures.

Business Administration

Labh S. Hira, Dean

Undergraduate Study

Kay M. Palan, Professor in charge, Undergraduate Programs in Business.

For undergraduate curriculum leading to the degree bachelor of science, majors in accounting, business economics, finance, management, management information systems, marketing, operations and supply chain management, logistics and supply chain management and a secondary major in international business, see College of Business, Curricula.

The department of Business Administration supports the undergraduate programs in the departments of Accounting, Finance, Logistics, Operations, and Management Information Systems, Management, and Marketing by providing specialized coursework in orientation to business, and cooperative education opportunities.

Graduate Study

Michael Crum, Professor in Charge, Graduate Programs in Business

The College of Business offers work towards two graduate programs in business administration: the master of business administration (MBA) and the master of science in business (M.S.), which are described below. The college also has two specialized master degree programs: the master of accounting (M.Acc.), which is described under the Department of Accounting and the master of science in information systems (M.S.I.S.) which is described under Management Information Systems. The college also offers a Ph.D. in business and technology, with specialization in customer management, supply chain management, and management of information technology. Finally, the College of Business is a participating member of the following interdepartmental programs: master of science in transportation, master of science in seed technology and business, master of science and Ph.D. in human computer interaction, and master of science in information assurance.

Master of Business Administration (M.B.A.)

The College of Business offers a 48 credit program leading to a nonthesis master of business administration degree with a specialization in accounting, agribusiness, family financial planning, finance, information systems, international business, marketing, or supply chain management. The coursework is designed to provide the knowledge, skills, and abilities for managerial success and leadership in organizations. The M.B.A. is the professional management education program for those pursuing careers in business.

Students working toward the M.B.A. are required to complete a series of core courses in the basic functional areas of business (accounting, economics, statistics, finance, supply chain management, organizational behavior, management information systems, marketing, international business, ethics and social responsibility, strategic management), and advanced elective coursework.

Courses for the M.B.A. are provided by the departments of Accounting, Economics, Finance, Logistics, Operations and Management Information Systems, Management, Marketing, and Statistics. Courses from other departments may also be chosen to meet specific student interests.

A concurrent B.S./M.B.A. is available to eligible engineering undergraduate students majoring in civil, computer, electrical, industrial, or mechanical engineering. The College of Business and the College of Veterinary Medicine offer a concurrent M.B.A./D.V.M. degree.

Double master's degree programs are offered with architecture (M.Arch./M.B.A.), community and regional planning (M.B.A./ M.C.R.P.), information systems (M.B.A./M.S.I.S.) and Statistics (M.B.A./ M.S.-Statistics).

Students may enroll in the M.B.A. on either a full-time or part-time basis. The part-time M.B.A. is designed for employed professionals. Part-time MBA classes are held in the evenings in Ames and Des Moines.

The M.B.A. program is open to all individuals with a baccalaureate degree. Undergraduates from liberal arts, science, and technical programs are especially encouraged to apply. Academic potential and promise for a productive career in business and for managerial success and leadership in organizations are important criteria for admission. Applicants must submit Graduate Management Admission Test (GMAT) scores, official transcripts of previous academic work, personal essays, a resume, and three letters of reference. International students whose native language is not English and who did not graduate from a U.S. college or university are required to submit the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS) scores.

Applicants are considered for fall semester entry only into the full-time M.B.A. Although applications will be considered after this date, candidates are encouraged to submit their application materials by June 1 (March 1 for international students). Part-time M.B.A. applications are considered for fall, spring, or summer entry.

Master of Science (M.S.) in Business

The College of Business offers graduate work leading to the master of science degree with a major in business. All the departments in the college, (Accounting, Finance, Logistics, Operations and Management Information Systems, Management, and Marketing), and the departments of Economics and Statistics cooperate in providing coursework toward this degree. The program is designed to serve those students who desire specialized study of an area within business at the master's level. It also serves to develop their research capabilities.

The M.S. degree is best suited for students with degrees or academic backgrounds in business as they may complete the program within the 30 credit minimum. Students without business backgrounds are required to fulfill pre-requisites and common body of knowledge coursework in accounting, finance, management information systems, marketing, organizational behavior, supply chain management, global business, business ethics, and strategy. The program is composed of 7 credits of required courses in economics and Statistics plus 3 to 6 credits of thesis and 17 to 20 credits of coursework in an area of emphasis. The student, with the help of a program of study committee, designs an educational program in specialized functional or industry areas within business.

Application deadline for the M.S. program is May 1 for fall admission and November 1 for spring admission. Applicants must submit official transcripts of previous educational coursework and degrees, the Graduate Management Admission Test (GMAT) scores, personal essays, resume, and three letters of reference. International students whose native language is not English and who did not graduate from a U.S. college or university are required to submit the Test of English as a Foreign Language (TOEFL) scores.

Ph.D. in Business and Technology

The College of Business offers graduate work leading to the doctor of philosophy degree in business and technology, with one of three specializations—customer management (CM), supply chain management (SCM), or management of information technology (MIT). Many departments in the college (Logistics, Operations, Management Information Systems, marketing and Management), and the departments of Statistics, Economics, Psychology and Sociology cooperate in providing coursework toward this degree. The program will prepare individuals for academic careers in research, teaching, and public service at institutions of higher learning in the United States and other countries. The PhD program consists of a 44-credit course curriculum followed by a 12-credit thesis or dissertation.

Students do not need to have an undergraduate or master's degree in business in order to qualify for enrollment in the PhD program. However, students without a graduate degree in business will be required to complete 18 hours of business foundation requirements. These include:

- Financial and managerial accounting (min. 2 Cr)
- Corporate finance (min. 2 Cr)
- Strategic management (min. 2 Cr)
- Management information systems (min. 2 Cr)
- Marketing (min. 2 Cr)
- Supply chain management (min. 2 Cr)
- Economics – micro and macro (min. 6 Cr)

Students can choose one of three areas of specialization—CM, SCM or MIT. The customer management (CM) area will focus on identification and delivery of solutions that help improve the ways in which businesses attract, capture, service and maintain customers. To do these activities well, organizations will need to integrate process goals and activities across different functional areas and across multiple organizational partners. This area of study will examine issues relating to inter-functional and inter-organizational relationships and their management in pursuit of maximizing the lifetime value of a businesses' customer base.

The supply chain management (SCM) specialization will focus on the design, development, and control of business processes for conversion of inputs into outputs and distribution of those outputs. The traditional focus of SCM was on integration of processes across multiple functions within the firm—operations management, logistics, and purchasing primarily, with elements of marketing and information systems included as well. However, in today's world, where competition is across supply chain networks, SCM, just like CM, will involve integrating business processes across firms.

The management of information technology (MIT) specialization examines issues related to the development, building, management, and use of information and knowledge-based technologies. Such technologies enable users to collect organizational data, provide a platform for organizing and disseminating the data, and offer operational, decision support, and knowledge management tools through which users can leverage data and information for making better organizational decisions. Students in the MIT specialization will study areas such as information technology analysis and development, database and knowledge management systems, decision support and data mining, human computer interaction, system security and integrity, and project management and collaborative teamwork.

Programs of study for the doctoral study are designed for each student in consultation with the major professor and the student's PhD committee. Each student must complete advanced courses in their area of specialization, a minor area that supports the major area, and research methods. Students must demonstrate competence in theory and research methods by passing qualifying examinations.

Application deadline for the Ph.D. program is February 1 for fall admission. Applicants must submit official transcripts of previous educational coursework and degrees, the Graduate Management Admission Test (GMAT) scores, personal essays, resume, and three letters of reference. International students whose native language is not English and who did not graduate from a U.S. college or university are required to submit TOEFL (Test of English as a Foreign Language) scores.

Courses primarily for undergraduate students

BusAd 101. Orientation. (1-0) Cr. 0.5. F.S. First 8 weeks. A required orientation for all College of Business students. Review of college and university requirements, transfer credits, academic planning, university policies and deadlines, and registration procedures. Includes group advising for course selection and registration. Either BusAd 101 or 102 may be counted towards graduation. Satisfactory-fail only.

BusAd 101H. Orientation. (1-0) Cr. 0.5. F. *Prereq: Membership in the Freshman Honors Program.* Designed to supplement the Freshman Honors orientation (Hon 121) with college specific information, to facilitate the development of Honors programs of study in business, and to acquaint students with university policies and procedures. Either BusAd 101 or 102 may be counted towards graduation. Satisfactory-fail only.

BusAd 102. Expanded Orientation. (1-0) Cr. 1. F.S. A required orientation for all College of Business Students involved with a Business Learning Team. Review of college and university requirements, transfer credits, academic planning, university policies and deadlines and registration procedures. Includes a consideration of various business majors and careers, tools for success in college including writing skills and presentations from employers, alumni and current students. Either BusAd 101 or 102 may be counted towards graduation. Satisfactory-fail only.

BusAd 150. Computer Competencies for Business. Cr. R. Students will demonstrate proficiency in MS Word, Excel, and PowerPoint, as well as the ability to conduct research using the Internet, use WebCT, and communicate via e-mail. Self-paced instruction available for students who are unable to demonstrate appropriate proficiency. Satisfactory-fail only.

BusAd 201. Career Issues in Business. (1-0) Cr. 0.5. F.S. *Prereq: 101.* Eight-week course designed to provide students with knowledge of careers in business and issues relevant to any workplace. Presentations by business professionals, current students who have previously interned, and faculty and staff with knowledge of careers in the various majors. Includes coverage of diversity and ethics issues in the workplace. Satisfactory-fail only.

BusAd 250. Introduction to Business. (3-0) Cr. 3. *Prereq: 101, 150 or Com S 103.* Introduction to the functional areas of business and how the functional areas are integrated for the purpose of implementing business strategy. Introduces students to decision making tools (spreadsheets and databases) that are integral to business decision making. Includes application exercises to all functional areas of business.

BusAd 291. Experiential Learning. Cr. arr. Repeatable. *Prereq: Written approval of supervising instructor and department chair on required form prior to the learning experience.* Supervised travel and/or work experience in a business related discipline. Satisfactory-fail only.
A. Domestic Internship.
B. International Internship.
C. Domestic Travel and Study.
D. International Travel and Study.

BusAd 292. Entrepreneurship & Innovation Learning Community (EILC) Seminar. (1-0) Cr. 1. *Prereq: Current member of or have applied to be a member of Entrepreneurship and Innovation Learning Community (see www.isupjcenter.org/ELC for more information).* Topics related to entrepreneurship and entrepreneurial thinking. Presentations by entrepreneurs and faculty, field trips, business concept development.

BusAd 301. Professional Employment Preparation. (1-0) Cr. 0.5. *Prereq: 201.* Eight-week course designed to provide students with the skills to develop and implement a professional job search and to function professionally in a workplace setting. Topics include resume and professional correspondence, interviewing, working a career fair, the comprehensive job search, evaluating offers, business etiquette, networking, and transitioning to employee. Satisfactory-fail only.

BusAd 325. Biorenewable Systems. (Cross-listed with A E, Agron, An S, Econ, TSM). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing.

BusAd 398. Cooperative Education. Cr. R. Repeatable. *Prereq: Permission of department.* Required of all cooperative students. Students must register for this course prior to commencing each work period. No more than three credits may be taken in addition to BusAd 398 during any given semester. Satisfactory-fail only.

BusAd 490. Independent Study. Cr. arr. Repeatable. *Prereq: 490A: Mgmt 414, Mkt 448, LSCM 466 or Fin 380; senior classification, permission of instructor; for 490H: Admission to the Business Honors Program.*
A. International Business
E. Entrepreneurship
H. Honors

BusAd 491. Professional Experiential Learning. Cr. arr. Repeatable. *Prereq: Professional program, 12 credits from College of Business; written approval of supervising instructor and department chair on required form prior to the learning experience.* Supervised travel and/or work experiences in a business related discipline. Satisfactory-fail only.
A. Domestic Internship.
B. International Internship.
C. Domestic Travel and Study.
D. International Travel and Study.
E. Other Experiential Learning Experience.

BusAd 492. The Washington Center Experience. Cr. arr. *Prereq: Professional program, written approval of supervising instructor and department chair on required form prior to the learning experience.* Participation in The Washington Center seminar/internship program. Includes seminars/forums, work experience, and a portfolio of experiences.

Courses primarily for graduate students, open to qualified undergraduate students

BusAd 501. Strategy and Planning. (2-0) Cr. 2. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Critical analysis of current practice and case studies in strategic management with an emphasis on integrative decision making. Strategy formulation and implementation will be investigated in the context of complex business environments.

BusAd 503. information Systems. (2-0) Cr. 2. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Introduction to a broad variety of information systems (IS) topics, including current and emerging developments in information technology (IT), IT strategy in the context of corporate strategy, and IS planning and development of enterprise architectures. Cases and discussions highlight the techniques and tactics used by managers to cope with strategic

issues within an increasingly technical competitive environment.

BusAd 504. Marketing and Logistics. (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Integration of the business functions concerned with the marketing and movement of goods along the supply chain with the primary goal of creating value for the ultimate customer. Coordination of marketing, production, and logistics activities within the firm and with outside suppliers and customers in the supply chain.

BusAd 507. Organizational Behavior. (2-0) Cr. 2. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Understanding human behavior in organizations, and the nature of organizations from a managerial perspective. Special emphasis on how individual differences, such as perceptions, personality, and motivation, influence individual and group behavior in organizations and on how behavior can be influenced by job design, leadership, groups, and the structure of organizations.

BusAd 508. Accounting and Finance. (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Survey of fundamental topics in accounting and finance. Financial statement reporting and analysis for agriculture firms, corporate governance issues related to financial reporting, (e.g., Sarbanes-Oxley). Basic tools and techniques used in financial management, including stock and bond valuation. How to assess and use capital budgeting methods to evaluate proposed firm investments.

BusAd 509. Seed Trade, Policy and Regulation. (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Cultural, financial, economic, political, legal/regulatory environments shaping an organization's international business strategy. Topics include entry (and repatriation) of people, firms, goods, services, and capital. Special attention to the institutions of seed regulation and policy. Ethical issues facing managers operating in an international context.

BusAd 533. Economic and Business Decision Tools. (Cross-listed with Econ). (3-0) Cr. 3. *Prereq: Econ 501 or Econ 532.* Team taught by faculty in the Department of Economics and the College of Business, this course focuses on applied economic and business tools for decision making. The topics covered include: Monte Carlo analysis with applications to option pricing and insurance mechanism design, portfolio analysis using existing standard spreadsheet software and add-ons, dynamic programming tools for inventory management and sequential decisions, discrete choice modeling and Statistical bootstrapping, and financial performance evaluation using commercially available software.

BusAd 591. Professional Experiential Learning. Cr. arr. Repeatable. *Prereq: Graduate standing; written approval of supervising instructor and department chair on required form prior to the learning experience.* Academically supervised travel and/or work experiences in a business related discipline.

BusAd 592. MBA Professional Skills Development. Cr. R. *Prereq: Admission to Full-time MBA Program.* Provides first-year MBA students with tools necessary to develop and implement a successful internship and career search, and to develop professional skills critical for success in the competitive business environment. Topics include career search strategy, resume and cover letter development, interviewing, strategic networking, salary negotiation, impression management, team skills development, presentation skills development, and business etiquette. Required for all full-time MBA students. Satisfactory-fail only.

BusAd 598. Cooperative Education. Cr. R. *Prereq: Permission of instructor.* Professional work experience. Students must register for this course prior to commencing work. Satisfactory-fail only.

BusAd 599. Creative Component. Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair.* Preparation and writing of creative component.
A. Accounting
C. Finance
E. Management
F. Marketing
H. Logistics and Supply Chain Management
I. Agribusiness
J. General Business
K. Management Information Systems
L. Operations and Supply Chain Management

Courses primarily for graduate students

BusAd 699. Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification, permission of major professor.* Research.

Chemical Engineering

(Administered by the Department of Chemical and Biological Engineering)

www.cbe.iastate.edu

James Hill, Chair of Department

Distinguished Professors: Brown, Reilly

Distinguished Professors (Emeritus): Burnet, Doraiswamy, Seagrave

University Professor: Hill

University Professor (Emeritus): Wheelock

Professors: Fox, Glatz, Hebert, Jolls, Kushner, Mallapragada, Narasimhan, Rollins, B. Shanks, J. Shanks

Professors (Emeritus): Abraham, Boylan, Schrader, Ulrichson, Youngquist

Professor (Collaborator): Porter

Associate Professors: Hillier, Olsen, Vigil

Associate Professor (Emeritus): Collins

Associate Professors (Adjunct): Hanneman

Assistant Professors: Clapp, Cochran, Dong, Jarboe, Lamm, O'Donnell, Schneider

Senior Lecturer: Loveland

Lecturer: Stiehl

Undergraduate Study

For undergraduate curriculum in chemical engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*. This curriculum is accredited by the Engineering Accreditation Commission of ABET.

Chemical engineering is a profession which provides a link between scientific knowledge and manufactured products. The chemical engineer relies on science, experience, creativity, and ingenuity to produce these materials economically. Almost everything of a material nature used by Society today has at some point felt the influence of the chemical engineer. From raw materials such as minerals, coal, petroleum, and agricultural products, chemical engineers create versatile intermediate and commodity chemicals, high performance fuels, new materials for construction, pharmaceuticals, high performance foodstuffs, synthetic textiles, plastics, solid state electronic components, and dozens of other engineered materials. The chemical engineer's influence has been important in the development of catalysts, fuel cells, automatic controls, biochemical processes, artificial kidneys, tissue engineering, nuclear energy, medical instruments and devices, as well as in the development of air and water pollution control systems. Many new and equally exciting challenges await the practicing chemical engineer of the future.

The profession of chemical engineering embraces a wide variety of activities including research, process development, product development, design, manufacturing supervision, technical sales, consulting, and teaching. The engineer can be behind a desk, in a laboratory, in a manufacturing plant, or engaged in nationwide and worldwide travel. Successful chemical engineers find chemistry, mathematics, and physics to be interesting and exciting. Many chemical engineers also have interest in the biological sciences. The curriculum in chemical engineering includes continued study of chemistry, mathematics, and physics as well as intensive study in the engineering sciences such as chemical reaction engineering, thermodynamics, mass transfer, fluid mechanics, heat transfer, system analysis and process synthesis, and design.

The curriculum in chemical engineering is designed to produce graduates that have the ability to apply knowledge of mathematics, science, and engineering; the ability to design, conduct and interpret experiments, and the ability to design a chemical engineering system, component, or process. Graduates should also have the ability to function on multi-disciplinary teams; the ability to identify, formulate, and solve chemical engineering problems; and the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The curriculum should also assure that graduates have the ability to communicate effectively, the broad education necessary to understand the impact of chemical engineering solutions in a global and Societal context, and recognition of the need for, and an ability to engage in life-long learning, as well as a knowledge of contemporary issues and an understanding of professional and ethical responsibility.

The curriculum assures that graduates have a thorough grounding in chemistry, along with a working knowledge of advanced chemistry such as organic, inorganic, physical, analytical, materials chemistry, or biochemistry. In addition, a working knowledge, including safety and environmental aspects, of material and energy balances applied to chemical processes; thermodynamics of physical and chemical equilibria; heat, mass, and momentum transfer; chemical reaction engineering; continuous and stage-wise separation operations; process dynamics and control; process design; and appropriate modern experimental and computing techniques is assured.

A significant number of chemical engineering graduates should have an ability to function as engineers in an international setting, and an ability to pursue research and advanced studies in chemical engineering, or in related fields such as medicine, law, and business.

A cooperative education program is available to students in chemical engineering. See *Cooperative Programs, College of Engineering.*

Graduate Study

The department offers work for the degrees master of science, master of engineering, and doctor of philosophy with major in chemical engineering, and minor work to students taking major work in other departments. Prerequisite to major graduate work is a bachelor's degree in chemical engineering, chemistry, or other related field. Students with undergraduate background other than chemical engineering should contact the department for further details. A thesis is required for the master of science degree. The master of science degree also requires a minimum of 30 graduate credits (minimum of 15 for coursework,

13 within Ch E and 2 outside). The master of engineering requirements are the same for credits and include a special project rather than research thesis. The doctor of philosophy degree requires a minimum of 72 graduate credits (minimum of 30 for coursework, 19 inside Ch E and a minimum of 8 credits taken outside of Ch E). Candidates for the doctor of philosophy degree can refer to the department's home page and/or the department's Graduate Student Handbook for degree options and credit requirements.

Courses primarily for undergraduate students

Ch E 104. Chemical Engineering Learning Community. Cr. R. F.S. *Prereq: Enrollment in Chemical Engineering Learning Team.* (1-0) Curriculum in career planning and academic course support for Freshmen learning team.

Ch E 204. Chemical Engineering Continuing Learning Community. Cr. R. F.S. *Prereq: Corequisite-enrollment in Chemical Engineering Learning Team.* (1-0) Curriculum and career planning, academic course support for learning community.

Ch E 210. Material and Energy Balances. (3-0) Cr. 3. F.S. *Prereq: Chem 178, Math 166.* Introduction to chemical processes. Physical behavior of gases, liquids, and solids. Application of material and energy balances to chemical engineering equipment and processes.

Ch E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

Ch E 302. Seminar. (1-0) Cr. 1. F. *Prereq: Junior classification in chemical engineering.*

Ch E 310. Computational Methods in Chemical Engineering. (3-0) Cr. 3. F.S. *Prereq: 210 and Engr 160.* Numerical methods for solving systems of linear and nonlinear equations, ordinary differential equations, numerical differentiation and integration, and nonlinear regression using chemical engineering examples. Nonmajor graduate credit.

Ch E 325. Chemical Engineering Laboratory I. (0-4) Cr. 2. F.S. *Prereq: 357, credit or enrollment in 381.* Experiments covering fundamental material and energy balances, momentum and energy transport operations, and thermodynamics. Computer applications. Nonmajor graduate credit.

Ch E 356. Transport Phenomena I. (3-0) Cr. 3. F.S. *Prereq: 210, Phys 221, credit or enrollment in Math 267.* Momentum and mechanical energy balances. Incompressible and compressible fluid flow. Applications to fluid drag, piping system design, filtration, packed beds and settling. Nonmajor graduate credit.

Ch E 357. Transport Phenomena II. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in 310; 356.* Conduction and diffusion, convective heat and mass transfer, boiling and condensation, radiation, and design of heat exchange equipment. Introduction to diffusion. Nonmajor graduate credit.

Ch E 358. Separations. (3-0) Cr. 3. F.S. *Prereq: 310, 357.* Diffusion and mass transfer in fluids. Analysis and design of continuous contacting and multistage separation processes. Binary and multicomponent distillation, absorption, extraction, evaporation, membrane processes, and simultaneous heat and mass transfer. Nonmajor graduate credit.

Ch E 381. Chemical Engineering Thermodynamics. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in 310; Math 267, Phys 222, Chem 325.* Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of fluids, phase equilibria, and chemical reaction equilibria. Nonmajor graduate credit.

Ch E 382. Chemical Reaction Engineering. (3-0) Cr. 3. F.S. *Prereq: Credit in 310; 381, credit or enrollment in 357.* Kinetics of chemical reactions. Design of homogeneous and heterogeneous chemical reactors. Nonmajor graduate credit.

Ch E 391. Foreign Study Orientation. Cr. arr. *Prereq: Credit or enrollment in 357 and 381 or permission of instructor.* Credit for graduation allowable only upon completion of Ch E 392. Satisfactory-fail only.
A. Foreign Study Orientation ISU (1-0) Cr. 1.
S. B. Foreign Study Orientation Europe Cr. 2. SS.

Ch E 392. Foreign Study Program. Cr. 4. SS. *Prereq: 391A, enrollment in 391B.* Study of chemical engineering including laboratories and lectures at University College London or other collaborating international universities. Comparative study of U.S. and international manufacturing facilities. Expenses required.

Ch E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period. Students must register for this course prior to commencing work.

Ch E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* One semester maximum per academic year professional work period. Students must register for this course prior to commencing work.

Ch E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

Ch E 406. Environmental Chemodynamics. (3-0) Cr. 3. F. *Prereq: 381, credit or enrollment in 358.* Examines the mechanisms and rates of chemical transport across air, water, and soil interfaces. Applications of transport and thermodynamic fundamentals to movement of chemicals in the environment. Nonmajor graduate credit.

Ch E 408. Surface and Colloid Chemistry. (Dual-listed with 508). (3-0) Cr. 3. F. *Prereq: 381 or equivalent.* Examines the factors underlying interfacial phenomena, with an emphasis on the thermodynamics of surfaces, structural aspects, and electrical phenomena. Application areas include emulsification, foaming, detergency, sedimentaton, fluidization, nucleation, wetting, adhesion, flotation, and electrophoresis. Nonmajor graduate credit.

Ch E 415. Biochemical Engineering. (Dual-listed with 515). (3-0) Cr. 3. S. *Prereq: 357, 382 recommended, Chem 331.* Application of basic chemical engineering principles in biochemical and biological process industries such as enzyme technology and fermentation. Nonmajor graduate credit.

Ch E 421. Process Control. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in 358, 382, Math 267.* Control of industrial chemical processes. Device applications and limitations. Dynamics of chemical process components and process control systems. Nonmajor graduate credit.

Ch E 426. Chemical Engineering Laboratory II. (0-4) Cr. 2. F.S. *Prereq: 325, 358, 382.* Experiments in heat and mass transfer, staged operations, chemical reactor performance, unit processes. Computer applications. Only one of Ch E 426 or 427 may count toward graduation. Nonmajor graduate credit.

Ch E 427. Biological Engineering Laboratory. (0-4) Cr. 2. S. *Prereq: Credit in 325, 358, 382 and BBMB 301.* Experiments on biological applications in chemical engineering. Only one of Ch E 426 or 427 may count toward graduation. Nonmajor graduate credit.

Ch E 430. Process and Plant Design. (2-6) Cr. 4. F.S. *Prereq: 358, 382.* Synthesis of chemical engineering processes, equipment and plants. Cost estimation and feasibility analysis. Nonmajor graduate credit.

Ch E 440. Biomedical Applications of Chemical Engineering. (Dual-listed with 540). (3-0) Cr. 3. *Prereq: 210, Math 266, Phys 222.* Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical engineering and applied physiology; survey of biomedical engineering; biomaterials; biomedical imaging. Nonmajor graduate credit.

Ch E 442. Polymers and Polymer Engineering. (Cross-listed with Mat E). (3-0) Cr. 3. S. *Prereq: 382 and Chem 331 or Mat E 351.* Chemistry of polymers, addition and condensation polymerization. Physical and mechanical properties, polymer rheology, production methods. Applications of polymers in the chemical industry. Nonmajor graduate credit.

Ch E 490. Independent Study. (0-18) Cr. arr. Repeatable. Introduction to research methods; investigation of an approved topic.
H. Honors

Ch E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Ch E 499. Undergraduate Research. (0-9) Cr. 3. Repeatable. *Prereq: Permission of department.* Research in chosen area of chemical engineering, with final written report. Students are encouraged to elect this course for two consecutive semesters. For students majoring in chemical engineering. No more than 6 credits of Ch E 499 may be counted toward graduation.

Courses primarily for graduate students, open to qualified undergraduate students

Ch E 508. Surface and Colloid Chemistry. (Dual-listed with 408). (3-0) Cr. 3. F. Examines the factors underlying interfacial phenomena, with an emphasis on the thermodynamics of surfaces, structural aspects, and electrical phenomena. Application areas include emulsification, foaming, detergency, sedimentation, fluidization, nucleation, wetting, adhesion, flotation, and electrophoresis. Term project required for graduate credit.

Ch E 515. Biochemical Engineering. (Dual-listed with 415). (3-0) Cr. 3. S. *Prereq: 357, 382, Chem 331.* Application of basic chemical engineering principles in biochemical and biological process industries such as enzyme technology and fermentation. Term project required for graduate credit.

Ch E 540. Biomedical Applications of Chemical Engineering. (Dual-listed with 440). (3-0) Cr. 3. *Prereq: 210, Math 266, Phys 222.* Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical engineering and applied physiology; survey of biomedical engineering; biomaterials; biomedical imaging. Term project required for graduate credit.

Ch E 542. Polymeric Biomaterials. (3-0) Cr. 3. *Prereq: Chem 331 or a polymers class.* Polymeric biomaterials, overview of biomaterial requirements, different classes of polymers used as biomaterials, specific bioapplications of polymers.

Ch E 545. Analytical and Numerical Methods. (3-0) Cr. 3. F. *Prereq: 358, Math 267.* Analysis of equipment and processes by analytic and/or numerical solution of descriptive differential equations. Operational and series techniques, boundary value problems, numerical interpolation and approximation, integration techniques.

Ch E 554. Integrated Transport Phenomena. (4-0) Cr. 4. F. *Prereq: 357, 381, Math 267, credit or enrollment in 545.* Conservation equations governing diffusive and convective transport of momentum, thermal energy and chemical species. Transport during laminar flow in conduits, boundary layer flow, creeping flow. Heat and mass transport coupled with chemical reactions and phase change. Scaling and approximation methods for Mathematical solution of transport models. Diffusive fluxes; conservation equations

for heat and mass transfer; scaling and approximation techniques; fundamentals of fluid mechanics; unidirectional flow; creeping flow; laminar flow at high Reynolds number; forced-convection heat and mass transfer in confined and unconfined laminar flows.

Ch E 562. Bioseparations. (3-0) Cr. 3. *Prereq: 357 or advanced standing in a science major.* Principles and techniques for separation and recovery of biologically-produced molecules, especially proteins. Relationship between the chemistry of biological molecules and efficient separation and preservation of biological activity. Includes centrifugation and filtration, membrane processing, extraction, precipitation and crystallization, chromatography, and electrophoresis.

Ch E 572. Turbulence. (Cross-listed with Aer E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Aer E 543 or M E 538.* Qualitative features of turbulence. Statistical and spectral representation of turbulent velocity fields: averages, moments, correlations, length and time scales and the energy cascade. Averaged equations of motion, closure requirements, Reynolds stress, dissipation rate. Isotropic turbulence, homogeneous shear flows, free shear flows, wall bounded flows. Scalar transport, particulate transport.

Ch E 583. Advanced Thermodynamics. (3-0) Cr. 3. F. *Prereq: 381.* Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of non-ideal fluids and solutions; phase and chemical-reaction equilibria/stability.

Ch E 587. Advanced Chemical Reactor Design. (3-0) Cr. 3. S. *Prereq: 382.* Analysis of complex reactions and kinetics. Fixed bed, fluidized bed, and other industrial reactors. Analysis and design of non-ideal flow mixing, and residence times. Heterogeneous reactors.

Ch E 590. Special Topics. Cr. arr. Repeatable. Investigation of an approved topic on an individual basis.

Ch E 595. Special Topics. Cr. arr. Repeatable.
A. Separations
B. Advanced Control Theory
C. Crystallization
D. Thermodynamics
G. Biological Engineering
I. Materials & Biomaterials
J. Protein Engineering/Bioseparations
K. Surfaces
L. Combinatorial Design

Ch E 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

Ch E 601. Seminar. Cr. R. Repeatable. F.S. Satisfactory-fail only.

Ch E 625. Metabolic Engineering. (3-0) Cr. 3. *Prereq: 382, Chem 331.* Principles of metabolic engineering. Emphasis on emerging examples in biorenewables and plant metabolic engineering. Overview of biochemical pathways, determination of flux distributions by stoichiometric and labeling techniques; kinetics and thermodynamics of metabolic networks; metabolic control analysis; genetic engineering for overexpression, deregulation, or inhibition of enzymes; directed evolution; application of bioinformatics, genomics, and proteomics.

Ch E 632. Multiphase Flow. (Cross-listed with M E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: M E 538.* Single particle, mutliparticle and two-phase fluid flow phenomena (gas-solid, liquid-solid and gas-liquid mixtures); particle interactions, transport phenomena, wall effects; bubbles, equations of multiphase flow. Dense phase (fluidized and packed beds) and ducted flows; momentum, heat and mass transfer. Computer solutions.

Ch E 642. Principles and Applications of Molecular Simulation. (3-0) Cr. 3. *Prereq: 545.* Principles of Statistical physics. General features of molecular simulations including Monte Carlo (MC) methods, molecular mechanics (MM), and molecular dynamics (MD). Overview of intermolecular and interatomic potentials. Evaluation of phase equilibria, free energies, and surface/interfacial properties. Coarse-grained methods.

Ch E 652. Advanced Transport. (3-0) Cr. 3. *Prereq: 552 and 553.* Advanced topics in momentum transport, fluid mechanics, and mass transport including study of recent literature.

Ch E 688. Catalysis and Catalytic Processes. (3-0) Cr. 3. *Prereq: 382.* Principles and applications of heterogeneous and homogeneous catalysis. Adsorption. Reaction kinetics and mass transfer effects. Catalyst characterization. Industrial catalytic processes.

Ch E 690. Advanced Topics. Cr. arr. Repeatable.
A. Separations
B. Advanced Statistical Modeling and Control
C. Crystallization
D. Thermodynamics
E. Protein Engineering/Bioseparations
F. Biological Engineering
G. Materials & Biomaterials
H. Surfaces
I. Combinatorial Design

Ch E 697. Engineering Internship. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of major professor, graduate classification.* One semester and one summer maximum per academic year professional work period.

Ch E 699. Research. Cr. arr. Repeatable.

Chemistry

www.chem.iastate.edu

Jacob Petrich, Chair of Department

Distinguished Professors: Barton, Corbett, Gordon, Larock, Thiel

Distinguished Professors (Emeritus): Angelici, Espenson, Fritz, Johnson, Ruedenberg, Yeung

University Professors: Hoffman, Kraus, Verkade

Professors: Geoffroy, Greenbowe, Holme, Hong, Houk, Jenks, Lin, Miller, Petrich, Schmidt-Rohr, Shin, Trahanovsky, Windus, Woo

Professors (Emeritus): Franzen, Gerstein, Hutton, Jacobson, McCarley, Powell, Russell, Struve

Professor (Adjunct): Bakac, Pruski

Professor (Adjunct Emeritus): Trahanovsky

Professor (Collaborator): Porter

Associate Professors: Hillier, Pohl, Song, Zhao

Assistant Professors: Fang, Jeffries-El, Lee, Sadow, Smith, Stauffer

Senior Lecturers: Burnett

Lecturers: Bonaccorsi, Kingston

Undergraduate Study

For undergraduate curricula in liberal arts and sciences leading to the degrees bachelor of science and bachelor of arts, see *Liberal Arts and Sciences, Curriculum*.

Graduates holding the B.S. degree in chemistry qualify in many fields: as teachers of chemistry, as supervisors in industry, as technical sales personnel, and as research chemists in federal, state, municipal, academic, or industrial laboratories. Students with high scholastic standing often continue with graduate work, where they can explore more thoroughly the specialized areas of chemistry in which they are interested.

The B.A. degree is useful for students who intend to pursue studies in parallel areas, such as secondary school teaching, or to obtain joint majors or strong minors. The B.A. degree does not prepare students as well for graduate study or professional employment in chemistry.

Graduates have firm foundations in the fundamentals and application of current chemical theories. They are able to design, carry-out, record, and analyze the results of chemical experiments. They are able to use modern instrumentation and classical techniques to identify and solve chemical problems as well as explore new areas of research. Graduates are able to communicate the results of their work to chemists, as well as non-chemists. They understand the ethical and environmental dimensions of problems and issues facing chemists. They follow the proper procedures and regulations for safe storage, labeling, use of chemicals, and disposal of chemicals. Graduates are skilled in problem solving, critical thinking, and analytical reasoning. These skills can be applied to careers in education and industry and professions such as law, medicine, environmental sciences, and forensic sciences. The curricula in chemistry are approved by the American Chemical Society (ACS). Students who complete the program obtain an ACS certified baccalaureate degree provided they also take one Biochemistry course, typically BBMB 301 or 404.

Liberal arts majors who wish to transfer into chemistry at the end of their second year may still complete all degree requirements and graduate within five years.

Undergraduate students seeking the B.S. degree in chemistry usually take courses essential to the degree program according to the following schedule:

First year: Chem 177 and 178, or 201, 177L or 201L; 211, 211L; Math 165, 166; Engl 150; Lib 160.

Second year: Chem 331, 332, 333L, 334L; Math 265; Phys 221, 222.

Third year: Chem 324, 325, 322L, 316, 316L, 301; Engl 250 or 250H; Foreign language requirement.

Fourth year: Chem 402, 401L, 2 advanced chemistry courses (minimum 4 credits). Chem 399 or 499 is strongly recommended. Credits earned in 399/499 can only be used to meet one of the advanced course requirements.

Chemistry majors seeking certification to teach chemistry in secondary schools must meet the requirements of the College of Human Sciences as well as those of the chemistry program. In addition, they must apply formally for admission to the teacher education program.

Undergraduate students seeking the B.A. degree in chemistry have the following courses in their degree programs as minimum requirements: 177, 178, and 177L, or 201 and 177L or 201L; 211, 211L, 301, 316, 316L, 324, 321L or 322L, 325, 331, 331L, 332, 332L. Math 165, 166 and Phys 221, 222 are required as supporting work.

The Department offers a minor in chemistry which may be earned by credit in Chem 177, 177L (or 167 and 167L), 178, 211, 211L, 324, 331, 331L and one of the following: Chem 301; 316 and 316L or 325 and 321L, or 332 and 332L. The total minimum credits in chemistry thus will be 20 to 23 depending on which advanced courses are selected.

Communication Proficiency requirement: The Department requires a grade of C– or better in each of English 150 and 250 or 250H.

Graduate Study

The Department offers work for the degrees master of science and doctor of philosophy with majors in chemistry analytical, inorganic, organic, and physical chemistry. Co-majors may be taken between areas within chemistry or between one of the areas in chemistry and another department. Courses in other areas of chemistry as well as courses in other departments may be used to satisfy the requirement for coursework outside the major field. A Ph.D. student in chemistry may choose an additional specialty in one of the six areas: Materials Chemistry, Industrial Chemistry,

Biomolecular Sciences, Chemistry Education, Chemical Instrumentation, and forensic Chemistry. A minimum of ten credits is required for each additional specialty. A course which counts towards an additional specialty may also count toward the outside course requirement. A minor in chemistry is available to students in other departments. The Department participates in the interdepartmental major in toxicology.

The Department of Chemistry requires all graduate students majoring in chemistry to teach as part of their training for an advanced degree. Prerequisite to major graduate work is the completion of undergraduate work in chemistry, mathematics, and physics substantially equivalent to that required of undergraduate chemistry majors at this institution.

The course numbers for general chemistry courses include 155-178, and 201.

Index to field of work for 200 level courses and above is given by the second and third digits of course numbers:

(a) Inorganic Chemistry 00-09
(b) Analytical Chemistry 10-19
(c) Physical Chemistry 20-29 and 60-69
(d) Organic Chemistry 30-39
(e) Chemical Education 50-59
(f) Interdisciplinary Chemistry 70-89
(g) Research 99

Courses primarily for undergraduate students

Chem 050. Preparation for College Chemistry. (3-0) F. *Prereq: 1 year high school algebra.* An in-depth active learning experience designed to impart the fundamental concepts and principles of chemistry, with an emphasis on Mathematics skills and logical thinking. For students intending to enroll in general chemistry and who have not taken high school chemistry or who have not had a high school college preparatory chemistry course. Credit for Chem 50 does not count toward graduation.

Chem 155. Foundations of Chemistry for Engineers. (3-0) Cr. 3. F. *Prereq: Math 140 or the high school equivalent.* The first semester of a two semester sequence covering principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. Chem 155 may not be counted for credit toward graduation in any engineering curriculum.

Chem 160. Chemistry in Modern Society. (3-0) Cr. 3. Alt. S., offered 2010. Aspects of chemistry visible to a nonscientist in our Society. A survey of selected areas of chemistry with emphasis on the interface between chemistry and other fields of human activity.

Chem 163. College Chemistry. (4-0) Cr. 4. F.S. *Prereq: 1 year of high school algebra and geometry and either Chem 50 or 155 or 1 year of high school chemistry; and credit or enrollment in 163L.* The first semester of a two semester sequence. A general survey of chemistry and properties with an emphasis on conceptual problems. Stoichiometry, atomic structure, chemical bonding, states of matter, energy relations, acid-base theory and oxidation-reduction reactions. The 163, 164 sequence does not meet the prerequisite for 331. Credit for examination (test-out exams) for 163 is available only to students who are not currently enrolled in the course. Only one of Chem 163, 165, 167, 177, or 201 may count toward graduation.

Chem 163L. Laboratory in College Chemistry. (0-3) Cr. 1. F.S.SS. *Prereq: Credit or enrollment for credit in 163.* Laboratory to accompany 163. Must be taken with 163. Only one of Chem 163L, 167L, and 177L may count toward graduation.

Chem 165. Foundations of Chemistry for Engineers. (4-0) Cr. 4. S. *Prereq: 155.* Continuation of 155. Principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. Chem 165 or 167 satisfies the chemistry requirement in engineering curricula. Only one of Chem 163, 165, 167, 177, or 201 may count toward graduation.

Chem 167. General Chemistry for Engineering Students. (4-0) Cr. 4. F.S. *Prereq: Math 140 or the high school equivalent and one year of traditional college prep chemistry or Chem 50.* Principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. This is an accelerated course designed for students with an excellent preparation in Math and science and is a terminal course intended for engineering students who do not plan to take additional courses in chemistry. Credit by examination (test-out exams) for 167 is available only to students who are not currently enrolled in the course. Only one of Chem 163, 165, 167, 177, or 201 may count toward graduation.

Chem 167L. Laboratory in General Chemistry for Engineering. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment for credit in 167 or 165.* Laboratory to accompany 167. Only one of Chem 163L, 167L, and 177L may count toward graduation.

Chem 177. General Chemistry I. (4-0) Cr. 4. F.S.SS. *Prereq: Math 140 or high school equivalent and 50, 155 or 1 year high school chemistry and credit or enrollment in 177L. Chemistry and biochemistry majors may consider taking 201.* The first semester of a two semester sequence which explores chemistry at a greater depth and with more emphasis on concepts, problems, and calculations than 163-164. Recommended for physical and biological science majors, chemical engineering majors, and all others intending to take 300-level chemistry courses. Principles and quantitative relationships, stoichiometry, chemical equilibrium, acid-base chemistry, thermochemistry, rates and mechanism of reactions, changes of state, solution behavior, atomic structure, periodic relationships, chemical bonding. Credit by examination (test-out exams) for 177 is available only to students who are not currently enrolled in the course. Only one of Chem 163, 165, 167, 177, or 201 may count toward graduation.

Chem 177L. Laboratory in General Chemistry I. (0-3) Cr. 1. F.S.SS. *Prereq: Credit or enrollment for credit in 177.* Laboratory to accompany 177. 177L must be taken with 177. 177N: for chemistry and biochemistry majors. Only one of Chem 163L, 167L, and 177L may count toward graduation.

Chem 177N. Laboratory in General Chemistry I. (0-3) Cr. 1. F.S.SS. *Prereq: Credit or enrollment for credit in 177. For chemistry and biochemistry majors.* Laboratory to accompany 177. 177N must be taken with 177. Graduation Messages: Only one of Chem 163L, 167L, and 177N may count toward graduation.

Chem 178. General Chemistry II. (3-0) Cr. 3. F.S. *Prereq: 177, 177L.* Continuation of 177. Recommended for physical or biological science majors, chemical engineering majors, and all others intending to take 300-level chemistry courses. Credit by examination (test-out exams) for 178 is available only to students who are not currently enrolled in the course. Only one of Chem 164 and 178 may count toward graduation.

Chem 178L. Laboratory in College Chemistry II. (0-3) Cr. 1. F.S. *Prereq: 177L and credit or enrollment for credit in 178.* Laboratory to accompany 178. 178L is not a necessary corequisite with 178. Only one of Chem 164L and 178L may count toward graduation.

Chem 201. Advanced General Chemistry. (5-0) Cr. 5. F. *Prereq: Math 140 or high school equivalent and one year of high school chemistry. Co-enrollment in 201L.* A one semester course in general chemistry designed to give students an in-depth, broad-based view of modern chemistry, and, in part, to facilitate participation in independent undergraduate research. Topics include stoichiometry, atomic and molecular structure, chemical bonding, kinetics, chemical equilibria, and thermodynamics. Discussion of current trends in various chemical disciplines, which may be given by guest experts in chemistry, biochemistry, and chemical engineering, will help the student appreciate the scope of the chemical sciences and how research is carried out. Only one of Chem 163, 165, 167, 177, or 201 may count toward graduation.

Chem 201L. Laboratory in Advanced General Chemistry. (0-3) Cr. 1. *Prereq: Credit or enrollment for credit in 201.* Laboratory to accompany 201. Introductory lab experience in synthesis and analysis to prepare student for research activities 201L must be taken with 201. Only one of 163L, 167L, 177L, 177N or 201L may count toward graduation.

Chem 211. Quantitative and Environmental Analysis. (2-0) Cr. 2. F.S. *Prereq: 164 and 164L, credit or enrollment in 178, or 201 and 201L; and concurrent enrollment in 211L.* Theory and practice of elementary volumetric, chromatographic, electrochemical and spectrometric methods of analysis. Chemical equilibrium, sampling, and data evaluation. Emphasis on environmental analytical chemistry; the same methods are widely used in biological and materials sciences as well.

Chem 211L. Quantitative and Environmental Analysis Laboratory. (0-6) Cr. 2. F.S. *Prereq: Credit or enrollment in 164 and 164L, or 178; and concurrent enrollment in Chem 211.* Introductory laboratory experience in volumetric, spectrometric, electrochemical and chromatographic methods of chemical analysis.

Chem 231. Elementary Organic Chemistry. (3-0) Cr. 3. F.S.SS. *Prereq: 163, 163L, or 177, 177L; credit or enrollment in 231L.* A survey of modern organic chemistry including nomenclature, structure and bonding, and reactions of hydrocarbons and important classes of natural and synthetic organic compounds. For students desiring only an elementary course in organic chemistry. Students in physical or biological sciences and premedical or preveterinary curricula should take the full year sequence 331 and 332 (with the accompanying laboratories 331L and 332L). Only one of Chem 231 and 331 or BBMB 221 may count toward graduation.

Chem 231L. Laboratory in Elementary Organic Chemistry. (0-3) Cr. 1. F.S.SS. *Prereq: Credit or enrollment for credit in 231; 163L or 177L.* Laboratory to accompany 231. 231L must be taken with 231. Only one of Chem 231L and 331L may count toward graduation.

Chem 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the Department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Chem 299. Undergraduate Research (for Freshmen and Sophomores). Cr. arr. Repeatable. *Prereq: Permission of staff member with whom student proposes to work.*

Chem 301. Inorganic Chemistry. (2-0) Cr. 2. S. *Prereq: 324.* Atomic and molecular structure and bonding principles; molecular shapes and symmetry; acids and bases; solid-state structures and properties; inorganic chemistry of H, B, C. Nonmajor graduate credit.

Chem 316. Instrumental Methods of Chemical Analysis. (2-0) Cr. 2. F. *Prereq: 211, 211L, Math 166, and concurrent enrollment in 316L; Phys 222 recommended.* Quantitative and qualitative instrumental analysis. Operational theory of instruments, atomic and molecular absorption and emission spectroscopy, electroanalysis, mass spectrometry, liquid and gas chromatography, electrophoresis, literature of chemical analysis. Nonmajor graduate credit.

Chem 316L. Instrumental Analysis Laboratory. (0-6) Cr. 2. F. *Prereq: Credit or enrollment in Chem 316.* Advanced laboratory experience in UV-visible spectrophotometry, atomic absorption and emission spectrometry, electrochemistry, gas and liquid chromatography, electrophoresis, mass spectrometry, and other instrumental methods. Nonmajor graduate credit.

Chem 321L. Laboratory in Physical Chemistry. (1-3) Cr. 2. S. *Prereq: Credit or enrollment for credit in 324 or 325.* Error analysis; use of computers for interfacing to experiments and for data analysis; thermodynamics, infrared and optical spectroscopy, lasers. Not applicable towards the B.S. degree in Chemistry. Only one of Chem 321L and 322L may count toward graduation. Nonmajor graduate credit.

Chem 322L. Laboratory in Physical Chemistry. (1-6) Cr. 3. S. *Prereq: Chem 324.* Error analysis; use of computers for interfacing to experiments and for data analysis; thermodynamics, surface science, infrared and optical spectroscopy, lasers. Only one of Chem 321L and 322L may count toward graduation. Nonmajor graduate credit.

Chem 324. Introductory Quantum Mechanics. (3-0) Cr. 3. F. *Prereq: 178, Math 166, Phys 222 recommended.* Quantum mechanics, atomic and molecular structure, spectroscopy, kinetic theory of gases, chemical kinetics. Nonmajor graduate credit.

Chem 325. Chemical Thermodynamics. (3-0) Cr. 3. F.S. *Prereq: 178, Math 166, Phys 222 recommended.* Classical thermodynamics 1st, 2nd, and 3rd laws with applications to gases and interfacial systems, multicomponent, multiphase equilibrium of reacting systems, surface chemistry, and electrochemical cells. Students taking a two-semester physical chemistry sequence are advised to take 324 first; in the spring semester, a molecular-based section of this course, stressing Statistical thermodynamics, is offered for which knowledge of 324 is useful. Nonmajor graduate credit.

Chem 331. Organic Chemistry I. (3-0) Cr. 3. F.S. *Prereq: 178 or 201, enrollment in 331L highly recommended.* The first half of a two semester sequence. Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms. For students majoring in physical and biological sciences, premedical and preveterinary curricula, chemistry and biochemistry. Students desiring only one semester of organic chemistry should take 231 and 231L, not 331. Only one of Chem 231 and 331 may count toward graduation. Nonmajor graduate credit.

Chem 331L. Laboratory in Organic Chemistry I. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment for credit in 331, 177L.* Laboratory to accompany 331. Chemistry and biochemistry majors are encouraged to take 333L. Only one of Chem 231L and 331L may count toward graduation.

Chem 332. Organic Chemistry II. (3-0) Cr. 3. F.S. *Prereq: 331, enrollment in 332L highly recommended.* Continuation of 331. Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms, natural products, carbohydrates and proteins. For students majoring in physical and biological sciences, premedical and preveterinary curricula, chemistry and biochemistry. Nonmajor graduate credit.

Chem 332L. Laboratory in Organic Chemistry II. (0-3) Cr. 1. F.S. *Prereq: 331L, credit or enrollment for credit in 332.* Laboratory to accompany 332. Chemistry and biochemistry majors are encouraged to take 334L.

Chem 333L. Laboratory in Organic Chemistry I (for Chemistry and Biochemistry Majors). (0-6) Cr. 2. F. *Prereq: Credit or enrollment for credit in 331.* Laboratory to accompany 331 for chemistry and biochemistry majors.

Chem 334L. Laboratory in Organic Chemistry II (for Chemistry and Biochemistry Majors). (0-6) Cr. 2. S. *Prereq: 333L, credit or enrollment for credit in 332.* Laboratory to accompany 332 for chemistry and biochemistry majors.

Chem 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the Department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Chem 399. Undergraduate Research. Cr. arr. *Prereq: Permission of instructor with whom student proposes to work and junior or senior classification.* No more than Six total credits of Chem 399 and Chem 499 may count toward graduation.

Chem 401L. Inorganic Chemistry Laboratory. (0-3) Cr. 1. F. *Prereq: 301.* Preparation and characterization of inorganic and organometallic compounds by modern techniques. For students majoring in chemistry or biochemistry. Nonmajor graduate credit.

Chem 402. Advanced Inorganic Chemistry. (Dual-listed with 502). (3-0) Cr. 3. F. *Prereq: 301; 331 recommended.* Chemistry of the d and f metals. Structure, bonding, electronic spectra, and reaction mechanisms. Aspects of organometallic solid state and bioinorganic chemistry. Nonmajor graduate credit.

Chem 490. Independent Study. Cr. arr. *Prereq: Completion of 6 credits in chemistry at the 300 level or higher and permission of instructor.* No more than 9 credits of Chem 490 may count toward graduation.

Chem 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the Department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Chem 499. Senior Research. Cr. arr. Repeatable. *Prereq: Permission of instructor with whom student proposes to work; B average in all chemistry, physics, and mathematics courses.* Research in chosen area of chemistry, with final written report as senior thesis. This course should be elected for two consecutive semesters. For students majoring in chemistry. No more than Six total credits for Chem 399 and 499 may count toward graduation.

Courses primarily for graduate students, open to qualified undergraduate students

Chem 501L. Inorganic Preparations. (0-3) Cr. 1. F. *Prereq: 402.* Preparation and characterization of inorganic and organometallic compounds by modern research techniques.

Chem 502. Advanced Inorganic Chemistry. (Dual-listed with 402). (3-0) Cr. 3. F. *Prereq: 301; 331 recommended.* Chemistry of the d and f metals. Structure, bonding, electronic spectra, and reaction mechanisms. Aspects of organometallic, solid state, and bioinorganic chemistry.

Chem 503. Bioinorganic Chemistry. (Cross-listed with BBMB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 402 or BBMB 405.* Essential elements: transport and storage of ions and of oxygen; metalloenzymes and metallocoenzymes; electron-transfer processes in respiration and photosynthesis; metabolism of nonmetals and redox processes involved in it; medicinal aspects of inorganic chemistry.

Chem 505. Physical Inorganic Chemistry. (3-0) Cr. 3. S. *Prereq: 402 or 502 and 324.* Elementary group theory and molecular orbital theory applied to inorganic chemistry. Spectroscopic methods of characterization of inorganic compounds and organometallic compounds.

Chem 511. Advanced Quantitative Analysis. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 316 and 316L.* General methods of quantitative inorganic and organic analysis. Aqueous and nonaqueous titrimetry; selective reagents; sampling and sample dissolution; modern instrumentation; sensors; atomic and molecular microscopy; bioanalytical methods; data evaluation; chemometrics; and analytical literature.

Chem 512. Electrochemical Methods of Analysis. (3-0) Cr. 3. F. *Prereq: 316 and 316L, 324, and 322L.* Principles of convective-diffusional mass transport in electroanalysis. Applications of potentiometry, voltammetry, and coulometry. Introduction to heterogeneous and homogeneous kinetics in electroanalysis. Analog and digital circuitry. Interfacing.

Chem 513. Analytical Molecular and Atomic Spectroscopy. (3-0) Cr. 3. S. *Prereq: 316 and 316L, 324, 322L.* Introduction to physical optics and design of photometric instruments. Principles of absorption, emission, fluorescence, and Raman Spectroscopy. Error and precision of optical methods. Ultraviolet, visible, and infrared methods of qualitative and quantitative organic and inorganic analysis.

Chem 516. Analytical Separations. (3-0) Cr. 3. F. *Prereq: 316 and 316L, 324, 322L.* Principles and examples of inorganic and organic separation methods applied to analytical chemistry. Solvent extraction, volatilization, ion exchange, liquid and gas chromatography, and electrophoresis.

Chem 531. Organic Synthesis I. (2-0) Cr. 2. S. *Prereq: 332.* Survey of organic functional group transformations.

Chem 532. Organic Synthesis II. (2-0) Cr. 2. F. *Prereq: 531.* Synthesis of complex organic compounds including natural products.

Chem 537. Physical Organic Chemistry I. (3-0) Cr. 3. F. *Prereq: 332.* Molecular structure, stereochemistry, introduction to reaction mechanisms, thermodynamic and kinetic data, linear free energy relationships, isotope effects, orbital symmetry.

Chem 538. Physical Organic Chemistry II. (3-0) Cr. 3. S. *Prereq: 537.* Survey of reactive intermediates including cations, anions, carbenes, and radicals.

Chem 540. Seminar in forensic Sciences. (1-0) Cr. 1. Repeatable. S. *Prereq: Chem 231 or graduate enrollment.* Seminars by professional criminalists, research scientists, Certificate students, and educators. Emphasis on opportunities for research and development, citizen involvement, and educational outreach related to forensic science. Weekly report required.

Chem 542. Independent Research and Presentation in Forensic Science. (1-0) Cr. 1. S. *Prereq: Enrollment in the Graduate Certificate in Forensic Sciences.* Research topic approved by course instructor. Written and oral reports required. Oral report given in forensics seminar, Chem 540.

Chem 550. Safety in the Chemical Laboratory. (1-0) Cr. 1. S. *Prereq: 332L.* Introduction to laboratory safety and chemical hygiene. Use of engineering controls and personal protective equipment. Chemical storage and waste disposal practices. Handling hazardous chemicals. Radiation safety and laser safety. Satisfactory-fail only.

Chem 555. Teaching College Chemistry. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Graduate or senior classification..* Methods of instruction, strategies and techniques for effective teaching and learning along with practice teaching in undergraduate chemistry recitation and laboratory courses. Cooperative learning, guided-inquiry, learning cycles, conceptual change, models and modeling, concept maps, visualization, computer simulations, web-based delivery systems, and learning theories.

Chem 561. Fundamentals of Quantum Mechanics. (4-0) Cr. 4. F. *Prereq: 324.* Schroedinger equation and exact solutions; square wells and barriers; harmonic oscillator; the hydrogen atom; atomic orbitals; operators including angular momenta; time-independent and time-dependent perturbation theory; Schroedinger and Heisenberg representations; unitary operators; interaction picture, density matrix.

Chem 562. Fundamentals of Atomic and Molecular Quantum Mechanics. (3-0) Cr. 3. S. *Prereq: 561, credit or enrollment in 583.* Variational method, many electron atoms; addition of angular momentum, self-consistent field method for open and closed shells, linear combinations of atomic orbitals, origin of chemical bonding, many-electron diatomic and polyatomic molecules, treatments of electron correlation, approximation methods.

Chem 563. Statistical Mechanics. (3-0) Cr. 3. S. *Prereq: 325.* Microscopic and macroscopic properties, laws of thermodynamics, ensembles and distribution functions, applications to gases, solids, and chemical equilibrium.

Chem 564. Molecular Spectroscopy and Structure. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 505 or 562.* Maxwell's field equations, interaction of light with matter including time-dependent perturbation theory, microwave, vibrational (infra-red, Raman) and electronic spectroscopies, symmetry derived selection rules, special lineshapes and introduction to nonlinear and coherent laser spectroscopies.

Chem 571. Solid-State Chemistry. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 301, 324.* A study of solid state materials including structures, bonding, defects, disorder, phase transitions, ionic mobility, metal-insulator transitions, band theory, synthesis and intercalation.

Chem 572. Spectrometric Identification of Organic Compounds. (2-3) Cr. 3. F. *Prereq: 332.* Principles of infrared, ultraviolet, nuclear magnetic resonance, and mass spectroscopy as applied to organic chemistry.

Chem 574. Organometallic Chemistry of the Transition Metals. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 301, 332.* Transition metal complexes of ligands such as cyclopentadienyl, olefins, acetylenes, benzenes, and carbon monoxide. Homogeneous catalysis.

Chem 576. Surface Chemistry. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 324.* Gas-surface interactions and techniques of characterization. Idealized surface lattices, surface tension, Wulff plots, work function, adsorbate-adsorbate interactions, 2D phase diagrams, diffusion, thin film growth, adsorption and desorption mechanisms/energetics/kinetics, adsorption isotherms, vacuum techniques, electron- and ion-based spectroscopies for surface analysis (including AES, FIM, XPS, UPS, EXAFS, EELS, SIMS, LEED and STM).

Chem 577. Mass Spectrometry. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Basic physics, instrumentation, chemical and biological applications of mass spectrometry.

Chem 578. Chemical Kinetics and Mechanisms. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: 324.* Rates and mechanisms; reversible, consecutive, and competing reactions; chain mechanisms; kinetic isotope effects; very rapid reactions; acid-base catalysis, theories of unimolecular reactions; transition State and Marcus theories.

Chem 579. Introduction to Research in Chemistry. (1-0) Cr. R. F.S. Introduction to the various areas of research in chemistry at Iowa State University.

Chem 580. Introduction to Computational Quantum Chemistry. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 324.* Basic principles of quantum mechanics, schrodinger equation. Hartree-Fock/molecular orbital theory, introduction to group theory, introduction to modern methods of computational chemistry; applications include molecular structure, potential energy surfaces and their relation to chemical reactions; molecular spectroscopy, photochemistry, solvent effects and surface chemistry.

Chem 581. Principles of Lasers and Optics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 324, Phys 222.* Students with weak background should take Chem 580. For students working with lasers and optics; stimulated adsorption and emission based on the classical electron oscillator model; population inversion, laser amplification; laser pumping; oscillation and cavity modes; laser beam characterization; linear propagation; design of laser resonators, ray and wave optics; nonlinear optics.

Chem 583. Chemical Group Theory. (1-0) Cr. 1. F. *Prereq: 324.* Basic concepts and theorems, representation theory; point groups, molecular orbitals, molecular states, molecular vibrations, rotation group and angular momenta; space groups and crystals; permutation group, antisymmetry, and spin states.

Chem 589. Current Topics in Chemistry. (1-0) Cr. R. F.S. Presentation of recent literature and chemical problems under current investigation.

Chem 599. Nonthesis Research. Cr. arr. *Prereq: Permission of instructor concerned.*

Courses for graduate students

Chem 501L. Inorganic Preparations. (0-3) Cr. 1. F. *Prereq: 402.* Preparation and characterization of inorganic and organometallic compounds by modern research techniques.

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Chem 503. Bioinorganic Chemistry. (Cross-listed with BBMB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 402 or BBMB 405.* Essential elements: transport and storage of ions and of oxygen; metalloenzymes and metallocoenzymes; electron-transfer processes in respiration and photosynthesis; metabolism of nonmetals and redox processes involved in it; medicinal aspects of inorganic chemistry.

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Chem 511. Advanced Quantitative Analysis. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 316 and 316L.* General methods of quantitative inorganic and organic analysis. Aqueous and nonaqueous titrimetry; selective reagents; sampling and sample dissolution; modern instrumentation; sensors; atomic and molecular microscopy; bioanalytical methods; data evaluation; chemometrics; and analytical literature.

Chem 512. Electrochemical Methods of Analysis. (3-0) Cr. 3. F. *Prereq: 316 and 316L, 324, and 322L.* Principles of convective-diffusional mass transport in electroanalysis. Applications of potentiometry, voltammetry, and coulometry. Introduction to heterogeneous and homogeneous kinetics in electroanalysis. Analog and digital circuitry. Interfacing.

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Chem 540. Seminar in Forensic Sciences. (1-0) Cr. 1. Repeatable. S. *Prereq: Chem 231 or graduate enrollment.* Seminars by professional criminalists, research scientists, Certificate students, and educators. Emphasis on opportunities for research and development, citizen involvement, and educational outreach related to forensic science. Weekly report required.

Chem 542. Independent Research and Presentation in Forensic Science. (1-0) Cr. 1. S. *Prereq: Enrollment in the Graduate Certificate in Forensic Sciences.* Research topic approved by course instructor. Written and oral reports required. Oral report given in forensics seminar, Chem 540.

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Chem 563. Statistical Mechanics. (3-0) Cr. 3. S. *Prereq: 325.* Microscopic and macroscopic properties, laws of thermodynamics, ensembles and distribution functions, applications to gases, solids, and chemical equilibrium.

Chem 564. Molecular Spectroscopy and Structure. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 505 or 562.* Maxwell's field equations, interaction of light with matter including time-dependent perturbation theory, microwave, vibrational (infra-red, Raman) and electronic spectroscopies, symmetry derived selection rules, special lineshapes and introduction to nonlinear and coherent laser spectroscopies.

Chem 571. Solid-State Chemistry. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 301, 324.* A study of solid state materials including structures, bonding, defects, disorder, phase transitions, ionic mobility, metal-insulator transitions, band theory, synthesis and intercalation.

Chem 572. Spectrometric Identification of Organic Compounds. (2-3) Cr. 3. F. *Prereq: 332.* Principles of infrared, ultraviolet, nuclear magnetic resonance, and mass spectroscopy as applied to organic chemistry.

Chem 574. Organometallic Chemistry of the Transition Metals. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 301, 332.* Transition metal complexes of ligands such as cyclopentadienyl, olefins, acetylenes, benzenes, and carbon monoxide. Homogeneous catalysis.

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Chem 577. Mass Spectrometry. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Basic physics, instrumentation, chemical and biological applications of mass spectrometry.

Chem 578. Chemical Kinetics and Mechanisms. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: 324.* Rates and mechanisms; reversible, consecutive, and competing reactions; chain mechanisms; kinetic isotope effects; very rapid reactions; acid-base catalysis, theories of unimolecular reactions; transition State and Marcus theories.

Chem 579. Introduction to Research in Chemistry. (1-0) Cr. R. F.S. Introduction to the various areas of research in chemistry at Iowa State University.

Chem 580. Introduction to Computational Quantum Chemistry. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 324.* Basic principles of quantum mechanics, schrodinger equation. Hartree-Fock/molecular orbital theory, introduction to group theory, introduction to modern methods of computational chemistry; applications include molecular structure, potential energy surfaces and their relation to chemical reactions; molecular spectroscopy, photochemistry, solvent effects and surface chemistry.

Chem 581. Principles of Lasers and Optics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 324, Phys 222.* Students with weak background should take Chem 580. For students working with lasers and optics; stimulated adsorption and emission based on the classical electron oscillator model; population inversion, laser amplification; laser pumping; oscillation and cavity modes; laser beam characterization; linear propagation; design of laser resonators, ray and wave optics; nonlinear optics.

Chem 583. Chemical Group Theory. (1-0) Cr. 1. F. *Prereq: 324.* Basic concepts and theorems, representation theory; point groups, molecular orbitals, molecular states, molecular vibrations, rotation group and angular momenta; space groups and crystals; permutation group, antisymmetry, and spin states.

Chem 589. Current Topics in Chemistry. (1-0) Cr. R. F.S. Presentation of recent literature and chemical problems under current investigation.

Chem 599. Nonthesis Research. Cr. arr. *Prereq: Permission of instructor concerned.*

Chem 600. Seminar in Inorganic Chemistry. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.*

Chem 601. Selected Topics in Inorganic Chemistry. (2-0) Cr. arr. F.S. *Prereq: Permission of instructor.* Topics such as molecular structure and bonding; organometallic compounds; physical techniques of structure determination; nonaqueous solutions; Zintl phases; transition-metal oxides; free-radical reactions; electron transfer reactions; metal-metal bonding; and bioinorganic chemistry of nucleic acids.

Chem 611. Seminar in Analytical Chemistry. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.*

Chem 619. Special Topics in Analytical Chemistry. (2-0) Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Raman Spectroscopy, sensors, spectroelectrochemistry, capillary electrophoresis, analytical plasmas, chemometrics and bioanalytical chemistry.

Chem 631. Seminar in Organic Chemistry. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.*

Chem 632. Selected Topics in Organic Chemistry. (2-0) Cr. arr. Repeatable. F.S. *Prereq: 537.* Topics of current interest in organic chemistry such as spectroscopy, physical organic chemistry, photochemistry, organometallic chemistry, mechanisms of oxidations and reductions, modern organic synthesis, reactive intermediates, bioorganic chemistry, and polymers.

Chem 660. Seminar in Physical Chemistry. (1-0) Cr. 1. Repeatable. S. *Prereq: Permission of instructor.*

Chem 667. Special Topics in Physical Chemistry. (2-0) Cr. arr. F.S. *Prereq: Permission of instructor.* Advanced and recent developments in physical chemistry are selected for each offering.

Chem 699. Research. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

Civil Engineering

(Administered by the Department of Civil, Construction and Environmental Engineering)

James Alleman, Chair of Department

Distinguished Professors: Klaiber

Distinguished Professors (Emeritus): Baumann, Cleasby, Handy

University Professors (Emeritus): Lohnes

Professors: Alleman, Fanous, Jaselskis, Kannel, Maze, Nambisan, Ong, Pometto, Porter, Sarkar, Schaefer, Souleyrette, Van Leeuwen, Wipf

Professors (Emeritus): Bergeson, Brewer, Carstens, Greimann, Hardy, Jellinger, Kao, Lee, Mashaw, Mickle, Morgan, Northup, Oulman, Sanders

Professors (Collaborators): Surampalli

Associate Professors: Abendroth, Baenziger, Bhandari, Ellis, Gu, Hallmark, Jahren, Koziel, Rehmann, Sritharan, Strong, Sung, Wang, White, Williams

Associate Professors (Emeritus): Chase, Mercier, Sheeler, Ward

Assistant Professors: Aslock, Bolluyt, Ceylan, Gkritza, Grewell, Kandil, Rouse, Shane

Assistant Professors (Adjunct): Phares, Plazak, Schlorholtz, Smadi, Taylor

Instructors (Adjunct): Amenson, Gaunt

Senior Lecturers: Cormicle, Jones, Sirotiak, Walton

Lecturers: Baker, Cackler, Hawkins, Hunacek, Mescher, Perkins, Smith, Stout

Clinician: Gopalakrishnan

Undergraduate Study

For undergraduate curriculum in civil engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission of the ABET.

Civil engineering consists of the application of the laws, forces, and materials of nature to the planning, design, construction, maintenance, and operation of public and private facilities, subject to economic, social, and environmental constraints. Commonly included are transportation systems; bridges and buildings; water supply, pollution control, irrigation, and drainage systems; river and harbor improvements; dams and reservoirs. Civil engineering also includes the planning, design, and responsible execution of surveying operations, and the location, delimitation, and delineation of physical and cultural features on the surface of the earth. Research, testing, sales, management, and related functions are also a part of civil engineering. Work on the campus is supplemented by inspection trips which furnish an opportunity for firsthand study of engineering systems in operation, as well as projects under construction.

Environmental engineering, as a specialty area in civil engineering, is concerned with protecting the public and natural health; providing safe, palatable and ample water supply; management of solid and hazardous waste; proper treatment and disposal of domestic and industrial wastewaters and waste; resource recovery; providing adequate drainage of urban and rural areas for sanitation; and the control of water quality, soil contamination, and air pollution. At the undergraduate level, the study of various environmental and water resource engineering topics is part of the course of study leading to the Bachelor's degree in civil engineering.

Program Goal

Consultation with an industrial advisory board of employers of civil engineers, with a broad base of civil engineering educators, and with students and alumni has yielded a continuous process of program planning, program assessment, curriculum development, and instructional development to produce an integrated, learning-based curriculum. The curriculum listed in this catalog has the academic program goal of developing an effective program that fulfills student educational needs and that equips and empowers qualified students for a successful career in civil or environmental engineering.

Program Objectives

To achieve the program goal, the Department has developed objectives intended to result in the following outcomes such that graduates:

1. have a comprehensive education in the fundamentals of civil engineering,

2. are prepared to undertake civil engineering design tasks,

3. demonstrate effective communication skills and teamwork in multidisciplinary projects,

4. play a constructive role to address the needs of Society and the environment, and

5. are motivated to continue their professional development.

The faculty encourages the development of the student's professional skills through participation in cooperative education, internships, or progressive summer engineering employment. Qualified juniors and seniors interested in graduate studies may apply to the Graduate College to concurrently pursue the bachelor degree and a master of science in Civil Engineering or a master of business administration in the College of Business Administration.

Graduate Study

The Department of Civil, Construction and Environmental Engineering offers work for the master of science and doctor of philosophy degrees with a major in civil engineering with areas of specialization in structural engineering, environmental engineering, construction engineering and management, geotechnical engineering, civil engineering materials, and transportation engineering. The department also offers minor work to students from other engineering departments.

Candidates for the degree master of science are required to satisfactorily complete 30 credits of acceptable graduate work, including preparation of a thesis or creative component.

Candidates for the doctor of philosophy degree refer to the department's home page and/or the department's Graduate Student Handbook for degree options and credit requirements. The normal prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of engineering students at this university. However, because of the diversity of interests within the graduate programs in civil engineering, a student may qualify for graduate study even though undergraduate or prior graduate training has been in a discipline other than engineering. Supporting work will be required depending upon the student's background and area of interest. A prospective graduate student is urged to specify the degree program and area of specialization in which he or she is interested on the application for admission. The department participates in the interdepartmental majors in transportation (master of science only), environmental science, and biorenewable resources and technology (see Index).

The Department of Civil, Construction and Environmental Engineering offers a graduate certificate in environmental engineering. Completion of the certificate requires at least twelve credits including 520, 521, 591 (R) seminar, and any two courses related to environmental engineering from those available from the departments of Civil, Construction and Environmental Engineering, Agricultural and Biosystems Engineering, and Chemical and Biological Engineering.

Courses primarily for undergraduate students

C E 101. Technical Lecture. Cr. R. F.S. (1-0) Discussion of various phases of civil engineering. For transfer students only. Evaluation of transfer credits and discussion of graduation requirements. Satisfactory-fail only.

C E 105. Introduction to the Civil Engineering Profession. (1-0) Cr. 1. F.S. Overview of the nature and scope of the civil engineering profession. Exploration of the various specialty areas within civil engineering. Bloom's Taxonomy and creativity. Departmental rules, student services operations, degree requirements, educational objectives, program of study planning, career options, and student organizations.

C E 111. Fundamentals of Surveying I. (2-3) Cr. 3. F.S. *Prereq: 160, credit or enrollment in Engr 170 or C E 170, Math 165, credit or enrollment in C E 105 for C E majors.* Introduction to error theory. Fundamentals of observing distances, elevations, and angles. Traversing. Irregular areas. Circular and parabolic curves. Earthwork including mass diagrams. Construction staking. Computer applications and introduction to photogrammetry, geographic information systems and global positioning systems technology.

C E 120. Civil Engineering Learning Community. Cr. R. Repeatable. Integration of first-year students into the Civil Engineering program. Assignments and activities involving teamwork, academic preparation, study skills, and preparation for entry into the Civil Engineering profession. Completed both individually and in learning teams under the direction of faculty and peer mentors. Satisfactory-fail only.

C E 160. Engineering Problems with Computational Laboratory. (2-2) Cr. 3. F.S. *Prereq: Math 141, 142 or satisfactory scores on mathematics placement assessments; credit or enrollment in Math 165. Form*ulation of engineering problems using spreadsheets and Visual Basic for Application for solution. Presenting results using word processing, tables, and graphs. Introduction to engineering economics and statics. Civil engineering examples.

C E 170. Graphics for Civil Engineering. (0-4) Cr. 2. F.S. *Prereq: Math 165, credit or enrollment in C E 105.* Fundamental graphics. Introduction to computer aided drafting and modeling. Civil engineering applications.

C E 205. Economic Analysis and Technical Communication in Civil Engineering. (3-0) Cr. 3. F.S. *Prereq: Math 166, Engl 250.* Concepts and applications of civil engineering economics. Engineering economics basics including analysis of interest, present worth, annual worth, future worth, and rate of return. Comparison of project alternatives with incremental rate of return, benefit/cost ratio, taxation, depreciation, and inflation. Principles and processes of effective written and oral communication of civil engineering technical information.

C E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

C E 305. Professional Issues in Civil Engineering. (3-0) Cr. 3. F.S. *Prereq: 205.* Civil engineering history and heritage. Professionalism, licensure, liability, ethics, leadership, teamwork, critical thinking, and social responsibility in the practice of civil engineering. Engineering business management principles, including organizational structures and business economics. Applications and impacts of regulations in civil engineering. Written and oral technical presentations.

C E 306. Project Management for Civil Engineers. (2-3) Cr. 3. F.S. *Prereq: 305.* Project management, including work breakdown structures, cost estimating, scheduling, and project control. Civil engineering project life cycle, including planning, design, construction, and maintenance processes. Techniques in interpretation of contract documents and in estimating quantities.

C E 326. Principles of Environmental Engineering. (2-2) Cr. 3. F.S. *Prereq: Chem 167 or 178, Math 166, credit or enrollment in E M 378.* Introduction to environmental problems, water quality indicators and requirements, potable water quality and quantity objectives, water sources and treatment methods; water pollution control objectives and treatment methods; survey of solid and hazardous waste management and air pollution control. Nonmajor graduate credit.

C E 332. Structural Analysis I. (2-2) Cr. 3. F.S. *Prereq: E M 324.* Loads, shear, moment, and deflected shape diagrams for beams and framed structures. Approximate methods. Deformation calculations. Application of flexibility methods to frames and continuous beams. Application of moment distribution and stiffness methods to continuous beams and braced frames. Influence lines for determinate and indeterminate beams using Muller-Breslau principle. Computer applications to analyze beams and frames. Nonmajor graduate credit.

C E 333. Structural Steel Design I. (2-2) Cr. 3. F.S. *Prereq: 332, E M 327.* Design and behavior of the elements of steel structures, proportioning members and connections. Load and Resistance Factor Design. Preliminary design of a building structure. Nonmajor graduate credit.

C E 334. Reinforced Concrete Design I. (2-2) Cr. 3. F.S. *Prereq: 332, E M 327.* Analysis and design of beams, one-way slabs, and columns. Preliminary design of building frames using pattern loading and moment coefficients. Nonmajor graduate credit.

C E 350. Introduction to Transportation Planning. (3-0) Cr. 3. S. *Prereq: 3 credits in statistics, junior classification.* An introductory course for planning urban and regional transportation systems within government. Applications and impacts of legislation, financing, four-step planning process, population trends, land use, societal impacts, public transportation, master plans and traffic impact studies. Organization and coordination of the transportation planning function. Term paper and class participation required. Not available for graduation credit for students in civil engineering.

C E 355. Principles of Transportation Engineering. (2-0) Cr. 2. F.S. *Prereq: 111, 205, Phys 221, a course in statistics from the approved departmental list.* Introduction to planning and operations of transportation facilities. Vehicle/operation/infrastructure characteristics. Technological, economic and environmental factors. Travel demand modeling and capacity analysis.

C E 360. Geotechnical Engineering. (2-3) Cr. 3. F.S. *Prereq: E M 324, credit or enrollment in Geol 201.* Introduction to soil engineering and testing. Identification and classification tests, soil water systems, principles of settlement, stresses in soils, and shear strength testing; slope stability, retaining walls, bearing capacity. Nonmajor graduate credit.

C E 372. Engineering Hydrology and Hydraulics. (3-2) Cr. 4. F.S. *Prereq: E M 378, a course in statistics from the approved department list.* The hydrologic cycle: precipitation, infiltration, runoff, evapotranspiration, groundwater, and streamflow. Hydrograph analysis, flood routing, frequency analysis and urban hydrology. Applied hydraulics including pipe and channel flow with design applications in culverts, pumping, water distribution, storm and sanitary sewer systems. Design project required. Nonmajor graduate credit.

C E 382. Design of Concretes. (2-3) Cr. 3. F.S. *Prereq: Credit or enrollment in 360.* Physical and chemical properties of bituminous, portland, and other cements; aggregate properties and blending; mix design and testing of concretes; admixtures, mixing, handling, placing and curing; principles of pavement thickness design. Nonmajor graduate credit.

C E 383. Design of Portland Cement Concrete. (0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in 360.* For Con E students only. Physical and chemical properties of portland cement and p.c. concrete. Mix design and testing of p.c. concrete.

C E 388. Sustainable Engineering and International Development. (Cross-listed with A E, E E, M E, Mat E). (2-2) Cr. 3. F. *Prereq: Junior classification in engineering.* Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as non-government organizations (NGOs). Course readings, final project/design report.

C E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services, completion of two terms in residence in civil engineering, employment in civil engineering or related field.* Summer professional work period. Students must register for this course prior to commencing work. Satisfactory-fail only.

C E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* One semester maximum per academic year professional work period. Students must register for this course prior to commencing work. Satisfactory-fail only.

C E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

C E 403. Program and Outcome Assessment. Cr. R. F.S. *Prereq: Verification of undergraduate application for graduation by the end of the first week of class. Permission of instructor for students who are scheduled for summer graduation.* Assessment of C E Curriculum and educational objectives. Satisfactory-fail only.

C E 411. Bioprocessing and Bioproducts. (Dual-listed with 511). (Cross-listed with A E, BioE, BSE). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

C E 417. Land Surveying. (2-3) Cr. 3. S. *Prereq: 111.* Legal principles affecting the determination of land boundaries, public domain survey systems. Locating sequential and simultaneous conveyances. Record research, plat preparation, and land description. Study of selected court cases. Nonmajor graduate credit.

C E 420. Environmental Engineering Chemistry. (Dual-listed with 520). (2-3) Cr. 3. F. *Prereq: 326, Chem 177 and 178, Math 166.* Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilbria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions, and mass transfer principles. Individual laboratory practicals and group projects required.

C E 421. Environmental Biotechnology. (Dual-listed with 521). (2-2) Cr. 3. F. *Prereq: 326.* Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, bioenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens, parasites, and disinfection.

C E 424. Air Pollution. (Dual-listed with 524). (Cross-listed with EnSci, A E). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology
E. Agricultural sources of pollution

C E 428. Water and Wastewater Treatment Plant Design. (2-2) Cr. 3. S. *Prereq: 326.* Physical, chemical and biological processes for the treatment of water and wastewater including coagulation and flocculation, sedimentation, filtration, adsorption, chemical oxidation/disinfection, fixed film and suspended growth biological processes and sludge management.

C E 446. Bridge Design. (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 333, 334.* Bridge design in structural steel and reinforced concrete. Application of AASHTO Bridge Design Specifications. Analysis techniques for complex structures. Preliminary designs include investigating alternative structural systems and materials. Final designs include preparation of design calculations and sketches. Nonmajor graduate credit.

C E 447. Building Design. (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 333, 334.* Building design in structural steel and reinforced concrete. Investigation of structural behavior of frameworks. Lateral load resisting systems. Application of current building codes and design specifications. Review of building designs. Preliminary designs include investigating alternative structural systems. Final designs include preparation of design calculations and sketches. Nonmajor graduate credit.

C E 451. Urban Transportation Planning Models. (Dual-listed with 551). (2-2) Cr. 3. F. *Prereq: 350 or 355.* Urban transportation planning context and process. Project planning and programming. Congestion, mitigation, and air quality issues. Transportation data sources. Travel demand and network modeling. Use of popular travel demand software and applications of geographic information systems. Nonmajor graduate credit.

C E 453. Highway Design. (3-3) Cr. 4. F.S. *Prereq: 306, 355, 372, 382.* Introduction to traffic engineering and highway planning. Design, construction, and maintenance of highway facilities; earthwork, drainage structures; pavements. Preparation of environmental impact statement. A complete design project is required. Oral and written reports. Computer applications. Nonmajor graduate credit.

C E 460. Foundation Engineering. (3-0) Cr. 3. F.S. *Prereq: 360.* Fundamentals of foundation engineering. Exploration, sampling, and in-situ tests. Shallow and deep foundations. Settlement and bearing capacity analyses. Stability of excavations and earth retaining structures. Nonmajor graduate credit.

C E 473. Groundwater Hydrology. (Dual-listed with 573). (3-0) Cr. 3. F. *Prereq: 372.* Principles of groundwater flow, hydraulics of wells, super-position, slug and pumping tests, streamlines and flownets, and regional groundwater flow. Contaminant transport. Computer modeling. Nonmajor graduate credit.

C E 483. Pavement Analysis and Design. (Dual-listed with 583). (3-0) Cr. 3. *Prereq: 360 and 382.* Analysis, behavior, performance, and structural design of pavement systems. Topics include climate factors, rehabilitation, life cycle design economics, material and system response, pavement foundations and traffic loadings. Development of models for and analysis of pavement systems. Use of transfer functions relating pavement response to pavement performance. Evaluation and application of current and evolving pavement design practices and procedures. Mechanistic-based pavement design techniques and concepts. Analysis of the effects of maintenance activities on pavement performance and economic evaluation of pavement systems. Nonmajor graduate credit.

C E 485. Civil Engineering Design I. (1-2) Cr. 2. F.S. *Prereq: 306, 326, 333 or 334, 355, Sp Cm 212.* The civil engineering design process, interacting with the client, identification of the engineering problems, development of a technical proposal, identification of design criteria, cost estimating, planning and scheduling, codes and standards, development of feasible alternatives, selection of best alternative, oral presentation and poster.

C E 486. Civil Engineering Design II. (1-4) Cr. 3. F.S. *Prereq: 326, 333 or 334, 382; credit or enrollment in 428 or 453, and 485.* The engineering design computations, case histories of design inadequacies, environmental impact, safety and health in the work place, ethics, contract documents, design plans and specifications, teamwork, synthesis of previous coursework in a group project, oral presentations.

C E 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Independent study in any phase of civil engineering. Pre-enrollment contract required.
H. Honors

C E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

C E 501. Preconstruction Project Engineering and Management. (3-0) Cr. 3. *Prereq: Con E 221 and 421.* Application of engineering and management control techniques to construction project development from conceptualization to notice to proceed. Determinants of construction project success, conceptual estimating, design and engineering planning for automated construction techniques, constructability review procedures, planning for safety, value engineering.

C E 502. Construction Project Engineering and Management. (3-0) Cr. 3. *Prereq: Con E 221 and 421.* Application of engineering and management control techniques to construction projects. Construction project control techniques, equipment selection and utilization, project administration, construction process simulation, Quality Management, and productivity improvement programs.

C E 503. Construction Management Functions and Processes. (3-0) Cr. 3. *Prereq: Con E 421.* Analysis of critical construction management skills. Analysis of organizational systems related to construction management. Case studies. Analysis of theories of motivation, planning, leadership, organizational change, etc., as they relate to field construction operations.

C E 505. Design of Construction Systems. (3-0) Cr. 3. *Prereq: 334, 360, Con E 322 and 340.* Advanced design of concrete formwork and falsework systems. Design for excavation and marine construction including temporary retaining structures and cofferdams. Aggregate production operations, including blasting, crushing, and conveying systems. Rigging system design.

C E 506. Case Histories in Construction Documents. (3-0) Cr. 3. *Prereq: Con E 221, credit or enrollment in Con E 421.* Study of cases involving disputes, claims, and responsibilities encountered by management in construction contract documents. Analysis of methods of resolving differences among the owner, architect, engineer, and construction contractor for a project.

C E 510. Information Technologies for Construction. (3-0) Cr. 3. *Prereq: Con E 421, Engr 160 or C E 160 or equivalent.*Information technologies including microcomputer based systems, management information systems, automation technologies, computer-aided design, and expert systems and their application in the construction industry. Overview of systems acquisition, communications, and networking.

C E 511. Bioprocessing and Bioproducts. (Dual-listed with 411). (Cross-listed with A E, BRT, BSE). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis. Term paper for graduate level only.

C E 513. Geodetic and Satellite Surveying. (2-3) Cr. 3. *Prereq: 111.* Triangulation and trilateration observation and computation. Precise leveling. Electronic distance measuring instrument calibration. Geodetic astronomy for latitude and longitude determination. Global positioning systems of satellite observation and computation.

C E 520. Environmental Engineering Chemistry. (Dual-listed with 420). (Cross-listed with EnSci). (2-3) Cr. 3. *Prereq: Chem 177 and 178, Math 166.* Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilibria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions and mass transfer principles. Individual laboratory practicals and group projects required. Term paper and oral presentation for graduate level only.

C E 521. Environmental Biotechnology. (Dual-listed with 421). (Cross-listed with EnSci). (2-2) Cr. 3. *Prereq: 326.* Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, bioenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens and parasites, and disinfection. Term paper and oral presentation.

C E 522. Water Pollution Control Processes. (Cross-listed with EnSci). (2-2) Cr. 3. *Prereq: 521.* Fundamentals of biochemical processes, aerobic growth in a single CSTR, multiple events in complex systems, and techniques for evaluating kinetic parameters; unit processes of activated sludge system, attached growth systems, stabilization and aerated lagoon systems, biosolids digestion and disposal, nutrient removal, and anaerobic treatment systems.

C E 523. Physical-Chemical Treatment Process. (Cross-listed with EnSci). (2-2) Cr. 3. *Prereq: 520.* Material and energy balances. Principles and design of physical-chemical unit processes; including screening, coagulation, flocculation, chemical precipitation, sedimentation, filtration, lime softening and stabilization, oxidation, adsorption, membrane processes, ion exchange and disinfection; recovery of resources from residuals and sludges; laboratory exercises and demonstrations; case studies in mineral processing and secondary industries.

C E 524. Air Pollution. (Dual-listed with 424). (Cross-listed with A E, EnSci). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology
E. Agricultural sources of pollution

C E 527. Solid Waste Management. (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 326.* Planning and design of solid waste management systems; includes characterization and collection of domestic, commercial, and industrial solid wastes, waste minimization and recycling, energy and materials recovery, composting, incineration, and landfill design.

C E 529. Hazardous Waste Management. (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 326.* Regulatory requirements for the classification, transport, storage and treatment of hazardous wastes. Analysis and design of alternatives for treatment and disposal technologies, including physical, chemical, and biological treatment, solidification, incineration, and secure landfill design. Regulatory requirements and procedures for hazardous waste contaminated site investigations and risk analysis. Analysis and design of remedial action alternatives for site restoration.

C E 532. Structural Analysis II. (3-0) Cr. 3. F. *Prereq: 332.* Analysis of indeterminate structural problems by the force and generalized direct displacement methods. Direct stiffness method for 2-D frames, grids, 3-D frames. Additional topics for the stiffness method.

C E 533. Structural Steel Design II. (3-0) Cr. 3. *Prereq: 333.* Every third semester, offered F 2009. Development of the AISC design equations for and the design of tension members, columns, beams, beam-columns, and plate girders for Load and Resistance Factor Design. Elastic and inelastic buckling of members and member elements. Torsion of W-shapes.

C E 534. Reinforced Concrete Design II. (2-2) Cr. 3. *Prereq: 334.* Every third semester, offered F 2010. Design of reinforced concrete long columns, floor slabs, building frames, isolated footings and combined footings. Design and behavior considerations for torsion, biaxial bending, structural joints and shear friction. Introduction to cold-formed composite steel and composite floor slab design.

C E 535. Prestressed Concrete Structures. (3-0) Cr. 3. *Prereq: 334.* Every third semester, offered F 2009. Design of prestressed concrete structures, review of hardware, stress calculations, prestress losses, section proportioning, flexural design, shear design, deflections, statically indeterminate structures.

C E 536. Masonry and Timber Design. (2-2) Cr. 3. *Prereq: 334.* Every third semester, offered S 2010. Behavior and design of clay and concrete masonry beams, columns, walls, and structural systems. Behavior and design of timber and laminated timber beams, columns, connections, and structural systems.

C E 541. Dynamic Analysis of Structures. (3-0) Cr. 3. *Prereq: E M 345 and credit or enrollment in 532.* Every third semester, offered S 2010. Single and multi-degree-of-freedom systems. Free and forced vibrations. Linear and nonlinear response. Modal analysis. Response spectra. Seismic analysis.

C E 542. Structural Analysis by Finite Elements. (3-0) Cr. 3. S. *Prereq: 532.* Use of the finite element method for the analysis of complex structural configurations. Plane stress, plate and shell finite elements. General purpose finite element programs.

C E 545. Seismic Design. (3-0) Cr. 3. *Prereq: 333, 334.* Every third semester, offered F 2010. Seismic hazard in the United States. Engineering characteristics of ground motions. Structural damage in past earthquakes. Capacity design Philosophy for seismic resistant design. Conceptual design of structures. Capacity design process including design of structural members.

C E 547. Analysis and Design of Plate and Slab Structures. (3-0) Cr. 3. *Prereq: 334, E M 514, Math 266.* Bending and buckling of thin plate components in structures utilizing classical and energy methods. Analysis of shell roofs by membrane and bending theories.

C E 550. Advanced Highway Design. (3-0) Cr. 3. *Prereq: 453.* Evaluation of rural and urban street and highway design theory. Establishment of design criteria, application to street and highway systems, and to intersections and interchanges; drainage design, and urban freeway design aspects. Computer applications.

C E 551. Urban Transportation Planning Models. (Dual-listed with 451). (2-2) Cr. 3. F. *Prereq: 350 or 355.* Urban transportation planning context and process. Project planning and programming. Congestion, mitigation, and air quality issues. Transportation data sources. Travel demand and network modeling. Use of popular travel demand software and applications of geographic information systems. Term project required for graduate credit.

C E 552. Traffic Safety, Operations, and Maintenance. (2-2) Cr. 3. *Prereq: 355.* Engineering aspects of highway traffic safety. Reduction of accident incidence and severity through highway design and traffic control. Accident analysis. Legal implications. Safety in highway design, maintenance, and operation.

C E 553. Traffic Engineering. (2-2) Cr. 3. *Prereq: 355.* Driver, pedestrian, and vehicular characteristics. Traffic characteristics; highway capacity; traffic studies and analyses. Principles of traffic control for improved highway traffic service. Application of intersection, corridor or network analysis computer evaluation and optimization tools.

C E 554. Advanced Technology in Transportation. (3-0) Cr. 3. *Prereq: 350, 355, graduate standing in transportation or civil engineering.* Advanced traffic control systems including signal systems technology and field assets. Regional traffic management and communications centers. Traffic surveillance, monitoring and incident management. Advanced traveler information systems. The automated highway.

C E 555. Advanced Traffic Operations. (3-0) Cr. 3. *Prereq: 553.* Solve real-world traffic engineering problems; explore interactions between traffic systems components; advanced skills related to signal timing, coordination, and optimization; practical applications of common traffic engineering tools.

C E 556. Transportation Data Analysis. (3-0) Cr. 3. *Prereq: 355, Stat 101 or 105.* Analysis of transportation data, identification of data sources and limitations. Static and dynamic data elements such as infrastructure characteristics, flow and operations-related data elements. Spatial and temporal extents data for planning, design, operations, and management of transportation systems. Summarizing, analyzing, modeling, and interpreting data. Use of information technologies for highways, transit, and aviation systems.

C E 557. Transportation Systems Analysis. (3-0) Cr. 3. *Prereq: 355, 3 credits in statistics or probability.* Travel studies and analysis of data. Travel projections. Public transportation forecasts and analyses. Statewide, regional, and local transportation system planning. Corridor travel planning. Optimization of systems.

C E 558. Transportation Systems Development and Management Laboratory. (2-2) Cr. 3. *Prereq: 350 or 355.* Study of designated problems in traffic engineering, urban transportation planning, and urban development. Forecasting and evaluation of social, economic, and environmental impact of proposed solutions; considerations of alternatives. Formulation of recommendations and publication of a report. Presentation of recommendations in the host community.

C E 559. Transportation Infrastructure/Asset Management. (3-0) Cr. 3. *Prereq: 355 or 453, 382.* Engineering management techniques for maintaining and managing infrastructure assets. Systematic approach to management through value engineering, engineering economics, and life cycle cost analysis. Selection and scheduling of maintenance activities. Analysis of network-wide resource needs. Project level analysis.

C E 560. Fundamentals of Soil Mechanics. (3-0) Cr. 3. *Prereq: 360.* Limiting stress analysis, stress paths, introduction to critical state soil mechanics, constitutive models, soil strength under various drainage conditions, seepage, pore pressure parameters, consolidation, slope stability and retaining wall applications.

C E 561. Applied Foundation Engineering. (2-3) Cr. 3. *Prereq: 460.* Lateral earth pressure theories and retaining structures. Field investigations, in-situ testing, foundations on expansive soils, and analysis and design of shallow and deep foundations. Foundation engineering reports.

C E 562. Site Evaluations for Civil Engineering Projects. (2-2) Cr. 3. *Prereq: 360.* Identification and mapping of engineering soils from airphotos. Use of remote sensing and GIS, planning subsurface investigations, geomaterials prospecting, water resource applications.

C E 563. Experimental Methods in Geo-Engineering. (1-4) Cr. 3. *Prereq: 360.* Principles of geo-engineering laboratory testing including the conduct, analysis, and interpretation of soil classification tests, compaction tests, permeability tests, consolidation, triaxial, direct and ring shear tests. Issues regarding laboratory testing versus field testing and acquisition, transport, storage, and preparation of samples for geotechnical testing. Field and laboratory geotechnical monitoring techniques, including the measurements of deformation, strain, total stress and pore water pressure.

C E 564. Application of Numerical Methods to Geotechnical Design. (3-0) Cr. 3. *Prereq: 560.* Application of numerical methods to analysis and design of foundations, underground structures, and soil-structure interaction. Application of slope stability software. Layered soils, bearing capacity and settlement for complex geometries, wave equation for piles, and foundation vibrations.

C E 565. Fundamentals of Geomaterials Behavior. (2-3) Cr. 3. *Prereq: 382.* Atoms and molecules, crystal chemistry, clay minerals, structure of solids, phase transformations and phase equilibria. Surfaces and interfacial phenomena, colloid chemistry, mechanical properties. Applications to soils and civil engineering materials. Overview of state-of-the-art instrumental techniques for analysis of the physicochemical properties of soils and civil engineering materials.

C E 567. Geomaterials Stabilization. (2-2) Cr. 3. *Prereq: 565.* Soil and aggregate physical and chemical stabilization procedures. Soil stabilization analysis and design. Ground modification methods. Geosynthetics application and design.

C E 570. Applied Hydraulic Design. (2-2) Cr. 3. *Prereq: 372.* Flow characteristics in natural and constructed channels; principles of hydraulic design of culverts, bridge waterway openings, spillways, hydraulic gates and gated structures, pumping Stations, and miscellaneous water control structures; pipe networks, mathematical modeling. Design project.

C E 571. Surface Water Hydrology. (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 372.* Analysis of hydrologic data including precipitation, infiltration, evapotranspiration, direct runoff and streamflow; theory and use of frequency analysis; theory of streamflow and reservoir routing; use of deterministic and Statistical hydrologic models. Fundamentals of surface water quality modeling, point and non-point sources of contamination. Design project.

C E 572. Analysis and Modeling Aquatic Environments. (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 372.* Principles of surface water flows and mixing. Introduction to hydrologic transport and water quality simulation in natural water systems. Advection, diffusion and dispersion, chemical and biologic kinetics, and water quality dynamics. Applications to temperature, dissolved oxygen, primary productivity, and other water quality problems in rivers, lakes and reservoirs. Deterministic vs. stochastic models.

C E 573. Groundwater Hydrology. (Dual-listed with 473). (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 372.* Principles of groundwater flow, hydraulics of wells, super-position, slug and pumping tests,

streamlines and flownets, and regional groundwater flow. Contaminant transport. Computer modeling. Individual and group projects.

C E 574. Environmental Impact Assessment. (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 4 courses in natural, biological or engineering sciences and senior or above classification.* Review of federal and state requirements for environmental impact assessment, requirements of the National Environmental Policy Act and Council on Environmental Quality, methods of evaluating the environmental impacts on the physical, biological, socioeconomic, cultural/historical, human health and psychological environments, public participation in EIS, review and evaluate project environmental impact statements. An environmental impact assessment of a proposed project will be completed in small teams.

C E 576. Environmental Flows. (3-0) Cr. 3. *Prereq: EM 378 or equivalent.* Analysis and applications of flows in civil engineering, environmental engineering, and water resources. Primary topics include conservation laws, laminar flow, turbulence, mixing, diffusion, dispersion, water waves, and boundary layers. Associated applications include particle settling, transfer at air-water and water-sediment boundaries, flow and friction in pipes and open channels, contaminant transport, waves in lakes, jets, plumes, and salt wedges.

C E 581. Geotechnical and Materials Engineering Seminar. Cr. R. Repeatable. *Prereq: Graduate classification.* (1-0) Students and outside/invited speakers give weekly presentations about the ongoing research work and Geotechnical and Materials Engineering issues. Satisfactory-fail only.

C E 583. Pavement Analysis and Design. (Dual-listed with 483). (3-0) Cr. 3. *Prereq: 360 and 382.* Analysis, behavior, performance, and structural design of pavement systems. Topics include climate factors, rehabilitation, life cycle design economics, material and system response, pavement foundations and traffic loadings. Development of models for and analysis of pavement systems. Use of transfer functions relating pavement response to pavement performance. Evaluation and application of current and evolving pavement design practices and procedures. Mechanistic-based pavement design techniques and concepts. Analysis of the effects of maintenance activities on pavement performance and economic evaluation of pavement systems.

C E 586. Advanced Asphalt Materials. (2-3) Cr. 3. *Prereq: 382.* Advanced asphalt concrete (SUPERPAVE) mix designs. Aggregates. Admixtures. Production and construction, quality control and inspection. Nondestructive testing. Pavement thickness design. Materials engineering reports.

C E 587. Advanced Portland Cement Concretes. (2-3) Cr. 3. *Prereq: 382 or 383.* Hydraulic cements, aggregates, admixtures, and mix design; concrete production, quality control, early-age properties and durability. Concrete distress examination, identification, prevention, and nondestructive testing; advanced concrete technology, high-strength and high performance concrete.

C E 590. Special Topics. Cr. arr. Repeatable. F.S.SS. Pre-enrollment contract required.

C E 591. Seminar in Environmental Engineering. Cr. R. Repeatable. F.S. *Prereq: Graduate classification.* (1-0) Contemporary environmental engineering issues. Outside speakers. Review of ongoing research in environmental engineering. Satisfactory-fail only.

C E 594. Special Topics in Construction Engineering and Management. Cr. arr. Repeatable. *Prereq: Con E 322, Con E 340 or C E 306, and permission of instructor.* Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:
A. Planning and Scheduling
B. Computer Applications for Planning and Scheduling
C. Cost Estimating
D. Computer Applications for Cost Estimating
E. Project Controls
F. Computer Applications for Project Controls
G. Integration of Planning, Scheduling and Project Controls
J. Trenchless Technologies
K. Electrical and Mechanical Construction
L. Advanced Building Construction Topics
M. Design Build Construction
N. Industrial Construction
O. Highway and Heavy Construction
P. Advanced Technologies
Q. Construction Quality Control
R. Risk Management
S. Building Information Modeling

C E 595. Research Methods in Construction Engineering and Management. (0-1) Cr. 1. *Prereq: Credit or enrollment in 501, 502, 503, or 505.* Assigned readings and reports on research methods to solve construction engineering and management problems such as robotics, project controls, automation, etc. Identification of research methods and priorities, selection and development of research design, and critique of research in construction engineering and management.

C E 599. Creative Component. Cr. arr. Repeatable. Pre-enrollment contract required. Advanced topic for creative component report in lieu of thesis.

Courses for graduate students

C E 622. Advanced Topics in Environmental Engineering. (2-0) Cr. 2. Repeatable. *Prereq: Permission of environmental engineering graduate faculty.* Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:
A. Water Pollution Control
B. Water Treatment
C. Solid and Hazardous Waste
D. Water Resources

C E 649. Advanced Topics in Structural Engineering. (3-0) Cr. 3. Repeatable. *Prereq: Permission of structural engineering graduate faculty.* Advanced concepts in structural engineering topics. Emphasis for a particular offering will be selected from the following topics:
A. Behavior of Metal Structures
B. Design of Concrete Shells
D. Advanced Matrix Analysis of Structures
E. Dynamic Design of Structures
F. Reliability Assessment of Structures.

C E 690. Advanced Topics. Cr. arr. Repeatable. F.S.SS. Pre-enrollment contract required.

C E 697. Engineering Internship. Cr. R. Repeatable. *Prereq: Permission of coop advisor, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

C E 699. Research. Cr. arr. Repeatable. *Prereq: Pre-enrollment contract required.* Advanced topic for thesis/dissertation.

Classical Studies

www.iastate.edu/~classics

(Interdepartmental Undergraduate Program)

Program Committee: M. Henry, Chair; G. Betcher, T. Butler, J. Cunnally, J. Goodwin, M. Graham, J. Hagge, D. Hollander, R. Meyer, M. Mook

The Classical Studies program is a cross-disciplinary program in the College of Liberal Arts and Sciences which offers an integrated curriculum of courses in the languages, literatures, history, and thought of ancient Greece and Rome from prehistoric times to the reign of the Emperor Constantine. Complete and current information about the Program may be found on-line at: www.iastate.edu/ ~classics/

Courses in Classical Studies provide background for students whose major fields of study or career interests include Anthropology, English, World Languages and Cultures, History, Music, Philosophy, Women's Studies, law, medicine, material culture, political science, the life sciences and related fields. Students who wish to pursue an interdisciplinary major in Classical Studies should consult the Program Chair.

A student who wishes to declare a minor must successfully complete the following requirements: (a) Greek 102 or Latin 102; (b) Cl St 273 or 275; (c) Three additional courses (nine credits) from the courses listed below (primary or departmental), or as approved by the program committee

Courses primarily for undergraduate students

Cl St 273. Greek and Roman Mythology. (3-0) Cr. 3. F.SS. Survey of the legends, myths of the classical world with emphasis on the principal gods, and heroes, and their relation to ancient social, psychological, and religious practices; some attention may be given to important modern theories.
H. Honors (4-0) Cr. 4.

Cl St 275. The Ancient City. (3-0) Cr. 3. S. Examination of ancient urban life, including historical context, physical space, material culture, religion, literature, and art; examination of civic identity (the "polis"). Contrast between the concepts of urban and rural. Examples drawn from specific ancient cities; some attention to modern methods of recovering the conditions of ancient urban life and the fundamental concept of the city in European history.
H. Honors. (4-0) Cr. 4.

Cl St 304. Cultural Heritage of the Ancient World. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* Historical examination of art, literature, thought, and religious beliefs of major civilizations of the ancient Mediterranean countries until the end of the 8th century.

Cl St 310. Ancient Philosophy. (Cross-listed with Phil). (3-0) Cr. 3. F. *Prereq: Phil 201.* Survey of ancient Greek Philosophy, focusing on the pre-Socratics, Plato, and Aristotle. Questions concerning being, knowledge, language, and the good life are treated in depth. Nonmajor graduate credit.

Cl St 350. Rhetorical Theories and Issues in Context. (Cross-listed with Engl, Sp Cm). (3-0) Cr. 3. S. *Prereq: Engl 250.* Ideas about the relationship between rhetoric and Society in contemporary and historical contexts. An exploration of classical and contemporary rhetorical theories in relation to selected topics that may include politics, gender, race, ethics, education, science, or technology.

Cl St 353. World Literature: Western Foundations through Renaissance. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Engl 250.* Representative works from the drama, epics, poetry, and prose of the Ancient World through the late sixteenth century. May include Homer, Aeschylus, Sappho, Catullus, Dante, Marie de France, Boccaccio, Christine de Pizan, Cervantes, and others.

Cl St 367. Christianity in the Roman Empire. (Cross-listed with Relig). (3-0) Cr. 3. An historical introduction to the rise of Christianity in the Roman empire, with special attention to the impact of Greco-Roman culture on the thought and practice of Christians and the interaction of early Christians with their contemporaries. Nonmajor graduate credit.

Cl St 372. Greek and Roman Tragedy and Comedy. (3-0) Cr. 3. S. *Prereq: 273 or 275 or one course in Latin or Greek or English 250.* Greek and Roman drama from the beginnings until today. Readings in English from authors such as Aeschylus, Sophocles, Euripides, Aristophanes, Menander, Plautus, Terence, Seneca. Course may cover performance, theories of comedy and tragedy, recent and current expressions of the comic and tragic in film and other media.
H. Honors (4-0) Cr. 4.

Cl St 373. Heroes of Greece, Rome, and Today. (3-0) Cr. 3. F. *Prereq: 273 or 275 or one course in Latin or Greek or English 250.* Cultural and political significance of ancient epic, especially in Greece and Rome. Course may include study of the heroic code in antiquity and its modern expressions including in film. Readings in English from authors such as Homer and Vergil.
H. Honors (4-0) Cr. 4.

Cl St 374. Women in the Ancient Mediterranean World. (Cross-listed with Hist, W S). (3-0) Cr. 3. Repeatable. S. *Prereq: Any one course in Cl St, W S, Latin, or Greek.* Chronological and topical survey of the Status of women in the Ancient Mediterranean world; study of constructs of the female and the feminine. Readings from ancient and modern sources. Emphasis on either the Greek world and Hellenistic Egypt, or Hellenistic Egypt and Rome.
A. Hellenic World and Hellenistic Egypt
B. Roman World including Roman Egypt

Cl St 376. Classical Archaeology. (Cross-listed with Hist, Relig). (3-0) Cr. 3. Repeatable. S. Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.
A. Bronze Age (Minoan and Mycenaean palatial cultures) and Early Iron Age Greece. (ca 3000-700 BCE).
B. Archaic through Hellenistic Greece (ca 700-30 BCE).

Cl St 383. Greek and Roman Art. (Cross-listed with Art H, Dsn S). (3-0) Cr. 3. Greek art from Neolithic through Hellenistic periods. Roman art from the traditional founding to t he end of the empire in the West. Nonmajor graduate credit.

Cl St 394. The Archaeology of Greece: An Introduction. (2-0) Cr. 2. S. Introduction to the topography, history, archaeology, monuments and art of Greece from the Bronze Age through the Ottoman period; attention given to the culture of modern Greece, preparatory to study abroad in Greece (Cl St 395).

Cl St 395. Study Abroad: The Archaeology of Greece. Cr. arr. SS. *Prereq: 394.* Supervised on-site instruction in the archaeology, monuments, and art of Greece from the Bronze Age through the Ottoman period; attention given to the culture of modern Greece.

Cl St 402. Greek Civilization. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* Ancient Greece from the Bronze Age to the Hellenistic period; evolution of the Greek polis and its cultural contributions with a particular emphasis on the writings of Herodotus and Thucydides.

Cl St 403. Roman Civilization. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* Ancient Rome from the Regal Period to the Fall of the Western Empire; evolution of Roman institutions and Rome's cultural contributions studied through original sources. Nonmajor graduate credit.

Cl St 404. Roman Social History. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines major topics in Roman social history during the late Republic and early Empire such as class, family, slavery, religion and the economy. Nonmajor graduate credit.

Cl St 430. Western Political Thought: Plato to Machiavelli. (Cross-listed with Pol S). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European History.* Major concepts in original texts of classical, medieval, and renaissance authors: justice, community, man's basic nature; natural law; force; Society outside the political order. Nonmajor graduate credit.

Cl St 480. Seminar in Classical Studies. (3-0) Cr. 3. *Prereq: 30 credits in Classical Studies or related courses, permission of Program Chair.* Advanced study of a selected topic in Classical Studies. Research paper or project selected by the student.

Cl St 490. Independent Study. Cr. arr. Repeatable. *Prereq: 7 credits in classical studies at the 200 level or higher; permission of the Program Chair.* Designed to meet the needs of students who wish to study specific topics in classical civilization in areas where courses are not offered, or to pursue such study beyond the limits of existing courses.

Courses for graduate students, major or minor, open to qualified undergraduates

Cl St 512. Proseminar in Ancient European History. (Cross-listed with Hist). (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Readings in European History.
A. Ancient (Same as Hist 512A)

Cl St 594. Seminar in Ancient European History. (Cross-listed with Hist). (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Topics vary each time offered.
A. Ancient (Same as Hist 594A)

Primary Courses (Offered by Other Departments)

Art H 383. Greek and Roman Art. See *Art and Design.*

Greek 101. Elementary Ancient Greek I. See *World Languages and Cultures.*

Greek 102. Elementary Ancient Greek II. See *World Languages and Cultures.*

Greek 201. Intermediate Classical Greek. See *World Languages and Cultures.*

Greek 332. Introduction to Classical Greek Literature. See *World Languages and Cultures.*

Greek 441. Advanced Readings in Greek Literature. See *World Languages and Cultures.*

Greek 442. Advanced Topics in Greek Literature. See *World Languages and Cultures.*

Greek 490. Independent Study. See *Foreign Language and Literature* website. (www.language.iastate.edu)

Hist 280. Introduction to History of Science I. See *History.*

Latin 101. Elementary Latin I. See *World Languages and Cultures.*

Latin 102. Elementary Latin II. See *World Languages and Cultures.*

Latin 201. Intermediate Latin. See *World Languages and Cultures.*

Latin 332. Introduction to Latin Literature. See *World Languages and Cultures.*

Latin 441. Advanced Readings in Latin Literature. See *World Languages and Cultures.*

Latin 442. Advanced Topics in Latin Literature. See *World Languages and Cultures.*

Latin 490. Independent Study. See *World Languages and Cultures* website. (www.language.iastate.edu)

Communication Studies

(Administered by the College of Liberal Arts and Sciences)

The Communication Studies Major

The communication studies major prepares students for careers in business and industry and graduate education. Students majoring in ComSt will find their career opportunities enhanced in professions requiring applied communication expertise, e.g., human resource management, personnel, public relations, training and development, sales, management, organizational development, business communication, law, and international and intercultural relations.

ComSt majors master a focused course of inquiry into the contemporary study of human communication. The ComSt major provides this focus through emphasis in applied communication theory and research in interpersonal, small group, organizational, and intercultural communication.

ComSt majors must earn at least 120.5 credits, with 45 credits at the 300-400 levels, and a minimum of 33 credits in ComSt.

Communication Proficiency Requirement:

To meet the University's Communication Proficiency requirement students are required to take Engl 302, 309, 314, or 415. An average of C- is required in English 150, 250 (or 250H), and this additional writing course.

The Communication Studies Major

Core Requirements (15 credits)
- 3 Introduction to Communication Studies, ComSt 101
- 3 Introduction to Interpersonal Communication, ComSt 102
- 3 Introduction to Communication Research Methods, ComSt 203
- 3 Human Communication Theory, ComSt 301

Select one of these courses:
- 3 Professional Communication, ComSt 214
- 3 Conflict Management, ComSt 218
- 3 Fundamentals of Public Speaking, SpCm 212

Upper Division Requirements (Select five course/15 credits)
- 3 Language, Thought and Action, ComSt 305
- 3 Intercultural Communication, ComSt 310
- 3 Relational Communication, ComSt 311
- 3 Organizational Communication, ComSt 314
- 3 Small Group Communication, ComSt 317
- 3 Nonverbal Communication, ComSt 325
- 3 Computer Mediated Communication, ComSt 330
- 3 Semantics, SpCm 305
- 3 Gender and Communication, ComSt 323

Select one of these seminars:
- 3 Communication Theory or Research, ComSt 404A
- 3 Interpersonal Communication, ComSt 404B
- 3 Small Group Communication, ComSt 404C
- 3 Organizational Communication, ComSt 404D
- 3 Intercultural Communication, ComSt 404E
- 3 Nonverbal Communication, ComSt 404F
- 3 Training and Development, ComSt 404G
- 3 Computer Mediated Communication, ComSt 404H

33 Total

Enhancement Requirement (4 credits)
- 4 Computer Applications, Com S 103
  Recommended: Stat 101 or equivalent

Communication Studies. The requirements for a minor in ComSt may be fulfilled by credit in ComSt 101, ComSt 203, ComSt 301 plus at least 9 additional hours of communication studies, of which 6 credits are in courses numbered 300 or above. Students must earn a grade of C or better in all courses taken for the minor. No credits in 490, 499, or 590 may apply toward the minor.

Communication Studies (ComSt)

Courses primarily for undergraduate students

ComSt 101. Introduction to Communication Studies. (3-0) Cr. 3. An introduction to communication theory, the development and functions of communication, and a survey of interpersonal, small group, organizational, and intercultural communication.

ComSt 102. Introduction to Interpersonal Communication. (3-0) Cr. 3. Application of communication principles, theory, and research to the process of interpersonal communication; includes verbal, nonverbal, listening, conflict management, and communication skills most relevant to a broad range of interpersonal settings.

ComSt 203. Introduction to Communication Research Methods. (3-0) Cr. 3. An introduction to analyzing and conducting communication research. Includes theory development, statistics, and methodologies.

ComSt 214. Professional Communication. (3-0) Cr. 3. Communication theory and skill development in organizational settings. Emphasis on: interpersonal skill development, team and meeting facilitation, informational interviewing, and team presentations and self-assessment.

ComSt 218. Conflict Management. (3-0) Cr. 3. Exploration of communication theories, principles and methods associated with effective conflict management.

ComSt 301. Human Communication Theory. (3-0) Cr. 3. *Prereq: 101.* Examination of the major theories related to human communication; with particular emphasis on theories underlying interpersonal, small group, organizational, and intercultural communication.

ComSt 305. Language, Thought and Action. (Cross-listed with Sp Cm, Ling). (3-0) Cr. 3. F.S.SS. *Prereq: Engl 250.* The study of symbolic processes and how meaning is conveyed in words, sentences, and utterances; discussion of modern theories of meaning; and an exploration of relationships among language, thought and action. Nonmajor graduate credit.

ComSt 310. Intercultural Communication. (3-0) Cr. 3. *Prereq: 101 or 102, 203, 301.* Examines the theories, principles and research on intercultural communication to enhance cultural sensitivity and to recognize, accept, and adapt to cultural diversity. Interactive assignments.

ComSt 311. Relational Communication. (3-0) Cr. 3. *Prereq: 102, 203, 301.* A study of contemporary interpersonal communication theories and research. Emphasis on relational development research including initiation, maintenance, conflict management, and dissolution.

ComSt 314. Organizational Communication. (3-0) Cr. 3. *Prereq: 101 or 102, 203, 301.* Theory and research in organizational communication; strategies for assessing and improving individual and organizational communication effectiveness; an understanding of how organizational meaning is created and sustained through human communication.

ComSt 317. Small Group Communication. (3-0) Cr. 3. *Prereq: 101 or 102, 203, 301.* Theory and research in small group communication; application to group decision-making and leadership. Includes communication analyses of groups and teams.

ComSt 323. Gender and Communication. (Cross-listed with Sp Cm, W S). (3-0) Cr. 3. F. *Prereq: Sp Cm 212.* The rhetorical strategies women and men use to succeed in oral communication; the theory, principles, and practice of effective gender communication in a variety of settings. Nonmajor graduate credit.

ComSt 325. Nonverbal Communication. (Cross-listed with Sp Cm). (3-0) Cr. 3. *Prereq: ComSt 101 or 102, 203, 301.* Theory and research in nonverbal communication; exploration of nonverbal subcodes; function of nonverbal communication in various contexts; student-designed investigations.

ComSt 330. Computer Mediated Communication. (3-0) Cr. 3. *Prereq: 101 or 102, 203, 301.* Theories and perspectives related to mediated communication in interpersonal and organizational settings. Focus on how new technology will impact human interaction with computers as well as between and among humans.

ComSt 404. Seminar in Communication Studies. (Dual-listed with 504). (3-0) Cr. 3. Repeatable. *Prereq: ComSt 301 plus 9 additional hours of 300 level ComSt courses.*
A. Communication Theory or Research
B. Interpersonal Communication
C. Small Group Communication
D. Organizational Communication
E. Intercultural Communication
F. Nonverbal Communication
G. Training and Development
I. Computer Mediated Communication

ComSt 490. Independent Study. Cr. arr. Repeatable. *Prereq: 9 credits in communication studies and junior classification.* Application must be submitted for approval the semester prior to the independent study.

ComSt 499. Professional Internship. Cr. arr. Repeatable. Four hundred hours of on-site work is required for 3 hours credit. Registration by application only. Application must be submitted to Communication Studies faculty adviser for approval the semester prior to the internship.

Courses primarily for graduate students, open to qualified undergraduate students

ComSt 504. Seminar in Communication Studies. (Dual-listed with 404). (3-0) Cr. 3. Repeatable. F.S. *Prereq: Graduate standing and permission of instructor.*
A. Communication Theory and Research
B. Interpersonal Communication
C. Small Group Communication
D. Organizational Communication
E. Intercultural Communication
F. Nonverbal Communication
G. Training and Development
I. Computer Mediated Communication

ComSt 590. Special Topics. Cr. arr. Repeatable. Application must be submitted for approval the semester prior to the independent study.

Community Development

www.gpidea.org

(Interinstitutional Graduate Program)

Participating Institutions:

Iowa State University
Kansas State University
University of Nebraska
North Dakota State University
South Dakota State University

Community Development is an interinstitutional distance education program offered through the Web. The student selects a home institution, which grants the degree. After admission at the home institution, the student takes courses from each of the six institutions: Iowa State University, Kansas State University, University of Nebraska, North Dakota State University, and South Dakota State University.

At Iowa State University, Community Development is an optional area of specialization within the Interdisciplinary Graduate Studies degree program that consists of 37 semester credits for completion of the program. A thesis or creative component is required. A computer with minimum specifications, Web access, and an email address are required for completing the program.

Registration

Students choosing to receive their degree from Iowa State University complete all the admissions, registration and fee payment processes through ISU.

C Dev 502. Community and Natural Resource Management. (3-0) Cr. 3. Detailed introduction to community resource management. Theoretical frameworks, methodological investigation, applied practices. Enhancement of ability of community development professionals to work with communities to plan, develop and monitor conversation and development of natural resources with multiple functions.

C Dev 503. Community Development I: Principles and Strategies of Community Change. (3-0) Cr. 3. Analysis of principles and practices of community change and development. Use of case studies to relate community development approaches to conceptual models from diverse disciplines. Exploration of professional practice principles, and student construction of their personal framework for practicing community development.

C Dev 504. Community Analysis: Introduction to Methods. (3-0) Cr. 3. Introduction to research methods relevant to community development. Formulate and begin a research effort, methods of data collection and how conceptual frameworks are used to develop the questions and analyze data. Emphasis on strategies for reporting findings and applying findings in community action and methods of evaluating the entire research process. Significant attention paid to issues of research ethics and inclusiveness.

C Dev 505. Community Development II: Organizing for Community Change. (3-0) Cr. 3. Examines role of civil Society in community planning efforts. Comparative approach to planning theories and approaches. Focus on change within communities and the roles of government, planners, and citizens in reacting to or shaping change. Dimensions of social capital and the context of change covered.

C Dev 506. Community and Regional Economic Analysis. (3-0) Cr. 3. Introduction to concepts of communities and regions, theories of economic growth, drivers of economic growth, the economic base of a community, sources of growth or decline in the community, roles of local government and institutions, and analytical tools. Strategies for local economic Development will also be explored.

C Dev 507. Introduction to Native Communities. (3-0) Cr. 3. A base knowledge course. For students currently working within, in partnership with, or considering working with Native communities. Basic understanding within the context of community development of the diversity of the tribal structures and cultures and the unique history and jurisdictional considerations of these nations. Working with tribes, Federal and Indian relations, and governance and cultural issues.

C Dev 508. Ecological Economics. (3-0) Cr. 3. Approaches economy and community by looking at the inherent interdependence, jointness, and potential complimentarity between ecology and economy (utility) of a place.

C Dev 509. Building Native Community and Economic Capacity. (3-0) Cr. 3. Focus on non-western approaches to helping Native communities build their capacity. Students will learn to take a participatory, culture-centered, and strength-based approach to development.

C Dev 510. Indian Country Agriculture and Natural Resources. (3-0) Cr. 3. Introduction to the historical and contemporary issues related to natural resource management on Native American lands. Philosophical and economic arguments concerning natural resource conservation, preservation and extraction will be explored.

C Dev 512. Sustainable Communities. (3-0) Cr. 3. Students will learn the conceptual relationships among Community and Sustainable Development and Sustainable Communities and examine the social, environmental, and economic aspects of sustainable communities. The course includes analysis of public policy impacts on community sustainability, practical actions for enhancing sustainability, and changing power dynamics and reward structures involved in incorporating sustainability into Community Development.

C Dev 513. Economic Development Strategies and Programs. (3-0) Cr. 3. Course explores theories of local economic Development and addresses the development issues faced by communities in the 21st century. Students will understand and apply concepts from economic Development planning, economic analysis, business development, human resource development, community-based development, and high-technology development.

C Dev 520. Orientation in Community Development. (1-0) Cr. 1. Introduction to the Community Development program. Focus on on-line delivery methods, graduate level research and writing, technology skills.

C Dev 522. Community Leadership and Capacity Building. (3-0) Cr. 3. Defining leadership and applying it to the workplace. Understanding of potential link between leadership and community capacity. Identifying strategies for leadership development in communities.

C Dev 523. Grantwriting for Community Development Professionals. (3-0) Cr. 3. Basic Grant Development and Management will introduce students to the grant-getting process and provide an overview of what happens after a project is funded. The following topics will be covered: researching funding sources, generating cutting edge ideas, assessing needs, planning a project, establishing credibility, formulating a sustainable budget, designing an evaluation plan, managing the funded project, and disseminating project results.

C Dev 524. Non-Profit Management in Community Development. (3-0) Cr. 3. Understanding of how non-profit organizations are run in order that they may participate more fully in community development efforts. Learning skills necessary to assist organizations to manage community development projects and programs, such as, budgeting, planning, personnel, facilities, volunteer management, and fundraising.

C Dev 542. The Policy and Politics of Coastal Areas. (Cross-listed with Pol S). (3-0) Cr. 3. Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, tradeoffs between conservation and jobs, the quality of coastal lifestyle, ways in which citizens participate in policy for coastal areas.

C Dev 599. Creative Component. Cr. arr.

Community and Regional Planning

Douglas Johnston, Chair of Department

Professors: Johnston, Mahayni

Professors (Emeritus): Shinn

Associate Professors: Borich, Bradbury, Coates, Owusu

Associate Professors (Emeritus): Huntington, Knox, Malone

Assistant Professors: Basmajian, Clapp, Haddad, Sandoval, Taylor, Trabalzi

Assistant Professors (Adjunct): Swenson

Lecturers: Jensen, Mehrotra

Undergraduate Study

For undergraduate curriculum in community and regional planning leading to the degree bachelor of science, see College of Design, Curricula.

Community and regional planning is a professional field of study aimed at assessing the ever-changing socioeconomic and physical environments of our communities and planning for their future. Planners evaluate and seize opportunities to understand and solve problems. Most planners work at the local level, but they are concerned with issues that affect the world: the preservation and enhancement of the quality of life in a community, the protection of the environment, the promotion of equitable economic opportunity; and the management of growth and change of all kinds.

Planning has its roots in landscape architecture, architecture, engineering, law, economics, and public administration. Most contemporary planners are trained in the physical and social sciences so they can understand the society and economy in which plans must be implemented. Planning demands technical competence as well as creativity, plus pragmatism and an ability to envision alternatives to the physical and social environments in which we live.

Graduates of the Community and Regional Planning department will be capable of performing in entry level positions in public planning agencies or with planning consulting firms. Graduates are able to integrate planning knowledge and skills in practical applications to current planning issues, and to communicate in written and oral form.

Graduates of the Community and Regional Planning Department are expected to have knowledge of the structure and functions of urban settlements, the history of planning, and aspects of plan and policy making. Graduates should have skills in problem formulation, quantitative analysis, written/oral and graphic communications, collaborative approaches to these, and in synthesizing and applying knowledge to practice. Graduates are expected to assess the impact of values in terms of equity and social justice, economic welfare and efficiency, environmental sustainability, and cultural heritage in the context of citizen involvement in decision making.

The curriculum is accredited by the Planning Accreditation Board of the American Institute of Certified Planners and the Association of Collegiate Schools of Planning, thus providing the student with an education which, when combined with experience, supports the individual's eligibility for membership in the American Institute of Certified Planners.

The department cooperates in the undergraduate minors in design studies and environmental studies.

Graduate Study

The Department offers work for the Master of Community and Regional Planning degree with areas of concentration in land use and transportation, community design and development, and rural and environmental planning. In addition, students can design their own area of concentration if it does not fit in any of the three areas, with the assistance of their major professor. The program of graduate study is accredited by the Planning Accreditation Board of the American Institute of Certified Planners and the Association of Collegiate Schools of Planning.

Degree requirements include completion of a 2-year, 48-credit program, including a thesis of 6 credits or a professional planning report of 4 credits. The planning core consists of C R P 501, 502, 511, 521, 523, 532, 561, and 592. Satisfactory completion of the core requirements and the acceptance of a thesis (6 credits) or a professional planning report (4 credits) are required for the M.C.R.P. degree. Students with a bachelors' degree in community and regional planning from an accredited planning school can waive up to 9 credits. The ability to waive credits is determined by a review of the coursework completed during undergraduate study, the grades received (only a grade of "B" or higher is acceptable) and the student's planning experience. The decision to waive up to 9 credits of the masters program should be made before first time registration for classes through a petition to the DOGE. In addition, the student is encouraged to complete three months of acceptable work experience in a planning office between the first and second year of study. No foreign language is required for the degree master of community and regional planning.

Double degree programs are offered with architecture (M.C.R.P/M.Arch.), business (M.C.R.P/M.B.A.), public administration (M.C.R.P/M.P.A.), and landscape architecture (M.C.R.P/M.L.A.). The department also participates in the interdepartmental major in transportation.

The department also offers a 13-credit graduate certificate in Geographic Information Systems (GIS) in spatial analysis, GIS applications and program management. The program is open to graduate students in all disciplines of the University. Information guides for the graduate degree and certificate may be obtained from the department office at the department's web page at: http://www.design.iastate.edu/CRP/

CRP currently offers several courses via distance learning to graduates and planning professionals interested in expanding their knowledge of planning. Further details of current distance course offerings may be found on the CRP website and on the ISU Continuing Education website. For more information, send an e-mail to crp@iastate.edu

Courses primarily for undergraduate students

C R P 253. Survey of Community and Regional Planning. (3-0) Cr. 3. F. A historical survey of planning, the nature and problems of urban areas, and the goals, procedures, and results of urban planning.

C R P 270. Forces Shaping Our Metropolitan Environment. (Cross-listed with Dsn S). (3-0) Cr. 3. S. Must be taken prior to completing 9 credits in C R P. Introduction to the social, political, physical, and economic forces as they shape metropolitan areas. A comprehensive picture of metropolitan development showing important roles other urban disciplines play in the planning process and the interrelationships of the disciplines.

C R P 272. Planning Analysis and Techniques I. (2-2) Cr. 3. F. Existing and emerging techniques for preparation of community planning studies. Sources of planning information and data. Survey techniques including survey instruments, sampling methods, sample size for demographic studies. Land use surveys for comprehensive and transportation planning. Student's oral and graphic presentation of analytical results. Laboratory emphasizes practical uses and computer applications for data analysis.

C R P 274. Planning Analysis and Techniques II. (2-2) Cr. 3. S. *Prereq: 272.* Use of quantitative methods for analysis of population, land use, economic and transportation make-up of a community; activities and location, intensity, and timing of land uses and public services. Student's oral and graphic presentation of analytical results. Laboratory emphasizes practical uses and computer applications for data analysis.

C R P 291. World Cities and Globalization. (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Sophomore classification.* World cities and globalization in developed and developing countries. Topics include globalization, world cities and regions, uneven economic development, the international division of labor, multinational corporations, international environmentalism, tourism, popular culture and place-based identity.

C R P 293. Environmental Planning. (Cross-listed with Dsn S, Env S). (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Comprehensive overview of the field of environmental relationships and the efforts being made to organize, control, and coordinate environmental, aesthetic, and cultural characteristics of land, air, and water.

C R P 320. Urban form. (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 253 or 270, or permission of instructor.* Examines how urban form is shaped, what constitutes good urban form, and what are the trends in emerging urban forms. Descriptive, explanatory and normative theories of urban form, and the relationships between urban form and social, economic, political, cultural, and institutional forms.

C R P 330. Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Major in community and regional planning.* Structured work experience under close supervision of a professional planner. Practical planning experience; relationships between theory and practice, professional responsibilities, and the scope of various planning roles.

C R P 331. Professional Practice Seminar. (Dual-listed with 531). (1-0) Cr. 1. S. *Prereq: Major in community and regional planning.* Preparation for working in a planning office; discussion of expectation of employer; presentations from planning professionals, and discussion of differences/similarities between public and private planning offices. Satisfactory-fail only.

C R P 332. Community Planning Studio I. (2-4) Cr. 4. F. *Prereq: 253, 274.* Application of planning methods and skills to issue identification and investigation. Introduction to problem formulation, study, and analysis in a community setting.

C R P 376. Rural, Urban and Regional Economics. (Cross-listed with Econ). (3-0) Cr. 3. F.S. *Prereq: Econ 101.* Firm location with respect to regional resources, transport, scale economies, externalities, and policies. Measures of local comparative advantage and specialization. Spatial markets. Population location considering jobs, wages, commuting, and local amenities. Business, residential, and farm land use and value. Migration. Other topics may include market failure, regulation, the product cycle, theories of rural and urban development, developmental policy, firm recruiting, local public goods and public finance, schools, poverty, segregation, and crime. Nonmajor graduate credit.

C R P 383. Theory of the Planning Process. (3-0) Cr. 3. S. *Prereq: 253, junior Status.* The nature of planning and its relation to social and economic planning; levels of planning, place of planning in decision making; steps in the planning process, uses and limitation of knowledge in planning, relation of facts and values.

C R P 391. Field Travel. Cr. arr. Repeatable. F.S.SS. *Prereq: CRP major and permission of instructor.* Observation of professional practice and community or regional problems and issues. Satisfactory-fail only.

C R P 410. Professional Work Experience. Cr. R. F.S.SS. *Prereq: Permission of department chair.* Approved professional work experience.

C R P 416. Urban Design and Practice. (Dual-listed with 516). (3-6) Cr. 6. S. *Prereq: 253 or 270.* Principles of urban design and their application to residential and commercial development in studio projects.

C R P 417. Urban Revitalization. (Dual-listed with 517). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 253 or 270.* Planning methods available to further revitalization and preservation efforts, with particular attention to housing and neighborhoods. Relationship between neighborhood change and urban development process; public policy implications.

C R P 425. Growth Management. (Dual-listed with 525). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Junior classification.* Review of techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban, suburban and rural relationships; and land preservation.

C R P 429. International Planning. (Dual-listed with 529). (Cross-listed with Dsn S). (3-0) Cr. 3. S. *Prereq: Junior classification.* Introduction to issues in planning and governance in an international setting. Problems and strategies may include population movement and change, economic globalization, urban growth, rural development, and housing.

C R P 432. Community Planning Studio II. (1-6) Cr. 4. F.S.SS. *Prereq: 332, 383.* Integration of planning methods and theory in dealing with a community planning problem. Analysis of problem and formulation of strategies for implementation. Preparation of a community planning report.

C R P 435. Planning in Small Towns. (Dual-listed with 535). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 253, 270, or junior classification.* Contemporary planning problems in small towns and the design of viable strategies to enhance their social and economic position in today's society.

C R P 442. Site Development. (Dual-listed with 542). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 253, 272.* Introduction to site analysis using landscape architecture and environmental principles, drawing also on basic engineering concepts. Work will evolve from analysis to land development design.

C R P 445. Transportation Policy Planning. (Dual-listed with 545). (3-0) Cr. 3. F. *Prereq: C E 350 or equivalent.* Comprehensive overview of key policy issues related to transportation planning and investment in the United States and abroad. Policy issues explored include safety, environmental impact, sustainable communities, and economic development. Policy analysis and planning are studied in conjunction with each policy issue explored. Issues of concern to state, metropolitan, and local governments.

C R P 451. Introduction to Geographic Information Systems. (Dual-listed with 551). (2-2) Cr. 3. F.S.SS. Introduction to geographic information systems, including discussions of GIS hardware, software, data structures, data acquisition, data presentation, analytical techniques, and implementation procedures. Laboratory emphasizes practical applications and uses of GIS.

C R P 452. Geographic Data Management and Planning Analysis. (Dual-listed with 552). (2-2) Cr. 3. F.S. *Prereq: C R P 451 or equivalent.* Extensive coverage of geo-relational database concept and design, GIS database creation and maintenance, geographic data manipulation and analysis. GIS output generation and geographic data presentation. Laboratory emphasizes practical applications and uses of GIS.

C R P 455. Community Economic Development. (Dual-listed with 555). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Sophomore classification.* The nature and process of economic development in the context of community development. Recent changes and trends and their implications for local and regional development. Selected case studies and applications. Contemporary community economic development issues.

C R P 475. Grant Writing. (Dual-listed with 575). (1-0) Cr. 1. F. *Prereq: 253 or 270 and junior classification.* A short introduction to effective grant writing for the public and non-profit sectors. Includes identifying appropriate funding sources for an organization, identifying goals and objectives, and budgeting.

C R P 481. Regional and State Planning. (Dual-listed with 581). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 253 or 270.* Analysis of theories, policies, and functions at the metropolitan, regional, and state levels with emphasis on area-wide governance structures and strategies for guiding development.

C R P 484. Sustainable Communities. (Dual-listed with 584). (Cross-listed with Dsn S, Env S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Senior classification.* The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

C R P 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on required form.* Investigation of an approved topic commensurate with student's interest and ability. Satisfactory-fail only.
H. Honors

C R P 491. Environmental Law and Planning. (Dual-listed with 591). (Cross-listed with Dsn S, Env S). (3-0) Cr. 3. S. *Prereq: 6 credits in natural sciences.* Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

C R P 492. Planning Law, Administration and Implementation. (3-0) Cr. 3. F. *Prereq: 383.* The basis in constitutional, common, and Statutory law for the powers of plan effectuation. Problems of balancing public and private interests as revealed in the study of leading court cases. Administration of planning agencies and programs.

C R P 494. Senior Seminar in Planning. Cr. arr. Repeatable. F.S.SS. *Prereq: Senior classification, 332 should be taken prior to or concurrently.* An advanced forum for seniors that focuses upon recent trends and important issues affecting planning today. Topics addressed will vary. A demonstration of understanding current issues and their affects upon planning applications is expected.

C R P 498. Portfolio Development and Review. (1-0) Cr. 1. F.S. Should be taken in the final semester of the planning program. Preparation of a portfolio of student work that represents student learning throughout the entire planning program.

Courses primarily for graduate students, open to qualified undergraduate students

C R P 501. Methods I. (3-0) Cr. 3. F. *Prereq: Graduate classification and Stat 401.* Applications of quantitative methods in planning with emphasis on the collection, description, analysis, presentation, and interpretation of planning data. Primary data collection using survey techniques. Secondary data types and sources of planning information for population projection and demographic analysis.

C R P 502. Methods II. (3-0) Cr. 3. S. *Prereq: Graduate classification and 501.* Investigative and participatory methods for citizen involvement and planning research including public meetings and processes, consultation, case studies, and focus groups. Research design for planning practice, and thesis and professional report proposal development.

C R P 504. Why Change Anything?. (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Introduction to a range of approaches to justifying innovations, changes, and interventions proposed by designers, planners, and artists. Reasons for change and their bases in social, philosophical, and design reasoning; and their usefulness in justifying change to different audiences. Investigation of fallacies, ideologies, and contemporary problems in justifications.

C R P 510. Professional Work Experience. Cr. R. F.S.SS. *Prereq: Permission of department chair.* Approved professional work experience.

C R P 511. Introduction to Community and Regional Planning. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Development of planning in the United States; history and evolution of the planning profession and constructs of current practice. Theoretical basis of planning.

C R P 516. Urban Design Practice. (Dual-listed with 416). (3-6) Cr. 6. S. *Prereq: Graduate classification.* Principles of urban design and their application to residential and commercial development in studio project.

C R P 517. Urban Revitalization. (Dual-listed with 417). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Planning methods available to further revitalization and preservation efforts, with particular attention to housing and neighborhoods. Relationship between neighborhood change and urban development process; public policy implications.

C R P 519. Middle Eastern Cities. (3-0) Cr. 3. F. *Prereq: Graduate or senior standing.* Middle Eastern cities introduce a particular continuity between history and contemporary life where in some cases the latter is about re-defining the former. Introduction to basic academic writings on Middle Eastern cities in addition to other contemporary cultural productions of the region. Study of various aspects of Middle Eastern life and the built environments that this life produces.

C R P 521. Land Use Planning. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Theories of the origin and growth of urban places and the dynamics of urban structure and land use. Methods and techniques for making land use plans dealing with orderly, efficient, and equitable development and arrangement of land uses within the planning process. Examination of the interrelationships among land use, transportation, environment, and infrastructure and public facilities.

C R P 523. Economic Analysis and the Financing of Public Planning Projects. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Analytical approaches to local and regional economic change and performance in the context of the changing economic geography of the U.S. Traditional and contemporary approaches to industrial location theory and analysis. Recent developments in public sector finance, capital budgeting, project evaluation and the financing of planning projects and economic development activity.

C R P 525. Growth Management. (Dual-listed with 425). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Graduate classification.* Review of techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban, suburban, rural relationships; and land preservation.

C R P 529. International Planning. (Dual-listed with 429). (Cross-listed with Dsn S). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Introduction to issues in planning and governance in an international setting. Problems and strategies may include population movement and change, economic globalization, urban growth, rural development, and housing.

C R P 530. Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification in community and regional planning.* Practical planning experience. Structured work in range of tasks under close supervision of a professional planner. Relationships between theory and practice, exposure to variety of roles in functioning specialties. Satisfactory-fail only.

C R P 531. Professional Practice Seminar. (Dual-listed with 331). (1-0) Cr. 1. S. *Prereq: Graduate classification.* Preparation for working in a planning office; discussion of expectations of employer; presentations from planning professionals, and discussion of differences and similarities between public and private planning offices. Satisfactory-fail only.

C R P 532. Community Planning Studio. (1-6) Cr. 4. F.SS. *Prereq: 521, 523.* Integration of planning methods and theory in dealing with a community planning problem. Analysis of problem and formulation of strategies for implementation. Preparation of a community planning report.

C R P 535. Planning in Small Towns. (Dual-listed with 435). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Graduate classification.* Contemporary planning problems in small towns and the design of viable strategies to enhance their social and economic position in today's Society.

C R P 542. Site Development. (Dual-listed with 442). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Introduction to site analysis using landscape architecture and environmental principles, but drawing also on basic engineering concepts. Work will evolve from analysis to land development design based on that analysis.

C R P 545. Transportation Policy Planning. (Dual-listed with 445). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Comprehensive overview of key policy issues related to transportation planning and investment in the United States and abroad. Policy issues explored include safety, environmental impact, sustainable communities, and economic development. Tools like policy analysis and planning are studied in conjunction with each policy issue explored. Issues of concern to State, metropolitan, and local governments.

C R P 551. Introduction to Geographic Information Systems. (Dual-listed with 451). (2-2) Cr. 3. F.S.SS. Introduction to geographic information systems, including discussions of GIS hardware, software, data structures, data acquisition, data presentation, analytical techniques, and implementation procedures. Laboratory emphasizes practical applications and uses of GIS.

C R P 552. Geographic Data Management and Planning Analysis. (Dual-listed with 452). (2-2) Cr. 3. F.S. *Prereq: 551.* Extensive coverage of geo-relational database concept and design, GIS database creation and maintenance, geographic data manipulation and analysis. GIS output generation and geographic data presentation. Laboratory emphasizes practical applications and uses of GIS.

C R P 553. Analytical Planning/GIS. (2-2) Cr. 3. S. *Prereq: 451/551.* Integration of exploratory, participatory and predictive spatial analyses and 3D visualization into the planning process. GIS tools and techniques are used to automate decision analysis and facilitate future planning in analyzing and visualizing planning actions. Laboratory emphasizes practical uses of GIS tools and techniques.

C R P 555. Community Economic Development. (Dual-listed with 455). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Graduate classification.* The nature and process of economic development in the context of community development. Recent changes and trends and their implications for local and regional development. Selected case studies and applications. Contemporary community economic development issues.

C R P 561. Seminar in Planning Theory. (3-0) Cr. 3. S. *Prereq: graduate classification.* Current planning theories: comprehensive land use, advocacy, participatory, radical, and transactive planning models. Decision making and organization models as they affect planning practice. Value conflicts and conflict resolution.

C R P 575. Grant Writing. (Dual-listed with 475). (1-0) Cr. 1. F. *Prereq: Graduate classification.* A short introduction to effective grant writing for the public and non-profit sectors. Includes identifying appropriate funding sources for an organization, identifying goals and objectives, and budgeting.

C R P 581. Regional and State Planning. (Dual-listed with 481). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Analysis of theories, policies, and functions at the metropolitan, regional, and state levels with emphasis on area-wide governance structures and strategies for guiding development.

C R P 584. Sustainable Communities. (Dual-listed with 484). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate classification.* The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

C R P 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form.*
A. Planning Law, Administration and Implementation
B. Economic Development
C. Urban Design
D. Housing and Urban Revitalization
H. Environmental Planning
I. Land Use and Transportation Planning
N. International Planning
O. Spatial Analytical Methods
P. Planning in Small Towns
Q. Diversity and Equity in Planning
R. Geographic Information Systems

C R P 591. Environmental Law and Planning. (Dual-listed with 491). (Cross-listed with Dsn S, L A). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

C R P 592. Land Use and Development Regulation Law. (3-0) Cr. 3. F. *Prereq: Graduate classification.* An in-depth analysis of the legal constructs that shape the practice of planning and plan implementation in the United States. An exploration of how land use regulations are applied to reconcile the competing needs and diverse uses of land. The positive and negative consequences of developing and implementing regulatory controls will be addressed.

C R P 595. Seminar in GIS Applications/Research. (1-0) Cr. 1. F.S. *Prereq: 9 credits in GIS Certificate program.* Discussion and demonstration of current GIS applications and research in multiple disciplines. Satisfactory-fail only.

C R P 599. Professional Planning Report. Cr. arr. Repeatable. F.S.SS. Independent student research on planning topic. The course will serve as a capstone experience for the student, demonstrating ability to integrate planning knowledge and skills in the practical application of the student's abilities on a current planning issue. The completed report must be submitted to and approved by the POS committee as evidence of the mastery of the principles of community and regional planning.

Courses for graduate students

C R P 699. Research. Cr. arr. Repeatable. F.S.SS.

Complex Adaptive Systems

(Interdepartmental Graduate Minor)

Program Co-chairs: K.M. Bryden and J. E. Mayfield

The Complex Adaptive Systems (CAS) minor provides graduate students with an understanding of the interrelationships among the various methodologies often collectively referred to as Artificial Life. Of special importance in the program is the interplay of biological principles and computer simulations in various fields including Economics, Engineering, Mathematics, and Biology.

Graduates understand the ways in which artificial life techniques may be applied to their major field of study. They have an appreciation and understanding of the cross-disciplinary aspects of artificial life techniques. Students who complete a minor in this graduate program are able to describe and report on various artificial life techniques as applied to many fields, even outside their own field of application.

Work in the CAS minor is offered for students pursuing any graduate degree. The primary cooperating departments are Economics; Computer Science; Electrical and Computer Engineering; Mechanical Engineering; Mathematics; Psychology; Ecology, Evolution, and Organismal Biology; and Genetics, Development and Cell Biology.

Each student's Masters Program of Study (POS) must include at least 9 CAS relevant course credits chosen in consultation with the student's POS committee and the CAS program, plus two credits (one credit each time taken) of the CAS seminar and three credits of CAS 503 (see below). Each student's Ph.D. POS must include at least 12 CAS relevant courses credits chosen in consultation with the student's POS committee and the CAS program, plus two credits (one credit each time taken) of the CAS seminar and three credits of CAS 503. Ph.D. students who also minored in CAS at the master's level must take one additional CAS relevant course (3 cr.) and two additional credits of CAS seminar. Courses that satisfy CAS requirements may also be used to satisfy major requirements if such "double counting" is acceptable to the major program.

Interested students may contact the chairperson of the advisory committee for complete lists of courses and of CAS faculty members.

Courses primarily for graduate students, open to qualified undergraduate students

CAS 502. Complex Adaptive Systems Seminar. (Cross-listed with Com S). (1-0) Cr. 1. F.S. *Prereq: Admission to CAS minor.* Understanding core techniques in artificial life is based on basic readings in

complex adaptive systems. Techniques of complex system analysis methods including: evolutionary computation, neural nets, agent based simulations (agent based computational economics). Large-scale simulations are to be emphasized, e.g. power grids, whole ecosystems.

CAS 503. Complex Adaptive Systems Concepts and Techniques. (Cross-listed with Com S). (3-0) Cr. 3. S. *Prereq: Admission to CAS minor or related field.* Survey of complex systems and their analysis. Examples are drawn from engineering, computer science, biology, economics and physics.

Computer Engineering

www.ece.iastate.edu

(Administered by the Department of Electrical and Computer Engineering)

Arun Somani, Chair of Department

Distinguished Professors: Somani, Soukoulis

Distinguished Professors (Emeritus): Brown, Fouad, Lord, Nilsson, Pohm

University Professor: Jacobson

University Professor (Emeritus): Jones

Professors: Ajjarapu, Aluru, J. Bowler, Dalal, Geiger, Kamal, Kothari, Kumar, Kushner, Liu, Luecke, Mccalley, Oliver, Rover, Shinar, Weber

Professors (Emeritus): Anderson, Basart, Brearley, Brockman, Comstock, Fanslow, Hale, Horton, Hsieh, Kopplin, Melsa, Potter, Read, Sheble, Smay, Stewart, Swift, Townsend, Venkata

Professor (Adjunct): Shinar

Professor (Emeritus Adjunct): Hillesland

Professors (Collaborators): Jiles, Lee

Associate Professors: N. Bowler, Chang, Chen, Chu, Davidson, Davis, Dickerson, Dogandzic, Elia, Govindarasu, Guan, S. Kim, Song, Tirthapura, Tuttle, Tyagi, Z. Wang

Associate Professors (Emeritus): Bond, Carlson, Coady, Mericle, Pavlat, Scott, Stephenson

Associate Professors (Adjunct): Biswas, Sosonkina

Associate Professors (Collaborators): Ashlock, Salapaka

Assistant Professors: Aliprantis, Bigelow, Chaudhary, Chung, Daniels, Dong, Fayed, Hornbuckle, Jones, J. Kim, Ma, Neihart, Nguyen, Pandey, Qiao, Ramamoorthy, Stoytchev, Vaidya, Vaswani, L. Wang, Ying, Zambreno, Zhang

Assistant Professor (Adjunct): Amin, Bode

Assistant Professor (Collaborators): Balasubramaniam

Senior Lecturer: Mina, Wiersema

Undergraduate Study

For the undergraduate curriculum in computer engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission of ABET.

The Electrical and Computer Engineering (ECPE) Department at Iowa State University provides undergraduate students with the opportunity to learn electrical and computer engineering fundamentals, to study applications of the most recent advances in state-of-the-art technologies, and to prepare for the practice of computer engineering. The student-faculty interaction necessary to realize this opportunity occurs within an environment that is motivated by the principle that excellence in undergraduate education is enhanced by an integrated commitment to successful, long-term research and outreach programs.

The computer engineering curriculum offers focus areas in software, software systems, embedded systems, networking, information security, computer architecture, and VLSI.

Students may also take elective courses in control systems, electromagnetics, microelectronics, VLSI, power systems, and communications and signal processing.

The objective of the computer engineering program at ISU is that its graduates should demonstrate expertise, engagement, learning, leadership, and teamwork within five years after graduation.

Expertise: Graduates should establish peer-recognized expertise together with the ability to articulate that expertise and use it for problem solving in the analysis, design, and evaluation of computer and software systems, including system integration and implementation, using contemporary practices.

Engagement: Graduates should be engaged in the engineering profession, locally and globally, contributing through the ethical, competent, and creative practice of computer engineering in industry, academia, or the public sector, or graduates may use the program as a foundation for interdisciplinary careers in business, law, medicine, or public service.

Learning: Graduates should demonstrate sustained learning through graduate work or professional improvement opportunities and through self study, and they should demonstrate the ability to adapt in a constantly changing field.

Leadership: Graduates should exhibit leadership and initiative to advance professional and organizational goals, facilitate the achievements of others, and obtain results.

Teamwork: Graduates should demonstrate effective teaming and commitment to working with others of diverse cultural and interdisciplinary backgrounds by applying engineering abilities, communication skills, and knowledge of contemporary and global issues.

As a complement to the instructional activity, the ECPE Department provides opportunities for each student to have experience with broadening activities. Through the cooperative education and internship program, students have the opportunity to gain practical industry experience. See College of Engineering, Cooperative Programs. Students have the opportunity to participate in advanced research activities; and through international exchange programs, students learn about engineering practices in other parts of the world. Well qualified juniors and seniors in computer engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both the bachelor of science and master of science or the bachelor of science and master of business administration degrees. See *Graduate Study* for more information.

Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with major in computer engineering and minor work to students with other majors. Minor work for computer engineering majors is usually selected from a wide range of courses outside computer engineering.

The degree master of science with thesis is recommended for students who intend to continue toward the doctor of philosophy degree or to undertake a career in research and development. The nonthesis master of science degree requires a creative component.

The normal prerequisite to major work in computer engineering is the completion of undergraduate work substantially equivalent to that required of computer engineering students at this university. It is possible for a student to qualify for graduate study in computer engineering even though the student's undergraduate or prior graduate training has been in a discipline other than computer engineering. Supporting work, if required, will depend on the student's background and area of research interest. Prospective students from a discipline other than computer engineering are required to submit, with the application for admission, a statement of the proposed area of graduate study.

The department requires submission of GRE General test scores by applicants. All students whose first language is not English and who have no U.S. degree must submit TOEFL examination scores. Students pursuing the doctor of philosophy must complete the department qualifying process.

The Department of Electrical and Computer Engineering is a participating department in the interdepartmental master of science and doctor of philosophy degree programs in bioinformatics and computational biology. Students interested in these programs may earn their degrees while working under an adviser in electrical and computer engineering.

The Department of Electrical and Computer Engineering is also a participating department in the interdepartmental master of science in information assurance program. Students interested in studying information assurance topics may earn a degree in computer engineering or in information assurance. (See catalog section on Information Assurance.)

Well qualified juniors and seniors in computer engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both bachelor of science and master of science or bachelor of science and master of business administration degrees. Under concurrent enrollment, students are eligible for assistantships and simultaneously take undergraduate and graduate courses. Details are available in the Student Services Office and on the department's web site.

Courses primarily for undergraduate students

Cpr E 166. Professional Programs Orientation. (Cross-listed with E E). Cr. R. F.S. (1-0) Overview of the nature and scope of electrical engineering and computer engineering professions. Overview of portfolios. Departmental rules, student services operations, degree requirements, program of study planning, career options, and student organizations.

Cpr E 185. Introduction to Computer Engineering and Problem Solving I. (2-2) Cr. 3. *Prereq: Credit or enrollment in Math 141.* Introduction to Computer Engineering. Project based examples from computer engineering. Individual interactive skills for small and large groups. Computer-based projects. Solving engineering problems and presenting solutions through technical reports. Solution of engineering problems using the C language.

Cpr E 186. Introduction to Computer Engineering and Problem Solving II. (0-2) Cr. 1. S. *Prereq: 185.* Project based examples from computer engineering. Group skills needed to work effectively in teams.

Group problem solving. Computer based projects. Technical reports and presentations. Students will work on 2 or 3 self-directed team based projects that are representative of problems faced by computer engineers.

Cpr E 281. Digital Logic. (3-2) Cr. 4. F.S. *Prereq: sophomore classification.* Number systems and representation. Boolean algebra and logic minimization. Combinational and sequential logic design. Arithmetic circuits and finite state machines. Use of programmable logic devices. Introduction to computer-aided schematic capture systems, simulation tools, and hardware description languages. Design of a simple digital systems.

Cpr E 288. Embedded Systems I: Introduction. (3-2) Cr. 4. F.S. *Prereq: 281, Com S 207 or Com S 227.* Embedded C programming. Interrupt handling. Memory mapped I/O in the context of an application. Elementary embedded design flow/methodology. Timers, scheduling, resource allocation, optimization, state machine based controllers, real time constraints within the context of an application. Applications laboratory exercises with embedded devices.

Cpr E 294. Program Discovery. (Cross-listed with E E). Cr. R. *Prereq: 166 or E E 166.* The roles of professionals in computer and electrical engineering. Relationship of coursework to industry and academic careers. Issues relevant to today's world. Satisfactory-fail only.

Cpr E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

Cpr E 308. Operating Systems: Principles and Practice. (3-3) Cr. 4. F.S. *Prereq: 381, 310.* Operating system concepts, processes, threads, synchronization between threads, process and thread scheduling, deadlocks, memory management, file systems, I/O systems, security, Linux-based lab experiments. Nonmajor graduate credit.

Cpr E 310. Theoretical Foundations of Computer Engineering. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in Cpr E 288, Com S 228.* Propositional logic and methods of proof; set theory and its applications; Mathematical induction and recurrence relations; functions and relations; and counting; trees and graphs; applications in computer engineering.

Cpr E 329. Software Project Management. (Cross-listed with S E). (3-0) Cr. 3. *Prereq: Com S 309.* Process-based software development. Capability Maturity Model (CMM), Project planning, cost estimation, and scheduling. Project management tools. Factors influencing productivity and success. Productivity metrics. Analysis of options and risks. Version control and configuration management. Inspections and reviews. Managing the testing process. Software quality metrics. Modern software engineering techniques and practices. Nonmajor graduate credit.

Cpr E 330. Integrated Electronics. (Cross-listed with E E). (3-3) Cr. 4. *Prereq: E E 201, credit or enrollment in E E 230, Cpr E 281.* Semiconductor technology for integrated circuits. Modeling of integrated devices including diodes, BJTs, and MOSFETs. Physical layout. Circuit simulation. Digital building blocks and digital circuit synthesis. Analysis and design of analog building blocks. Laboratory exercises and design projects with CAD tools and standard cells. Nonmajor graduate credit.

Cpr E 339. Software Architecture and Design. (Cross-listed with S E). (3-0) Cr. 3. *Prereq: S E 319.* Modeling and design of software at the architectural level. Architectural styles. Basics of model-driven architecture. Object-oriented design and analysis. Iterative development and unified process. Design patterns. Design by contract. Component based design. Product families. Measurement theory and appropriate use of metrics in design. Designing for qualities such as performance, safety, security, reliability, reusability, etc. Analysis and evaluation of software architectures. Introduction to architecture definition languages. Basics of software evolution, reengineering, and reverse engineering. Case studies. Introduction to distributed system software. Nonmajor graduate credit.

Cpr E 370. Toying with Technology. (Cross-listed with Mat E). (2-2) Cr. 3. F.S. *Prereq: C I 201, junior standing in non-engineering major.* A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on laboratory experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Future K-12 teachers will leave the course with complete lesson plans for use in their upcoming careers.

Cpr E 381. Computer Organization and Assembly Level Programming. (3-2) Cr. 4. F.S. *Prereq: 281.* Introduction to computer organization, evaluating performance of computer systems, instruction set design. Assembly level programming: arithmetic operations, control flow instructions, procedure calls, stack management. Processor design. Datapath and control, scalar pipelines, introduction to memory and I/O systems.

Cpr E 394. Program Exploration. (Cross-listed with E E). Cr. R. *Prereq: 294 or E E 294.* Exploration of academic and career fields for electrical and computer engineers. Examination of professionalism in the context of engineering and technology with competencies based skills. Introduction to professional portfolio development and construction. Satisfactory-fail only.

Cpr E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period.

Cpr E 397. Engineering Internship. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* One semester maximum per academic year professional work period.

Cpr E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

Cpr E 412. Formal Aspects of Specification and Verification. (Cross-listed with Com S, S E). (3-0) Cr. 3. *Prereq: Com S 309, S E 319.* Introduction to prepositional/predicate/temporal logic, program verification using theorem proving, model-based verification using model checking, and tools for verification. Nonmajor graduate credit.

Cpr E 416. Software Evolution and Maintenance. (Cross-listed with S E). (3-0) Cr. 3. *Prereq: Com S 309, S E 319.* Fundamental concepts in software evolution and maintenance; practical software evolution processes; legacy systems, program comprehension, impact analysis, program migration and transformation, refactoring. Tools for software evolution and maintenance. Case studies, experimental software projects. Written reports and oral presentation. Nonmajor graduate credit.

Cpr E 418. High Speed System Engineering Measurement and Testing. (Cross-listed with E E). (3-2) Cr. 4. F. *Prereq: E E 230 and 311.* Measurement of high speed systems and mixed signal systems. Measurement accuracy and error. Network analysis and spectrum analysis used in high speed measurement and testing. Test specification process and parametric measurement. Sampling and digital signal processing concepts. Design for testability. Testing equipment. Applications. Nonmajor graduate credit.

Cpr E 425. High Performance Computing for Scientific and Engineering Applications. (Cross-listed with Com S). (3-1) Cr. 3. S. *Prereq: Com S 311, Com S 330, Engl 250, Sp Cm 212.* Introduction to high performance computing platforms including parallel computers and workstation clusters. Discussion of parallel architectures, performance, programming models, and software development issues. Sample applications from science and engineering. Practical issues in high performance computing will be emphasized via a number of programming projects using a variety of programming models and case studies. Oral and written reports. Nonmajor graduate credit.

Cpr E 426. Introduction to Parallel Algorithms and Programming. (Dual-listed with 526). (Cross-listed with Com S). (3-2) Cr. 4. F. *Prereq: Cpr E 308 or Com S 321, Com S 311.* Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms. Nonmajor graduate credit.

Cpr E 431. Basics of Information System Security. (3-0) Cr. 3. S. *Prereq: credit or enrollment in Cpr E 489 or Com S 454.* Introduction to and application of basic mechanisms for protecting information systems from accidental and intentional threats. Basic cryptography use and practice. Computer security issues including authentication, access control, and malicious code. Newtork security mechanisms such as intrusion detection, firewalls, IPSEC, and related protocols. Ethics and legal issues in information security. Other selected topics. Programming and system configuration assignments. Nonmajor graduate credit.

Cpr E 435. Analog VLSI Circuit Design. (Cross-listed with E E). (3-3) Cr. 4. S. *Prereq: 330, E E 332, 324, and either E E 322 or Stat 330.* Basic analog integrated circuit and system design including design space exploration, performance enhancement strategies, operational amplifiers, references, integrated filters, and data converters. Nonmajor graduate credit.

Cpr E 444. Introduction to Bioinformatics. (Dual-listed with 544). (Cross-listed with BCB, Com S, Biol, Gen). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic tree, comparative and functional genomics. Nonmajor graduate credit.

Cpr E 450. Distributed Systems and Middleware. (Dual-listed with 550). (3-0) Cr. 3. *Prereq: 308 or Com S 352.* Fundamentals of distributed computing, software agents, naming services, distributed transactions, security management, distributed object-based systems, web-based systems, middleware-based application design and development, case studies of middleware and internet applications. Nonmajor graduate credit.

Cpr E 454. Distributed and Network Operating Systems. (Dual-listed with 554). (Cross-listed with Com S). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: Com S 311, Com S 352, Engl 250, Sp Cm 212.* Laboratory course dealing with practical issues of design and implementation of distributed and network operating systems and distributed computing environments (DCE). The client server paradigm, interprocess communications, layered communication protocols, synchronization and concurrency control, and distributed file systems. Graduate credit requires additional in-depth study of advanced operating systems. Written reports. Nonmajor graduate credit.

Cpr E 458. Real Time Systems. (Dual-listed with 558). (3-0) Cr. 3. *Prereq: 308 or Com S 352.* Fundamental concepts in real-time systems. Real time task scheduling paradigms. Resource management in uniprocessor, multiprocessor, and distributed real-time systems. Fault-tolerance, resource reclaiming, and overload handling. Real-time channel, packet scheduling, and real-time LAN protocols. Case study of real-time operating systems. Laboratory experiments. Nonmajor graduate credit.

Cpr E 465. Digital VLSI Design. (Cross-listed with E E). (3-3) Cr. 4. S. *Prereq: E E 330.* Digital design of integrated circuits employing very large scale integration (VLSI) methodologies. Technology considerations in design. High level hardware design languages, CMOS logic design styles, area-energy-delay design

space characterization, datapath blocks: arithmetic and memory, architectures and systems on a chip (Soc) considerations. VLSI chip hardware design project. Nonmajor graduate credit.

Cpr E 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Aer E, E E, Engr, I E, Mat E, M E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

Cpr E 488. Embedded Systems Design. (3-3) Cr. 4. *Prereq: 381 or Com S 321.* Embedded microprocessors, embedded memory and I/O devices, component interfaces, embedded software, program development, basic compiler techniques, platform-based FPGA technology, hardware synthesis, design methodology, real-time operating system concepts, performance analysis and optimizations. Nonmajor graduate credit.

Cpr E 489. Computer Networking and Data Communications. (3-2) Cr. 4. F.S. *Prereq: 381 or E E 324.* Modern computer networking and data communications concepts. TCP/IP, OSI protocols, client server programming, data link protocols, local area networks, and routing protocols. Nonmajor graduate credit.

Cpr E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Senior classification in computer engineering.* Investigation of an approved topic.
H. Honors

Cpr E 491. Senior Design Project I and Professionalism. (Cross-listed with E E). (2-3) Cr. 3. F.S. *Prereq: 308 or E E 322, completion of 24 credits in the E E core professional program or 29 credits in the Cpr E core professional program, Engl 314.* Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; design review presentation. First of two-semester team-oriented, project design and implementation experience.

Cpr E 492. Senior Design Project II. (Cross-listed with E E). (1-3) Cr. 2. F.S. *Prereq: 491 or E E 491.* Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in E E 491 or Cpr E 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements; project poster.

Cpr E 494. Portfolio Assessment. (Cross-listed with E E). Cr. R. *Prereq: Credit or enrollment in 491.* Portfolio update and evaluation. Portfolios as a tool to enhance career opportunities.

Cpr E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduate students

Cpr E 501. Analog and Mixed-Signal VLSI Circuit Design Techniques. (Cross-listed with E E). (3-3) Cr. 4. F. *Prereq: 435.* Design techniques for analog and mixed-signal VLSI circuits. Amplifiers; operational amplifiers, transconductance amplifiers, finite gain amplifiers and current amplifiers. Linear building blocks; differential amplifiers, current mirrors, references, cascading and buffering. Performance characterization of linear integrated circuits; offset, noise, sensitivity and stability. Layout considerations, simulation, yield and modeling for high-performance linear integrated circuits.

Cpr E 505. CMOS and BiCMOS Data Conversion Circuits. (Cross-listed with E E). (3-3) Cr. 4. Alt. S., offered 2010. *Prereq: 501.* Theory, design and applications of data conversion circuits (A/D and D/A converters) including: architectures, characterization, quantization effects, conversion algorithms, spectral performance, element matching, design for yield, and practical comparators, implementation issues.

Cpr E 507. VLSI Communication Circuits. (Cross-listed with E E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 330 or 501.* Phase-locked loops, frequency synthesizers, clock and data recovery circuits, theory and implementation of adaptive filters, low-noise amplifiers, mixers, power amplifiers, transmitter and receiver architectures.

Cpr E 511. Design and Analysis of Algorithms. (Cross-listed with Com S). (3-0) Cr. 3. F. *Prereq: Com S 311.* A study of basic algorithm design and analysis techniques. Advanced data structures, amortized analysis and randomized algorithms. Applications to sorting, graphs, and geometry. NP- completeness and approximation algorithms.

Cpr E 525. Numerical Analysis of High-Performance Computing. (Cross-listed with Com S, Math). (3-0) Cr. 3. S. *Prereq: 308, or one of Math 471, 481; experience in scientific programming; knowledge of FORTRAN or C.* Development, analysis, and testing of efficient numerical methods for use on state-of-the-Art High performance computers. Applications of the methods to the student's area of research.

Cpr E 526. Introduction to Parallel Algorithms and Programming. (Dual-listed with 426). (Cross-listed with Com S). (3-2) Cr. 4. F. *Prereq: 308 or Com S 321, Com S 311.* Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms.

Cpr E 528. Probabilistic Methods in Computer Engineering. (3-0) Cr. 3. *Prereq: Com S 311.* The application of randomization and probabilistic methods in the design of computer algorithms, and their efficient implementation. Discrete random variables in modeling algorithm behavior, with applications to sorting, selection, graph algorithms, hashing, pattern matching, cryptography, distributed systems, and massive data set algorithmics.

Cpr E 530. Advanced Protocols and Network Security. (Cross-listed with InfAs). (3-0) Cr. 3. *Prereq: 381.* Detailed examination of networking standards, protocols, and their implementation. TCP/IP protocol suite, network application protocols, IP routing, network security issues. Emphasis on laboratory experiments.

Cpr E 531. Information System Security. (Cross-listed with InfAs). (3-0) Cr. 3. *Prereq: 489 or 530 or Com S 586 or MIS 535.* Computer and network security: basic cryptography, security policies, multilevel security models, attack and protection mechanisms, legal and ethical issues.

Cpr E 532. Information Warfare. (Cross-listed with InfAs). (3-0) Cr. 3. S. *Prereq: 531.* Computer system and network security: implementation, configuration, testing of security software and hardware, network monitoring. Authentication, firewalls, vulnerabilities, exploits, countermeasures. Ethics in information assurance. Emphasis on laboratory experiments.

Cpr E 533. Cryptography. (Cross-listed with Math, InfAs). (3-0) Cr. 3. S. *Prereq: Math 301 or Cpr E 310 or Com S 330.* Basic concepts of secure communication, DES and AES, public-key cryptosystems, elliptic curves, hash algorithms, digital signatures, applications. Relevant material on number theory and finite fields.

Cpr E 534. Legal and Ethical Issues in Information Assurance. (Cross-listed with InfAs, Pol S). (3-0) Cr. 3. S. *Prereq: Graduate classification, Cpr E or InfAs 531.* Legal and ethical issues in computer security. State and local codes and regulations. Privacy issues.

Cpr E 535. Steganography and Watermarking. (Cross-listed with Math, InfAs). (3-0) Cr. 3. S. *Prereq: Cpr E 531 or E E 524 or Math 533/Cpr E 533/InfAs 533.* Basic principles of steganography and watermarking. Algorithms based on spatial domain approaches, transformations of data, statistical approaches. Techniques for images, video, and audio data. Communications models for data hiding. Analysis, detection and recovery of hidden data. Military, commercial and e-commerce applications. Known theoretical results. Software packages for data hiding. Social and legal issues, case studies, and digital rights management issues that affect technological development of steganography and watermarking. Current developments in the area.

Cpr E 536. Computer and Network Forensics. (Cross-listed with InfAs). (3-0) Cr. 3. *Prereq: 381 and 489 or 530.* Fundamentals of computer and network forensics, forensic duplication and analysis, network surveillance, intrusion detection and response, incident response, anonymity and pseudonymity, privacy-protection techniques, cyber law, computer security policies and guidelines, court testimony and report writing, and case studies. Emphasis on hands-on experiments.

Cpr E 537. Wireless Network Security. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 489 or 530.* Introduction to the physical layer and special issues associated with security of the airlink interface. Communication system modeling, wireless networking, base Stations, mobile Stations, airlink multiple access, jamming, spoofing, signal intercept, wireless LANS and modems, cellular, position location, spread spectrum, signal modeling, propagation modeling, wireless security terminology.

Cpr E 541. High-Performance Communication Networks. (3-0) Cr. 3. *Prereq: 489 or 530.* Selected topics from recent advances in high performance networks; next generation internet; asynchronous transfer made; traffic management, quality of service; high speed switching.

Cpr E 542. Optical Communication Networks. (3-0) Cr. 3. S. *Prereq: 489.* Optical components and interfaces; optical transmission and reception techniques; wavelength division multiplexing; network architectures and protocol for first generation, single and multihop optical network; routing and wavelength assignment in second generation wavelength routing networks; traffic grooming, optical network control; access networks; metro networks.

Cpr E 543. Wireless Network Architecture. (3-0) Cr. 3. *Prereq: Credit or enrollment in 489 or 530.* Introduction to the protocol architecture of the data link layer, network layer and transport layer for wireless networking. Operation and management of Medium Access Control in wireless local area networks; recent developments in 802.11 and Bluetooth; wireless ATM; Mobile Internet Protocol; Mobile Transmission Control Protocol; wireless application protocol; ad-hoc wireless networks.

Cpr E 544. Introduction to Bioinformatics. (Dual-listed with 444). (Cross-listed with BCB, Com S, GDCB). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics.

Cpr E 545. Fault-Tolerant Systems. (3-0) Cr. 3. *Prereq: 381.* Faults and their manifestations, errors, and failures; fault detection, location and reconfiguration techniques; time, space, and information (coding) redundancy management; design for testability; self-checking and fail-safe circuits; system-level fault diagnosis; Byzantine agreement; stable storage and RAID; fault-tolerant networks; fault tolerance in real-time systems; reliable software design; checkpointing and rollback recovery; and reliability evaluation techniques and tools.

Cpr E 546. Wireless Sensor Networks. (3-0) Cr. 3. *Prereq: Cpr E 489 or 530.* Selected topics from recent advances in wireless sensor networks, including data-centric routing, query, and storage; data fusion and aggregation; coverage, connectivity, and lifetime of wireless sensor networks; wireless sensor networks deployment and management; security issues; energy-efficiency issues; radio and link characteristics in wireless sensor networks; medium access control protocols and link layer techniques; tracking and localization; geographical routing; robust routing; time synchronization; wireless sensor networks applications. Introduction to TinyOS and the nesC language. Hands-on experiments with Crossbow Motes.

Cpr E 549. Advanced Algorithms in Computational Biology. (Cross-listed with Com S, BCB). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Com S 311 and either Com S 228 or Com S 208.* Design and analysis of algorithms for applications in computational biology, pairwise and multiple sequence alignments, approximation algorithms, string algorithms including in-depth coverage of suffix trees, semi-numerical string algorithms, algorithms for selected problems in fragment assembly, phylogenetic trees and protein folding. No background in biology is assumed. Also useful as an advanced algorithms course in string processing.

Cpr E 550. Distributed Systems and Middleware. (Dual-listed with 450). (3-0) Cr. 3. *Prereq: 308 or Com S 352.* Fundamentals of distributed computing, software agents, naming services, distributed transactions, security management, distributed object-based systems, web-based systems, middleware-based application design and development, case studies of middleware and internet applications.

Cpr E 554. Distributed and Network Operating Systems. (Dual-listed with 454). (Cross-listed with Com S). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: Com S 311, Com S 352.* Laboratory course dealing with practical issues of design and implementation of distributed and network operating systems and distributed computing environments (DCE). The client server paradigm, inter-process communications, layered communication protocols, synchronization and concurrency control, and distributed file systems. Graduate credit requires additional in-depth study of advanced operating systems. Written reports.

Cpr E 556. Scalable Software Engineering. (3-0) Cr. 3. *Prereq: Com S 309.* Study of methods, techniques and tools for design, development and evolution of complex software; aspect–oriented programming, domain-specific software technologies, automation for reliable and scalable software engineering, program analysis, comprehension, and program transformations.

Cpr E 557. Computer Graphics and Geometric Modeling. (Cross-listed with Com S, M E). (3-0) Cr. 3. F.S. *Prereq: M E 421, programming experience in C.* Fundamentals of computer graphics technology. Data structures. Parametric curve and surface modeling. Solid model representations. Applications in engineering design, analysis, and manufacturing.

Cpr E 558. Real-Time Systems. (Dual-listed with 458). (3-0) Cr. 3. *Prereq: 308 or Com S 352.* Fundamental concepts in real-time systems. Real-time task scheduling paradigms. Resource management in uniprocessor, multiprocessor, and distributed real-time systems. Fault-tolerance, resource reclaiming, and overload handling. Real-time channel, packet scheduling, and real-time LAN protocols. Case study of real-time operating systems. Laboratory experiments.

Cpr E 563. Modeling and Optimization of Interconnect in Deep Submicron Design. (3-0) Cr. 3. *Prereq: 465.* Modeling and optimization techniques for high-performance digital and analog interconnect designs. RLC extraction. Interconnect modeling: Elmore delay model, moment computation, asymptotic waveform evaluation, Pade Via Lanczos, pole analysis, transmission lines. Driver modeling. Interconnect optimization: topology optimization, device sizing, wire sizing, buffer insertion, high-performance clock sizing.

Cpr E 564. Synthesis and Optimization of Digital Circuits. (3-0) Cr. 3. S. *Prereq: 381.* Algorithms and techniques to generate application-specific VLSI circuits from high-level behavioral modeling in hardware description languages. Boolean logic representation, two-level and multi-level logic synthesis, sequential logic optimization, hardware models, architectural-level synthesis and optimization, scheduling algorithms, resource sharing and binding.

Cpr E 566. Physical Design of VLSI Systems. (3-0) Cr. 3. *Prereq: 465.* Physical design of VLSI systems. Partitioning algorithms. Placement and floorplanning algorithms. Routing-global and detailed. Layout compaction. Physical design of FPGA's and MCM's. Performance-driven layout synthesis.

Cpr E 567. Bioinformatics I (Fundamentals of Genome informatics). (Cross-listed with Com S, BCB). (3-0) Cr. 3. F. *Prereq: Com S 208; Com S 330; Stat 341; credit or enrollment in Biol 315, Stat 430.* Biology as an information science. Review of algorithms and information processing. Generative models for sequences. String algorithms. Pairwise sequence alignment. Multiple sequence alignment. Searching sequence databases. Genome sequence assembly.

Cpr E 569. Bioinformatics III (Structural Genome Informatics). (Cross-listed with BBMB, Com S, Math, BCB). (3-0) Cr. 3. F. *Prereq: BCB 567, Gen 411, Stat 430.* Algorithmic and Statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

Cpr E 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology). (Cross-listed with BCB, Com S, GDCB,Stat). (3-0) Cr. 3. S. *Prereq: BCB 567, Biol 315, Com S 311 and either 208 or 228, Gen 411, Stat 430.* Algorithmic and statistical approaches in computational functional genomics and systems biology. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Ontology-driven, network based, and probabilistic approaches to nformation integration.

Cpr E 575. Computational Perception. (Cross-listed with Com S, HCI). (3-0) Cr. 3. S. *Prereq: Graduate standing or permission of instructor.* This class covers Statistical and algorithmic methods for sensing, recognizing, and interpreting the activities of people by a computer. This semester we will focus on machine perception techniques that facilitate and augment human-computer interaction. The main goal of the class is to introduce computational perception on both theoretical and practical levels. You will work in small groups to design, implement, and evaluate a prototype of a human-computer interaction system that uses one or more of the techniques covered in the lectures.

Cpr E 581. Computer Systems Architecture. (Cross-listed with Com S). (3-0) Cr. 3. F. *Prereq: 381.* Quantitative principles of computer architecture design, instruction set design, processor architecture: pipelining and superscalar design, instruction level parallelism, memory organization: cache and virtual memory systems, multiprocessor architecture, cache coherency, interconnection networks and message routing, I/O devices and peripherals.

Cpr E 582. Computer Systems Performance. (3-0) Cr. 3. *Prereq: 381, 310 and Stat 330.* Review of probability and stochastic processes concepts; Markovian processes; Markovian queues; renewal theory; semi-Markovian queues; queueing networks, multiprocessor architectures; computer networks; switching systems; case studies.

Cpr E 583. Reconfigurable Computing Systems. (Cross-listed with Com S). (3-0) Cr. 3. *Prereq: Background in computer architecture, design, and organization.* Introduction to reconfigurable computing, FPGA technology and architectures, spatial computing architectures such as systolic and bit serial adaptive network architectures, static and dynamic rearrangeable interconnection architectures, processor architectures incorporating reconfigurabiltiy.

Cpr E 587. Text Mining, Text Processing, and the Internet. (3-0) Cr. 3. *Prereq: Com S 309 or Com S 311.* Mining, retrieval, and other processing of text, including text and hypermedia on the world wide web. Human computer interaction in the context of text and hyper media. Topics of particular interest to enrolled students.

Cpr E 588. Embedded Computer Systems. (3-0) Cr. 3. *Prereq: 308.* Hardware/software systems and codesign. Models of computation for embedded systems. System-level design. Modeling, specification, synthesis, and verification. Hardware/software implementation. Design space exploration. Performance analysis and optimization. Multiprocessor system on chip. Platform-based design. Design methodologies and tools. Case studies and design projects.

Cpr E 589. Multimedia Systems. (3-0) Cr. 3. S. *Prereq: 308 or Com S 352.* Fundamentals concepts in multimedia systems. Resource management issues in distributed/networked multimedia systems, QoS routing and multicasting. Traffic shaping, Task and message scheduling, Internet QoS. Adaptive multimedia applications over the Internet. Operating system support for multimedia. Storage architecture and scalable media servers. Compression techniques, synchronization techniques, processor architectures for multimedia.

Cpr E 590. Special Topics. Cr. arr. Repeatable. Formulation and solution of theoretical or practical problems in computer engineering.

Cpr E 592. Seminar in Computer Engineering. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Projects or seminar in Computer Engineering.

Cpr E 594. Selected Topics in Computer Engineering. (3-0) Cr. 3. Repeatable.

Cpr E 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

Cpr E 626. Parallel Algorithms for Scientific Applications. (Cross-listed with Com S). (3-0) Cr. 3. *Prereq: 526.* Algorithm design for high-performance computing. Applications to numerical simulations, sparse matrix computation, multidimensional tree data structure, and particle-based methods, random numbers and Monte Carlo applications, algorithms, and computational biology.

Cpr E 632. Information Assurance Capstone Design. (Cross-listed with InfAs). (3-0) Cr. 3. *Prereq: 531, 532, 534.* Capstone design course which integrates the security design process. Design of a security policy. Creation of a security plan. Implementation of the security plan. The students will attach each other's secure environments in an effort to defeat the security systems. Students evaluate the security plans and the performance of the plans. Social, political and ethics issues. Student self-evaluation, journaling, final written report, and an oral report.

Cpr E 681. Advanced Topics in Computer Architecture. (Cross-listed with Com S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 581.* Current topics in computer architecture design and implementation. Advanced pipelining, cache and memory design techniques. Interaction of algorithms with architecture models and implementations. Tradeoffs in architecture models and implementations.

Cpr E 697. Engineering Internship. (Cross-listed with E E). Cr. R. Repeatable. *Prereq: Permission of department chair and Engineering Career Services, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

Cpr E 699. Research. Cr. arr. Repeatable.

Computer Science

www.cs.iastate.edu

Undergraduate Study

Carl Chang, Chair of Department

Professors: Aluru, Bergman, C. Chang, Fernandez-Baca, Honavar, Huang, Kothari, J. Lutz, R. Lutz, Maddux, Miller, Slutzki, Wong

Professors (Emeritus): Brearley, Oldehoeft, Stewart, Thomas

Associate Professors: Aduri, J. Chang , Chaudhuri, Chou, Eulenstein, Gadia, Jia, Miner, Prabhu, Tavanapong, Tyagi, Zhu

Associate Professor (Collaborators): Mayordome

Assistant Professors: Basu, Cai, Harding, Margaritis, Rajan, Ruan, Song, Stoytchev, Tian, T. Zhang, W. Zhang

Senior Lecturers: Lathroup, Mitra

Lecturers: S. Chang, Johnson, Kautz

Undergraduate Study

The curriculum leading to the baccalaureate degree in computer science is designed to prepare students for positions as computer scientists with business, industry, or government, or for graduate study in computer science. The main objectives are to impart to students an understanding of the basics of computer science, to develop proficiency in the practice of computing, and to prepare them for continued professional development.

The following are intended learning outcomes for computer science majors. Seniors will assess these outcomes in a survey conducted before they graduate and feedback thus obtained will be used to improve the curriculum.

A. Impart an understanding of the basics of the discipline. Each graduate will know

A.1 Fundamental principles of computing,
A.2 Basic foundations of Mathematics, Statistics, and physical sciences
A.3 Design and implementation of programs

B. Develop proficiency in the practice of computing. The graduated student will be able to

B.1 formulate and solve problems in computing,
B.2 Understand design and performance requirements of software systems,
B.3 Apply sound principles to the synthesis and analysis of computer systems

C. Prepare for continued professional development. Our students will

C1 Engage in lifelong learning and expect to embrace change,
C.2 Communicate effectively and think critically and creatively, both independently and with others,
C.3 Be aware of social and ethical issues of computers in Society

Students must earn at least a C- in each course taken to fulfill the Degree Program.

Students must take at least 45 credits at the 300 level or higher at Iowa State University.

To complete an undergraduate degree in Computer Science, a student must satisfy the requirements of the College of Liberal Arts and Sciences (see *Liberal Arts and Sciences, Curriculum*) and include the following courses within the group requirements: Phil 343; Sp Cm 212; 14 credits of Math and Statistics including Math 165, Math 166, one Statistics course from Stat 105, 231, 305, 330, 333, or 341, and at least one Math course from Math 265, 266, 304, 307, 314, or 317; a minimum of 13 credits of natural science including Phys 221, 222, and at least one additional natural science course from the following list: A Ecl 312, Anthr 202, 307, BBMB 221, Biol 312, Biol 355, Chem 163-231, Ent 370, Env S 324, Env S 330, FS HN 167, Gen 260, Geol 100-108, 201, 311, 451, 475, Mat E 207, 211, Mteor 206, 301, Psych 310. Communication Proficiency requirement: Engl 150, 250 and one of Engl 302, 305, 309 or 314. The minimum grade accepted in each of the three required English courses is a C-.

Students wishing to pursue the B.S. degree in computer science must first successfully complete the premajor program consisting of the following courses and minimum grade requirements:

Course	Minimum Grade
227	C-
228	C-
Math 165	C-

Students majoring in computer science must successfully complete this premajor program prior to taking any other courses in the Department. Thus, for computer science majors, this premajor serves as a necessary prerequisite to all the other courses offered by the Department.

Computer science majors transferring from other institutions must take at least 15 of their credits at the 300-level or above in our department while in residence at Iowa State.

To graduate with a major in the Computer Science Department, a student must earn at least a C- in each of the courses taken to fulfill the program of study.

A minimum of 44 credits is required for the B.S. degree in computer science. The required courses are: Com S 101, 203, Cpr E 281, Com S 227, 228, 229, 309, 311, 321, 330, 331, 342, 352, 362 or 363. In addition, two advanced-level courses must be selected from the following groups:

Group W: 426, 440, 454, 477, 486

Group B: 401, 409, 416, 417, 425, 430, 455, 461, 472, 474

Group N: 412, 418, Math 421, 471, 481, 426; Cpr E 485, Cpr E 489, M E 557

Courses in Group W require written reports and those in Group B require both oral and written reports. Students must take one course from Group B and one course from any group.

Students must earn a C- or better in each course in the department which is a prerequisite to a course listed in the student's degree program.

Undergraduate Minor. The Computer Science Department offers an undergraduate minor in Computer Science. The minor requires at least 19 credits in computer science courses. Com S 227, 228, and 229, adding up to 10 credits are required. In addition, at least 9 credits should be taken in courses at the 300 level or above.

Undergraduate Curriculum in Software Engineering. The Department of Computer Science together with the Department of Electrical and Computer Engineering also offer a curriculum leading to an undergraduate degree in software engineering. The software engineering curriculum offers emphasis areas in software engineering principles, process, and practice. Students may also take elective courses in computer engineering and computer science.

See Index, Software Engineering. For curriculum information, see also College of Engineering and College of Liberal Arts and Sciences.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with a major in Computer Science. The Doctor of Philosophy degree may also be earned with computer science as a co-major with some other discipline. Additionally, the department offers a minor to students majoring in other departments.

Established research areas include algorithms, artificial intelligence, computational complexity, computer architecture, bioinformatics, computational biology, computer networks, database systems, formal methods, information assurance, machine learning and neural networks, multimedia, operating systems, parallel and distributed computing, programming languages, robotics, and software engineering. There are also numerous opportunities for interdisciplinary research.

Typically, students beginning graduate work in Computer Science have completed a bachelor's degree or equivalent in Computer Science. However, some students with undergraduate majors in other areas, such as Mathematical, physical, or biological science or engineering become successful graduate students in Computer Science.

For the degree Master of Science, a minimum of 30 semester credits is required. A thesis demonstrating research and the ability to organize and express significant ideas in computer science is required.

The purpose of the doctoral program is to train students to do original research in Computer Science. Each student is also required to attain knowledge and proficiency commensurate with a leadership role in the field. The Ph.D. requirements are governed by the student's program of study committee within established guidelines of the department and the graduate college. They include coursework, demonstrated proficiency in four areas of Computer Science, a research skills requirement, a preliminary examination, and a doctoral dissertation and final oral examination. The department recommends that all graduate students majoring in Computer Science teach as part of their training for an advanced degree.

Courses primarily for undergraduate students

Com S 101. Orientation. Cr. R. F.S. Introduction to the procedures and policies of Iowa State University and the Department of Computer Science, test-outs, honorary Societies, etc. Issues relevant to student adjustment to college life will also be discussed. Satisfactory-fail only.

Com S 103. Computer Applications. Cr. 4. F.S.SS. Introduction to computer literacy and applications. Applications: Windows, Internet browser/HTML, word processing, spreadsheets, database management and presentation software. Literacy: history of computing, structure of computers, telecommunications, computer ethics, computer crime, and history of programming languages. No prior computer experience necessary. Course is offered online only. Students must attend an orientation session the first week of class.

Com S 104. Introduction to Computers. (1.5-1) Cr. 2. F.S. Offered first 8 weeks and last 8 weeks. Use of personal computer and workstation operating systems and beginning programming. Project-oriented approach to computer operation and programming, including use of tools to aid in programming. Topics from computer history, using basic Windows and Unix tools, program structure, expression, variables, decision and logic, and iteration. No prior computer experience necessary.

Com S 107. Applied Computer Programming. (3-0) Cr. 3. F.S. Introduction to computer programming for non-majors using a language such as the Visual Basic language. Basics of good programming and algorithm development. Graphical user interfaces.

Com S 201. Computer Programming in COBOL. (3-0) Cr. 3. SS. *Prereq: 107 or 207 or 227.* Computer programming in COBOL. Emphasis on the design, writing, debugging, and testing of business applications programs in a transaction-oriented environment.

Com S 203. Careers in Computer Science. Cr. R. F.S. Computer science as a profession. Introduction to career fields open to computer science majors. Relationship of coursework to careers. Presentations by computer science professionals. Satisfactory-fail only.

Com S 207. Programming I. (3-1) Cr. 3. F.S. *Prereq: Math 150 or placement into Math 140/141/142 or higher.* An introduction to computer programming using an object-oriented programming language. Emphasis on the basics of good programming techniques and style. Extensive practice in designing, implementing, and debugging small programs. Use of abstract data types. Interactive and file I/O. Exceptions/error-handling. This course is designed for nonmajors. Credit may not be applied toward graduation for both Com S 207 and 227.

Com S 208. Programming II. (3-1) Cr. 3. S. *Prereq: 207, credit or enrollment in Math 151, 160, or 165.* Intermediate-level programming techniques. Emphasis on designing, writing, testing, debugging, and documenting medium-sized programs. Data structures and their uses. Dynamic memory usage. Inheritance and polymorphism. Algorithm design and efficiency: recursion, searching, and sorting. Event-driven and GUI programming. The software development process. This course is designed for nonmajors. Credit may not be applied toward the major.

Com S 227. Introduction to Object-oriented Programming. (3-2) Cr. 4. F.S. An introduction to object-oriented design and programming techniques. Symbolic and numerical computation. Recursion and iteration. Modularity procedural and data abstraction, specifications and subtyping. Object-oriented techniques. Imperative programming. Emphasis on principles of programming and object-oriented design through extensive practice in design, writing, running, debugging, and reasoning about programs. This course is designed for majors. Credit may not be applied toward graduation for both Com S 207 and 227.

Com S 228. Introduction to Data Structures. (3-1) Cr. 3. F.S. *Prereq: C- or better in 227, credit or enrollment in Math 165.* An object-oriented approach to data structures and algorithms. Object-oriented analysis, design, and programming, with emphasis on data abstraction, inheritance and subtype polymorphism. Abstract data type specification and correctness. Collections and associated algorithms, such as stacks, queues, lists, trees. Searching and sorting algorithms. Graphs. Data on secondary storage. Analysis of algoritms. Emphasis on object-oriented design, writing and documenting medium-sized programs. This course is designed for majors.

Com S 229. Advanced Programming Techniques. (3-0) Cr. 3. F.S. *Prereq: 228, credit or enrollment in Math 166.* Object-oriented programming experience using a language suitable for exploring advanced topics in programming. Topics include memory management, parameter passing, inheritance, compiling, debugging, and maintaining programs. Significant programming projects.

Com S 252. Linux Operating System Essentials. (2-2) Cr. 3. F. *Prereq: 103 or 207 or 227.* Selected topics include: Linux Distributions, installation, configuration, and management of a Linux based computer system, shell programming, network accessing technologies, package management systems, system security, user, file sharing techniques, interoperation with other computers on the network, and open-source software. This is a hands-on course designed to demonstrate the installation and utilization of the Linux operating system for a personal computer.

Com S 290. Independent Study. Cr. arr. F.S. *Prereq: Permission of instructor.* Satisfactory-fail only.
H. Honors

Com S 309. Software Development Practices. (3-1) Cr. 3. F.S. *Prereq: Com S 228 with C- or better, Com S 229 or Cpr E 211, Engl 250.* A practical introduction to methods for managing software development. Process models, requirements analysis, structured and object-oriented design, coding, testing, maintenance, cost and schedule estimation, metrics. Programming projects. Nonmajor graduate credit.

Com S 311. Design and Analysis of Algorithms. (3-1) Cr. 3. F.S. *Prereq: 228 with C- or better, Math 166, Engl 250, and Com S 330 or Cpr E 310.* Basic techniques for design and analysis of efficient algorithms. Sorting, searching, graph algorithms, computational geometry, string processing and NP-completeness. Design techniques such as dynamic programming and the greedy method. Asymptotic, worst-case, average-case and amortized analyses. Data structures including heaps, hash tables, binary search trees and red-black trees. Programming projects. Credit may not be applied toward graduation for both Com S 311 and 381. Nonmajor graduate credit.

Com S 319. Software Construction and User Interfaces. (Cross-listed with S E). (3-0) Cr. 3. F. Basic theory of grammars, parsing. Language paradigms. State transition and table-based software design. Rapid system prototyping. Review of principles of object orientation, object oriented analysis using UML. Event-driven and clock-driven simulation. Software construction methods. Frameworks and APIs. User interface architecture, evaluation of user interface. Design of windows, menus, and commands. Introduction to format specification and model-based software design. Introduction to domain-specific software engineering. Nonmajor graduate credit.

Com S 321. Introduction to Computer Architecture and Machine-Level Programming. (3-1) Cr. 3. F.S. *Prereq: C- or higher in 228, Cpr E 281 and Engl 250.* Introduction to computer architecture and organization. Emphasis on evaluation of performance, instruction set architecture, datapath and control, memory-hierarchy design, and pipelining. Assembly language on a simulator. Nonmajor graduate credit.

Com S 330. Discrete Computational Structures. (3-1) Cr. 3. F.S. *Prereq: C- or higher in 228, C- or higher in Math 166 and Engl 250.* Concepts in discrete Mathematics as applied to computer science. Logic, proof techniques, set theory, relations, graphs, combinatorics, discrete probability and number theory. Nonmajor graduate credit.

Com S 331. Theory of Computing. (Cross-listed with Ling). (3-1) Cr. 3. F.S. *Prereq: C- or higher in 228, C- or higher in Com S 330 or Cpr E 310, C- or higher in Math 166, and Engl 250.* Models of computation: finite state automata, pushdown automata and Turing machines. Study of grammars and their relation to automata. Limits of digital computation, unsolvability and Church-Turing thesis. Chomsky hierarchy and relations between classes of languages. Nonmajor graduate credit.

Com S 342. Principles of Programming Languages. (3-1) Cr. 3. F.S. *Prereq: 321; 330 or Cpr E 310; either 309, 362 or 363; Engl 250.* Organization of programming languages emphasizing language design concepts and semantics. Study of language features and major programming paradigms, especially functional programming. Programming projects. Nonmajor graduate credit.

Com S 350. Number Theory. (Cross-listed with Math). (3-0) Cr. 3. S. *Prereq: Math 166.* Divisibility, integer representations, primes and divisors, linear diophantine equations, congruences, and multiplicative functions. Applications to cryptography. Nonmajor graduate credit.

Com S 352. Introduction to Operating Systems. (3-1) Cr. 3. F.S. *Prereq: 229, and 321; Engl 250.* Survey of operating system issues. Introduction to hardware and software components including: processors, peripherals, interrupts, management of processes, threads and memory, deadlocks, file systems, protection, virtual machines and system organization, and introduction to distributed operating systems. Programming projects. Nonmajor graduate credit.

Com S 362. Object-Oriented Analysis and Design. (3-0) Cr. 3. F.S. *Prereq: 228 with C- or better, Engl 250.* Object-oriented requirements analysis and systems design. Design notations such as the Unifed Modeling Language. Design Patterns. Group design and programming with large programming projects. Nonmajor graduate credit.

Com S 363. Introduction to Database Management Systems. (3-0) Cr. 3. F.S. *Prereq: 228 with C- or better, Engl 250.* Relational, object-oriented, and semistructured data models and query languages. SQL, ODMG, and XML standards. Database design using entity-relationship model, data dependencies and object definition language. Application development in SQL-like languages and general purpose host languages with application program interfaces. Information integration using data warehouses, mediators and wrappers. Programming Projects. Nonmajor graduate credit.

Com S 398. Cooperative Education. Cr. R. *Prereq: Permission of department chair.* Required of all cooperative students. Students must register for this course prior to commencing each work period.

Com S 401. Projects in Computing and Business Applications. (2-2) Cr. 3. F. *Prereq: Engl 250, Sp Cm 212, Com S 309, and either 362 or 363.* Applications of software development methods (requirements collection and analysis, software design, project management, documentation and testing), programming techniques, database designs and administration, network application programming to solve computing needs in business settings. A study of practical applications of emerging technologies in computing. Emphasis on semester-long team programming projects. Lab assignments. Oral and written reports. Nonmajor graduate credit.

Com S 409. Software Requirements Engineering. (Dual-listed with 509). (Cross-listed with S E). (3-0) Cr. 3. F. *Prereq: Com S 309, Engl 250, Sp Cm 212.* The requirements engineering process, including identification of stakeholders, requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Non-functional requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports, and oral presentations will be required. Nonmajor graduate credit.

Com S 412. Formal Aspects of Specification and Verification. (Cross-listed with Cpr E, S E). (3-0) Cr. 3. *Prereq: Com S 309, 319.* Introduction to prepositional/predicate/temporal logic, program verification using theorem proving, model-based verification using model checking, and tools for verification. Nonmajor graduate credit.

Com S 417. Software Testing. (Cross-listed with S E). (3-0) Cr. 3. S. *Prereq: Com S 309, 319, Engl 250, Sp Cm 212.* Comprehensive study of software testing, principles, methodologies, management strategies and techniques. Test models, test design techniques (black box and white-box testing techniques), integration, regression, system testing methods, and software testing tools. Nonmajor graduate credit.

Com S 418. Introduction to Computational Geometry. (Dual-listed with 518). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 311 or permission of instructor.* Introduction to data structures, algorithms, and analysis techniques for computational problems that involve geometry. Line segment intersection, polygon triangulation, 2D linear programming, range queries, point location, arrangements and duality, Voronoi diagrams and Delaunay triangulation, convex hulls, robot motion

planning, visibility graphs. Other selected topics. Programming assignments. Nonmajor graduate credit.

Com S 421. Logic for Mathematics and Computer Science. (Cross-listed with Math). (3-0) Cr. 3. S. *Prereq: Math 301 or 307 or 317 or Com S 330.* Propositional and predicate logic. Topics selected from Horn logic, equational logic, resolution and unification, foundations of logic programming, reasoning about programs, program specification and verification, model checking and binary decision diagrams. Nonmajor graduate credit.

Com S 425. High Performance Computing for Scientific and Engineering Applications. (Cross-listed with Cpr E). (3-1) Cr. 3. S. *Prereq: 311, 330, Engl 250, Sp Cm 212.* Introduction to high performance computing platforms including parallel computers and workstation clusters. Discussion of parallel architectures, performance, programming models, and software development issues. Sample applications from science and engineering. Practical issues in high performance computing will be emphasized via a number of programming projects using a variety of programming models and case studies. Oral and written reports. Nonmajor graduate credit.

Com S 426. Introduction to Parallel Algorithms and Programming. (Dual-listed with 526). (Cross-listed with Cpr E). (3-2) Cr. 4. F. *Prereq: Cpr E 308 or Com S 321, Com S 311.* Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms. Nonmajor graduate credit.

Com S 430. Advanced Programming Tools. (3-1) Cr. 3. F. *Prereq: 311, 362 or 363, Engl 250, Sp Cm 212.* Topics in advanced programming techniques and tools widely used by industry (e.g., event-driven programming and graphical user interfaces, standard libraries, client/server architectures and techniques for distributed applications). Emphasis on programming projects in a modern integrated development environment. Oral and written reports. Nonmajor graduate credit.

Com S 433. Computational Models of Nanoscale Self-Assembly. (Dual-listed with 533). (3-0) Cr. 3. S. *Prereq: C- or higher in 331 or consent of the instructor.* Modeling and analysis of natural and engineered systems that spontaneously assemble themselves from small components. Topics include biomolecular self-assembly, tile assembly models, computation via self-assembly, distributed folding, origami models, and self-repair. Emphasis on Mathematical methods of describing, simulating, programming, and verifying the behaviors of self-assembling systems. Graduate credit requires a written or oral report on current research. Nonmajor graduate credit.

Com S 440. Principles and Practice of Compiling. (Dual-listed with 540). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: 331, 342, Engl 250, Sp Cm 212.* Theory of compiling and implementation issues of programming languages. Programming projects leading to the construction of a compiler. Projects with different difficulty levels will be given for 440 and 540. Topics: lexical, syntax and semantic analyses, syntax-directed translation, runtime environment and library support. Written reports. Nonmajor graduate credit.

Com S 444. Introduction to Bioinformatics. (Dual-listed with 544). (Cross-listed with BCB, Biol, Cpr E, Gen). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics. Nonmajor graduate credit.

Com S 454. Distributed and Network Operating Systems. (Dual-listed with 554). (Cross-listed with Cpr E). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: 311, 352, Engl 250, Sp Cm 212.* Laboratory course dealing with practical issues of design and implementation of distributed and network operating systems and distributed computing environments (DCE). The client server paradigm, inter-process communications, layered communication protocols, synchronization and concurrency control, and distributed file systems. Graduate credit requires additional in-depth study of advanced operating systems. Written reports. Nonmajor graduate credit.

Com S 455. Simulation: Algorithms and Implementation. (Dual-listed with 555). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 311 and 330, Stat 330, Engl 150, Sp Cm 212.* Introduction to discrete-event simulation with a focus on computer science applications, including performance evaluation of networks and distributed systems. Overview of algorithms and data structures necessary to implement simulation software. Discrete and continuous stochastic models, random number generation, elementary Statistics, simulation of queuing and inventory systems, Monte Carlo simulation, point and interval parameter estimation. Graduate credit requires additional in-depth study of concepts. Oral and written reports. Nonmajor graduate credit.

Com S 461. Principles and Internals of Database Systems. (Dual-listed with 561). (3-1) Cr. 3. F. *Prereq: 311, Engl 250, Sp Cm 212 and Com S 363.* Models for structured and semistructured data. Algebraic, first order, and user-oriented query languages. Database schema design. Physical storage, access methods, and query processing. Transaction management, concurrency control, and crash recovery. Database security. Information integration using data warehouses, mediators, wrappers, and data mining. Parallel and distributed databases, and special purpose databases. Oral and written reports. Nonmajor graduate credit.

Com S 471. Computational Linear Algebra and Fixed Point Iteration. (Cross-listed with Math). (3-0) Cr. 3. Alt. F., offered 2009. S. *Prereq: Math 265 and either Math 266, or 267; knowledge of a programming language.* Computational error, solutions of linear systems, least squares, similarity methods for eigenvalues, solution of nonlinear equations in one and several variables. Nonmajor graduate credit.

Com S 472. Principles of Artificial Intelligence. (Dual-listed with 572). (3-1) Cr. 3. F. *Prereq: 311, 330 or Cpr E 310, Stat 330, Engl 250, Sp Cm 212, Com S 342 or comparable programming experience.* Specification, design, implementation, and selected applications of intelligent software agents and multi-agent systems. Computational models of intelligent behavior, including problem solving, knowledge representation, reasoning, planning, decision making, learning, perception, action, communication and interaction. Reactive, deliberative, rational, adaptive, learning and communicative agents and multiagent systems. Artificial intelligence programming. Graduate credit requires a research project and a written report. Oral and written reports. Nonmajor graduate credit.

Com S 474. Elements of Neural Computation. (3-1) Cr. 3. Alt. F., offered 2010. *Prereq: 311, 330 or Cpr E 310, Stat 330, Math 165, Engl 250, Sp Cm 212, Com S 342 or comparable programming experience.* Introduction to theory and applications of neural computation and computational neuroscience. Computational models of neurons and networks of neurons. Neural architectures for associative memory, knowledge representation, inference, pattern classification, function approximation, stochastic search, decision making, and behavior. Neural architectures and algorithms for learning including perceptions, support vector machines, kernel methods, bayesian learning, instance based learning, reinforcement learning, unsupervised learning, and related techniques. Applications in Artificial Intelligence and cognitive and neural modeling. Hands-on experience is emphasized through the use of simulation tools and laboratory projects. Oral and written reports. Nonmajor graduate credit.

Com S 477. Problem Solving Techniques for Applied Computer Science. (Dual-listed with 577). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 228; 330 or Cpr E 310, Math 166, Math 307 or Math 317, or consent of the instructor.* Selected topics in applied Mathematics and modern heuristics that have found applications in areas such as geometric modeling, graphics, robotics, vision, human machine interface, speech recognition, computer animation, etc. Polynomial interpolation, roots of polynomials, resultants, solution of linear and nonlinear equations, approximation, data fitting, fast Fourier transform, linear programming, nonlinear optimization, Lagrange multipliers, genetic algorithms, integration of ODEs, curves, curvature, Frenet formulas, cubic splines, and Bezier curves. Programming components. Written report for graduate credit. Nonmajor graduate credit.

Com S 481. Numerical Solution of Differential Equations and Interpolation. (Cross-listed with Math). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 265 and either Math 266 or 267; knowledge of a programming language.* Polynomial and spline interpolation, orthogonal polynomials, least squares, numerical differentiation and integration, numerical solution of ordinary differential equations. Nonmajor graduate credit.

Com S 486. Fundamental Concepts in Computer Networking. (3-0) Cr. 3. S. *Prereq: 352.* An introduction to fundamental concepts in the design and implementation of computer communication in both the wired and wireless networks, their protocols, and applications. Layered network architecture in the Internet, applications, transport, Socket APIs, network, and data link layers and their protocols, multimedia networking, and network security. Nonmajor graduate credit.

Com S 490. Independent Study. Cr. arr. Repeatable. F.S. *Prereq: 6 credits in computer science, permission of instructor.* No more than 9 credits of Com S 490 may be counted toward graduation. Satisfactory-fail only. H. Honors

Courses primarily for graduate students, open to qualified undergraduate students

Com S 502. Complex Adaptive Systems Seminar. (Cross-listed with CAS). (1-0) Cr. 1. F.S. *Prereq: Admissions to CAS minor.* Understanding core techniques in artificial life are based on basic readings in complex adaptive systems. Understand techniques of complex system analysis methods including: Evolutionary computation, Neural nets, Agent based simulations (Agent based Computational Economics). Large-scale simulations are to be emphasized, e.g. power grids, whole ecosystems.

Com S 503. Complex Adaptive Systems Concepts and Techniques. (Cross-listed with CAS). (3-0) Cr. 3. S. *Prereq: Admission to CAS minor or related field.* Survey of complex systems and their analysis. Examples are drawn from engineering, computer science, biology, economics and physics.

Com S 509. Software Requirements Engineering. (Dual-listed with 409). (3-0) Cr. 3. F. *Prereq: 309.* The requirements engineering process including identification of stakeholders requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Non-functional requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports, and oral presentations will be required.

Com S 511. Design and Analysis of Algorithms. (Cross-listed with Cpr E). (3-0) Cr. 3. F. *Prereq: Com S 311.* A study of basic algorithm design and analysis techniques. Advanced data structures, amortized analysis and randomized algorithms. Applications to sorting, graphs, and geometry. NP-completeness and approximation algorithms.

Com S 512. Formal Methods in Software Engineering. (3-0) Cr. 3. S. *Prereq: 311, 330.* A study of formal techniques for specification and verification of software systems. Topics include temporal logic, propositional and predicate logic, model checking, process algebra, theorem proving. Tools providing automated support for these techniques will also be discussed.

Com S 515. Software System Safety. (3-0) Cr. 3. F. *Prereq: 309 or 311, 342.* An introduction to the analysis, design, and testing of software for safety-critical and high-integrity systems. Analysis techniques, formal verification, fault identification and recovery, model checking, and certification issues. Emphasizes a case-based and systematic approach to software's role in safe systems.

Com S 518. Introduction to Computational Geometry. (Dual-listed with 418). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 311 or permission of instructor.* Introduction to data structures, algorithms, and analysis techniques for computational problems that involve geometry. Line segment intersection, polygon triangulation, 2D linear programming, range queries, point location, arrangements and duality, Voronoi diagrams and Delaunay triangulation, convex hulls, robot motion planning, visibility graphs. Other selected topics. Programming assignments. A scholarly report must be submitted for graduate credit.

Com S 525. Numerical Analysis of High Performance Computing. (Cross-listed with Cpr E, Math). (3-0) Cr. 3. S. *Prereq: Cpr E 308, or one of Math 471, 481; experience in scientific programming; knowledge of FORTRAN or C.* Development, analysis, and testing of efficient numerical methods for use on current state-of-the-Art High performance computers. Applications of the methods to the students' areas of research.

Com S 526. Introduction to Parallel Algorithms and Programming. (Dual-listed with 426). (Cross-listed with Cpr E). (3-2) Cr. 4. F. *Prereq: Cpr E 308 or Com S 321, Com S 311.* Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms.

Com S 531. Theory of Computation. (3-0) Cr. 3. S. *Prereq: 331.* A systematic study of the fundamental models and analytical methods of theoretical computer science. Computability, the Church-Turing thesis, decidable and undecidable problems, and the elements of recursive function theory. Time complexity, logic, Boolean circuits, and NP-completeness. Role of randomness in computation.

Com S 533. Computational Models of Nanoscale Self-Assembly. (Dual-listed with 433). (3-0) Cr. 3. S. *Prereq: C- or higher in 331 or consent of the instructor.* Modeling and analysis of natural and engineered systems that spontaneously assemble themselves from small components. Topics include biomolecular self-assembly, tile assembly models, computation via self-assembly, distributed folding, origami models, and self-repair. Emphasis on Mathematical methods of describing, simulating, programming, and verifying the behaviors of self-assembling systems. Graduate credit requires a written or oral report on current research.

Com S 540. Principles and Practice of Compiling. (Dual-listed with 440). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: 331, 342, Engl 250, Sp Cm 212.* Theory of compiling and implementation issues of programming languages. Programming projects leading to the construction of a compiler. Projects with different difficulty levels will be given for 440 and 540. Topics: lexical, syntax and semantic analyses, syntax-directed translation, runtime environment and library support. Written reports.

Com S 541. Programming Languages. (3-1) Cr. 3. F. *Prereq: 342 or 440.* Survey of the goals and problems of language design. Formal and informal studies of a wide variety of programming language features including type systems. Creative use of functional and declarative programming paradigms.

Com S 544. Introduction to Bioinformatics. (Dual-listed with 444). (Cross-listed with BCB, Cpr E, GDCB). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics.

Com S 549. Advanced Algorithms in Computational Biology. (Cross-listed with BCB, Cpr E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 311 and either 228 or 208.* Design and analysis of algorithms for applications in computational biology, pairwise and multiple sequence alignments, approximation algorithms, string algorithms including in-depth coverage of suffix trees, semi-numerical string algorithms, algorithms for selected problems in fragment assembly, phylogenetic trees and protein folding. No background in biology is assumed. Also useful as an advanced algorithms course in string processing.

Com S 550. Evolutionary Problems for Computational Biologists. (Cross-listed with BCB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Com S 311 and some knowledge of programming.* Discussion and analysis of basic evolutionary principles and the necessary knowledge in computational biology to solve real world problems. Topics include character and distance based methods, phylogenetic tree distances, and consensus methods, and approaches to extract the necessary information from sequence-databases to build phylogenetic trees.

Com S 551. Computational Techniques for Genome Assembly and Analysis. (Cross-listed with BCB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 311 and some knowledge of programming.* Huang. Introduction to practical sequence assembly and comparison techniques. Topics include global alignment, local alignment, overlapping alignment, banded alignment, linear-space alignment, word hashing, DNA-protein alignment, DNA-cDNA alignment, comparison of two sets of sequences, construction of contigs, and generation of consensus sequences. Focus on development of sequence assembly and comparison programs.

Com S 552. Principles of Operating Systems. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 352.* A comparative study of high-level language facilities for process synchronization and communication. Formal analysis of deadlock, concurrency control and recovery. Protection issues including capability-based systems, access and flow control, encryption, and authentication. Additional topics chosen from distributed operating systems, soft real-time operating systems, and advanced security issues.

Com S 554. Distributed and Network Operating Systems. (Dual-listed with 454). (Cross-listed with Cpr E). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: 311, 352.* Laboratory course dealing with practical issues of design and implementation of distributed and network operating systems and distributed computing environments (DCE). The client server paradigm, inter-process communications, layered communication protocols, synchronization and concurrency control, and distributed file systems. Graduate credit requires additional in-depth study of advanced operating systems. Written reports.

Com S 555. Simulation: Algorithms and Implementation. (Dual-listed with 455). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Com S 311 and 330, Stat 330.* Introduction to discrete-event simulation with a focus on computer science applications, including performance evaluation of networks and distributed systems. Overview of algorithms and data structures necessary to implement simulation software. Discrete and continuous stochastic models, random number generation, elementary Statistics, simulation of queuing and inventory systems, Monte Carlo simulation, point and interval parameter estimation. Graduate credit requires additional in-depth study of concepts. Oral and written reports.

Com S 556. Analysis Algorithms for Stochastic Models. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Com S 331, Math 307, and Stat 330.* Introduction to the use of stochastic models to study complex systems, including network communication and distributed systems. Data structures and algorithms for analyzing discrete-State models expressed in high-level formalisms. State space and reachability graph construction, model checking, Markov chain construction and numerical solution, computation of performance measures, product-form models, approximations, and advanced techniques.

Com S 557. Computer Graphics and Geometric Modeling. (Cross-listed with M E, Cpr E). (3-0) Cr. 3. F.S. *Prereq: 421, programming experience in C.* Fundamentals of computer graphics technology. Data structures. Parametric curve and surface modeling. Solid model representations. Applications in engineering design, analysis, and manufacturing

Com S 558. Introduction to the 3D Visualization of Scientific Data. (Cross-listed with Geol, HCI). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate-student standing in the Mathematical or natural sciences.* Introduction to visualizing scientific information with 3D computer graphics and their foundation in human perception. Overview of different visualization techniques and examples of 3D visualization projects from different disciplines (natural sciences, medicine, engineering). Class project in interactive 3D visualization using the OpenDX, VTK or a similar system.

Com S 561. Principles and Internals of Database Systems. (Dual-listed with 461). (3-1) Cr. 3. F. *Prereq: Graduate classification.* Models for structured and semistructured data. Algebraic, first order, and user-oriented query languages. Database schema design. Physical storage, access methods, and query processing. Transaction management, concurrency control, and crash recovery. Database security. Information integration using data warehouses, mediators, wrappers, and data mining. Parallel and distributed databases, and special purpose databases. Oral and written reports. Satisfactory-fail only.

Com S 562. Implementation of Database Systems. (3-0) Cr. 3. F. *Prereq: 461 or 561.* Implementation topics and projects are chosen from the following: Storage architecture, buffer management and caching, access methods, design, parsing and compilation of query languages and update operations, application programming interfaces (APIs), user interfaces, query optimization and processing, and transaction management for relational, object-oriented, semistructured (XML), and special purpose database models; client-server architectures, metadata and middleware for database integration, web databases.

Com S 567. Bioinformatics I (Fundamentals of Genome Informatics). (Cross-listed with BCB, Cpr E). (3-0) Cr. 3. F. *Prereq: Com S 208; Com S 330; Stat 341; credit or enrollment in Biol 315, Stat 430.* Biology as an information science. Review of algorithms and information processing. Generative models for sequences. String algorithms. Pairwise sequence alignment. Multiple sequence alignment. Searching sequence databases. Genome sequence assembly.

Com S 568. Bioinformatics II (Advanced Genome Informatics). (Cross-listed with BCB, GDCB, Stat). (3-0) Cr. 3. S. *Prereq: BCB 567, BBMB 301, Biol 315, Stat 430, credit or enrollment in Gen 411.* Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

Com S 569. Bioinformatics III (Structural Genome Informatics). (Cross-listed with BBMB, BCB, Math, Cpr E). (3-0) Cr. 3. F. *Prereq: BCB 567, Gen 411, Stat 430.* Algorithmic and Statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

Com S 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology). (Cross-listed with BCB, GDCB, Stat, Cpr E). (3-0) Cr. 3. S. *Prereq: BCB 567, Biol 315, Com S 311 and either 208 or 228, Gen 411, Stat 430.* Algorithmic and

Statistical approaches in computational functional genomics and systems biology. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Ontology-driven, network based, and probabilistic approaches to information integration.

Com S 572. Principles of Artificial Intelligence. (Dual-listed with 472). (3-1) Cr. 3. F. *Prereq: 311, 331, Stat 330, Com S 342 or comparable programming experience.* Specification, design, implementation, and selected applications of intelligent software agents and multi-agent systems. Computational models of intelligent behavior, including problem solving, knowledge representation, reasoning, planning, decision making, learning, perception, action, communication and interaction. Reactive, deliverative, rational, adaptive, learning and communicative agents. Artificial intelligence programming. Graduate credit requires a research project and a written report. Oral and written reports.

Com S 573. Machine Learning. (3-1) Cr. 3. S. *Prereq: 311, 362, Stat 330.* Algorithmic models of learning. Design, analysis, implementation and applications of learning algorithms. Learning of concepts, classification rules, functions, relations, grammars, probability distributions, value functions, models, skills, behaviors and programs. Agents that learn from observation, examples, instruction, induction, deduction, reinforcement and interaction. Computational learning theory. Data mining and knowledge discovery using artificial neural networks, support vector machines, decision trees, Bayesian networks, association rules, dimensionality reduction, feature selection and visualization. Learning from heterogeneous, distributed, dynamic data and knowledge sources. Learning in multi-agent systems. Selected applications in automated knowledge acquisition, pattern recognition, program synthesis, bioinformatics and Internet-based information systems. Oral and written reports.

Com S 574. Intelligent Multiagent Systems. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 330; Com S 331; 572, 573, 472, or 474.* Specification, design, implementation, and applications of multi-agent systems. Intelligent agent architectures; infrastructures, languages and tools for design and implementation of distributed multi-agent systems; Multi-agent organizations, communication, interaction, cooperation, team formation, negotiation, competition, and learning. Selected topics in decision theory, game theory, contract theory, bargaining theory, auction theory, and organizational theory. Selected topics in knowledge representation and ontologies. Agent-based systems and the Semantic Web. Applications in distributed intelligent information networks for information retrieval, information integration, inference, and discovery from heterogeneous, autonomous, distributed, dynamic information sources.

Com S 575. Computational Perception. (Cross-listed with Cpr E, HCI). (3-0) Cr. 3. S. *Prereq: Graduate standing or permission of instructor.* Statistical and algorithmic methods for sensing, recognizing, and interpreting the activities of people by a computer. Focuses on machine perception techniques that facilitate and augment human-computer interaction. Introduce computational perception on both theoretical and practical levels. You will work in small groups to design, implement, and evaluate a prototype of a human-computer interaction system that uses one or more of the techniques covered in the lectures.

Com S 577. Problem Solving Techniques for Applied Computer Science. (Dual-listed with 477). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 228; 330 or Cpr E 310, Math 166, Math 307 or Math 317, or consent of the instructor.* Selected topics in applied Mathematics and modern heuristics that have found applications in areas such as geometric modeling, graphics, robotics, vision, human machine interface, speech recognition, computer animation, etc. Homogeneous coordinates and transformations, perspective projection, quaternions and rotations, polynomial interpolation, roots of polynomials, resultants, solution of linear and nonlinear equations, approximation, data fitting, Fourier series and fast Fourier transform, linear programming, nonlinear optimization, Lagrange multipliers, parametric and algebraic curves, curvature, Frenet formulas, Bezier curves. Programming components. A scholarly report is required for graduate credit.

Com S 581. Computer Systems Architecture. (Cross-listed with Cpr E). (3-0) Cr. 3. F. *Prereq: Cpr E 381.* Quantitative principles of computer architecture design, instruction set design, processor architecture: pipelining and superscalar design, instruction level parallelism, memory organization: cache and virtual memory systems, multiprocessor architecture, cache coherency, interconnection networks and message routing, I/O devices and peripherals.

Com S 583. Reconfigurable Computing Systems. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Background in computer architecture, design, and organization.* Introduction to reconfigurable computing, FPGA technology and architectures, spatial computing architectures such as systolic and bit serial adaptive network architectures, static and dynamic rearrangeable interconnection architectures, processor architectures incorporating reconfigurabiltiy.

Com S 586. Computer Network Architectures. (3-0) Cr. 3. F. *Prereq: 511, 552 or Cpr E 489.* Design and implementation of computer communication networks: layered network architectures, local area networks, data link protocols, distributed routing, transport services, network programming interfaces, network applications, error control, flow/congestion control, interconnection of heterogeneous networks, TCP/IP, ATM networks, multimedia communications, IP and application multicast, overlay networks, network security and web computing.

Com S 587. Principles of Distributed and Network Programming. (3-0) Cr. 3. F. *Prereq: 352 or Cpr E 489 or equivalent.* Programming paradigms for building modern distributed applications, including multithreaded client-server programming, distributed object frameworks and programming languages. Directory services. Web-based computing. Mobile computing. Peer-to-Peer computing. Network multimedia applications. Reliability and manageability of networked systems, including aspects of distributed system security, verification of concurrent systems, and network management.

Com S 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Satisfactory-fail only.

Com S 592. Research Colloquia. Cr. 1. F.S. *Prereq: Graduation classification.* Attend Computer Science Research Colloquia. Written summary is required. Satisfactory-fail only.

Com S 596. Genomic Data Processing. (Cross-listed with BCB, GDCB). (3-0) Cr. 3. F. *Prereq: Some knowledge of programming.* Study the practical aspects of genomic data processing with an emphasis on hand-on projects. Students will carry out major data processing steps using bioinformatics tools. Topics include base-calling, raw sequence cleaning and contaminant removal; shotgun assembly procedures and EST clustering methods; genome closure strategies and practices; sequence homology search and function prediction; annotation and submission of GenBank reports; and data collection and dissemination through the Internet. Useful post-genomic topics like microarray design and data analysis will also be covered.

Com S 598. Graduate Internship. Cr. R. Repeatable. F.S.SS. *Prereq: Graduate Classification.* Supervised internship working in professional settings appropriate to the student's degree program. Academic work under faculty supervision.

Com S 599. Creative Component. Cr. arr. Creative component for nonthesis option of Master of Science degree. Satisfactory-fail only.

Courses for graduate students

Com S 610. Seminar. Cr. arr. Satisfactory-fail only.

Com S 611. Advanced Topics in Analysis of Algorithms. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: 511, 531.* Advanced algorithm analysis and design techniques. Topics include graph algorithms, algebraic algorithms, number-theoretic algorithms, randomized and parallel algorithms. Intractable problems and NP-completeness. Advanced data structures.

Com S 612. Distributed Algorithms. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 511 or 531.* The theory of distributed computation. Algorithms, lower bounds and impossibility results. Leader Elections, mutual exlusion, consensus and clock synchronization algorithms. Synchronous, asynchronous and partially synchronous distributed systems models. Shared memory and message passing systems. Fault-tolerance and randomization. Broadcast and multicast. Wait-free object simulations. Distributed shared memory.

Com S 625. Issues in Parallel Programming and Performance. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 511.* Parallel solutions of numerical and non-numerical problems, implementation of parallel programs on parallel machines, performance and other computational issues in parallel programming.

Com S 626. Parallel Algorithms for Scientific Applications. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: 526.* Algorithm design for high-performance computing. Applications to numerical simulations, sparse matrix computation, multidimensional tree data structure, and particle-based methods, random numbers and Monte Carlo applications, algorithms, and computational biology.

Com S 631. Advanced Topics in Computational Complexity. (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 531.* Advanced study in the quantitative theory of computation. Time and space complexity of algorithmic problems. The structure of P, NP, PH, PSPACE, and other complexity classes, especially with respect to resource-bounded reducibilities and complete problems. Complexity relative to auxiliary information, including oracle computation and relativized classes, randomized algorithms, advice machines, Boolean circuits. Kolmogorov complexity and randomness.

Com S 633. Advanced Topics in Computational Randomness. (3-0) Cr. 3. Repeatable. Alt. F., offered 2009. *Prereq: 531.* Advanced study of the role of randomness in computation. Randomized algorithms, derandomization, and probabilistic complexity classes. Kolmogorov complexity, algorithmic information theory, and algorithmic randomness. Applications chosen from cryptography, interactive proof systems, computational learning, lower bound arguments, mathematical logic, and the organization of complex systems.

Com S 634. Theory of Games, Knowledge and Uncertainty. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 330.* Fundamentals of Game Theory: individual decision making, strategic and extensive games, mixed strategies, backward induction, Nash and other equilibrium concepts. Discussion of Auctions and Bargaining. Repeated, Bayesian and evolutionary games. Interactive Epistemology: reasoning about knowledge in multiagent environment, properties of knowledge, agreements, and common knowledge. Reasoning about and representing uncertainty, probabilities, and beliefs. Uncertainty in multiagent environments. Aspects and applications of game theory, knowledge, and uncertainty in other areas, especially Artificial Intelligence and Economics, will be discussed.

Com S 641. Advanced Topics in Programming Language Semantics. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: 531, 541.* Operational and other Mathematical models of programming language semantics. Type systems and their soundness. Applications of semantics on areas such as program correctness, language design or translation.

Com S 652. Advanced Topics in Distributed Operating Systems. (3-0) Cr. 3. Repeatable. Alt. F., offered 2009. *Prereq: 552.* Concepts and techniques for network and distributed operating systems: Communications protocols, processes and threads, name and object management, synchronization, consistency and replications for consistent distributed data, fault tolerance, protection and security, distributed file systems, design of reliable software, performance analysis.

Com S 657. Advanced Topics in Computer Graphics. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 228, I E/M E/Cpr E/Com S 557.* Modern lighting models: Rendering Equation, Spherical Harmonics, LaFortune, Cook-Torrance. Non-polygonal primitives: volumes, points, particles. Textures: filtering, reflections creation. Graphics hardware: pipeline, performance issues, programmability in vertex and fragment path. Per-pixel lighting. Nonphotorealistic rendering. Radiosity; Ray tracing.

Com S 661. Advanced Topics in Database Systems. (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 461 or 561.* Advanced topics chosen from the following: database design, data models, query systems, query optimization, incomplete information, logic and databases, multimedia databases; temporal, spatial and belief databases, semistructured data, concurrency control, parallel and distributed databases, information retrieval, data warehouses, wrappers, mediators, and data mining.

Com S 672. Advanced Topics in Computational Models of Learning. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: Com S 572 or 573 or 472 or 474.* Selected topics in Computational Learning Theory (PAC learning, Sample complexity, VC Dimension, Occam Learning, Boosting, active learning, Kolomogorov Complexity, Learning under helpful distributions, Mistake Bound Analysis). Selected topics in Bayesian and nformation Theoretic Models (ML, MAP, MDL, MML). Advanced Statistical methods for machine learning. Selected topics in reinforcement learning.

Com S 673. Advanced Topics in Computational Intelligence. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: Com S 572 or 573 or 472 or 474.* Advanced applications of artificial intelligence in bioinformatics, distributed intelligent information networks and the Semantic Web. Selected topics in distributed learning, incremental learning, multi-task learning, multi-strategy learning; Graphical models, multi-relational learning, and causal inference; Statistical natural language processing; modeling the internet and the web; automated scientific discovery; neural and cognitive modeling.

Com S 681. Advanced Topics in Computer Architecture. (Cross-listed with Cpr E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 581.* Current topics in computer architecture design and implementation. Advanced pipelining, cache and memory design techniques. Interaction of algorithms with architecture models and implementations. Tradeoffs in architecture models and implementations.

Com S 686. Advanced Topics in High-Speed Networks. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 586.* Advanced topics in IP networks and optical networks. QoS routing and scheduling, multicast, multiprotocol label switching (MPLS), traffic engineering. Optical network architectures, routing and wavelength assignment algorithms, optical multicast, traffic grooming, optical burst switching, lightpath protection/restoration schemes, and IP over WDM.

Com S 699. Research. Cr. arr. Repeatable. *Prereq: Approval of instructor.* Satisfactory-fail only.

Construction Engineering

(Administered by the Department of Civil, Construction and Environmental Engineering)

James Alleman, Chair of Department

Distinguished Professor: Klaiber

Distinguished Professors (Emeritus): Baumann, Cleasby, Handy

University Professor (Emeritus): Lohnes

Professors: Alleman, Fanous, Jaselskis, Kannel, Maze, Nambisan, Ong, Pometto, Porter, Sarkar, Schaefer, Souleyrette, Van Leeuwen, Wipf

Professors (Emeritus): Bergeson, Brewer, Carstens, Greimann, Hardy, Jellinger, Kao, Lee, Mashaw, Mickle, Morgan, Northup, Oulman, Sander

Professor (Collaborator): Surampalli

Associate Professors: Abendroth, Baenziger, Bhandari, Ellis, Gu, Hallmark, Jahren, Koziel, Rehmann, Sritharan, Strong, Sung, Wang, White, Williams

Associate Professors (Emeritus): Chase, Mercier, Sheeler, Ward

Assistant Professors: Aslock, Bolluyt, Ceylan, Gkritza, Grewell, Kandil, Rouse, Shane

Assistant Professors (Adjunct): Phares, Schlorholtz, Smadi, Taylor

Assistant Professors (Collaborators): Boyle, Khanal, Ozsoy

Instructors (Adjunct): Amenson, Gaunt

Senior Lecturers: Cormicle, Sirotiak, Walton

Lecturers: Baker, Cackler, Hawkins, Hunacek, Mescher, Perkins, Smith, Stout

Clinician: Gopalakrishnan

Undergraduate Study

For undergraduate curriculum in construction engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission of ABET.

Construction engineering is a curriculum administered by the Department of Civil, Construction and Environmental Engineering. For details of the curriculum in construction engineering leading to the degree bachelor of science, see the *College of Engineering, Curricula.* General objectives, which are common to all departments in engineering, are stated in the *College of Engineering, Objectives of Curricula in Engineering.* The curriculum in construction engineering is designed with the objective to prepare students for life-long careers in the constantly changing technical and managerial environment of the construction industry. Students who successfully complete the curriculum will be prepared for entry into the field or for further study at the graduate level in construction engineering or related fields of study, such as law, business and other engineering disciplines.

Construction engineers need to possess strong fundamental knowledge of engineering design and management principles, including knowledge of business procedures, economics, and human behavior. Graduates of this curriculum may expect to engage in design of temporary structures, coordination of project design, systems design, cost estimating, planning and scheduling, company and project management, materials procurement, equipment selection, and cost control. With the emergence of design-build construction, the role of the construction engineer is expanding the need for trained professionals that understand both aspects of the project delivery environment. The curriculum offers opportunities to study emphases concerned with building, heavy, mechanical or electrical construction. The process of construction involves the organization, administration, and coordination of labor resource requirements, temporary and permanent materials, equipment, supplies and utilities, money, technology and methods. These must be integrated in the most efficient manner possible to complete construction projects on schedule, within the budget, and according to the standards of quality and performance specified by the project owner or designer. The curriculum blends engineering, management and business sciences into a study of the processes of construction whereby designer's plans and specifications are converted into physical structures and facilities. To achieve this, a construction engineering graduate should have:

- confidence.
- initiative.
- leadership ability.
- the ability to think critically, systematically, and generatively.
- an understanding of the engineering and architectural design process.
- proficiency in construction engineering and the design of construction processes which includes the ability to:
  - apply knowledge of mathematics, science, and engineering.
  - design and conduct experiments, as well as to analyze and interpret data.
  - identify, formulate, and solve engineering problems.
  - design a system, component, or process to meet desired needs.
- an understanding of:
  - the overall construction process.
  - the estimating process.
  - the planning and scheduling process.
  - risk assessment.
  - contracts and laws.
  - business and management.
  - ethical reasoning.
  - contemporary issues in the industry.
  - construction engineering and the industry's impact on Society.- business and construction engineering terminology.
- an ability to:
  - function in multi-disciplinary teams.
  - communicate orally, graphically and in writing.
- a desire for life-long learning and intellectual and professional growth.
- an awareness of modern techniques, skills and technologies for construction.

The curriculum develops the ability of students to be team workers, creative thinkers, and effective communicators. This is achieved by providing students with opportunities to:

- interact with practicing professionals.
- gain work experience during summer jobs, internship, and cooperative education assignments that emphasize the knowledge required of construction engineers.
- develop leadership skills by participating in student organizations.
- develop, analyze, and interpret alternative solutions to open-ended problems.
- study abroad.

The construction industry is becoming increasingly global. Courses in humanities, social sciences, U.S. diversity, and international perspectives are included in the curriculum to broaden the student's perspective of the work environment. In addition, the department has several exchange program opportunities for students to participate in study-abroad programs. Interested and qualified students have the opportunity to participate in the cooperative education program or internship

program to supplement academic work with work experience. See *Cooperative Education Programs, College of Engineering*.

Construction engineering students are encouraged to participate in life-long learning, continuous professional development, and to achieve professional engineer registration and/or registration as a certified professional constructor. Qualified construction engineering students within 30 credits of completing their undergraduate degree may apply for concurrent enrollment in the Graduate College. See *Civil Engineering Graduate Study* for more information.

Graduate Study

An area of specialization in construction engineering and management is offered within the graduate program of the Department of Civil, Construction and Environmental Engineering. See *Civil Engineering, Courses and Programs*.

Courses are offered for minor work to students taking major work in other curricula or in interdepartmental programs.

Courses primarily for undergraduate students

Con E 121. Cornerstone Learning Community: Orientation to Academic Life. (0-2) Cr. 1. F. Integration of first-year and transfer students into the engineering profession and the Construction Engineering program. Assignments and activities completed both individually and in learning teams involving teamwork, academic preparation, and study skills. Teamwork topics include interdisciplinary teamwork, skills for academic success and diversity issues. Introduction to organization of program, department, college, and university. Overview of faculty, staff, policies, procedures and resources.

Con E 122. Cornerstone Learning Community: Orientation to Professional Life. (0-2) Cr. 1. S. Continuation of Con E 121. Integration of first-year and transfer students into the engineering profession. Career preparation, professional ethics, construction research. Introduction to construction industry professionals including how they interact with engineers in other disciplines. Continued introduction to program, department, college, and university organization. Overview of faculty, staff, policies, procedures and resources.

Con E 221. Contractor Organization and Management of Construction. (4-0) Cr. 4. F.S. *Prereq: Completion of basic program.* Entry level course for construction engineering: integration of significant engineering, economics, and management issues related to efficient construction company operations. Time value of money; methods of evaluating alternative projects; organization; operations; construction company administration; project administration; project management systems; construction contracts; integrated delivery systems (design/build and others); marketing; insurance and bonding; construction safety; labor law; labor relations; productivity; motivation and leadership; contract documents; interpretation and utilization of drawings, specifications, agreements, bidding forms, general conditions, subcontracts, shop drawings and related documents.

Con E 241. Construction Materials and Methods. (2-3) Cr. 3. F.S. *Prereq: 221.* Introduction to materials and methods of building construction and to construction drawings. Foundation, structural framing, floor, roof, and wall systems. Blueprint reading and quantity takeoff techniques.

Con E 251. Mechanical/Electrical Materials and Methods. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 241.* Introduction to the materials and methods for mechanical and electrical construction systems and drawings. HVAC, water and waste water, power distribution, lighting, and fire protection. Blueprint reading and quantity takeoff. Specialty contractor organization and management.

Con E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

Con E 322. Construction Equipment and Heavy Construction Methods. (2-3) Cr. 3. F.S. *Prereq: 241.* Selection and acquisition of construction equipment. Application of engineering fundamentals and economics to performance characteristics and production of equipment. Heavy construction methods and economic applications. Nonmajor graduate credit.

Con E 340. Concrete and Steel Construction. (2-3) Cr. 3. F.S. *Prereq: E M 324, credit or enrollment in Con E 322.* Planning and field engineering for concrete and steel construction. Design and applications of concrete formwork to construction. Erection of structural steel. Emerging industry themes. Nonmajor graduate credit.

Con E 352. Mechanical Systems in Buildings. (3-0) Cr. 3. F.S. *Prereq: 251, Phys 222.* Comprehensive coverage of mechanical systems, plumbing, fire protection, vertical transportation. Analysis techniques and design principles for each system. Required comprehensive design project for a major building project.

Con E 353. Electrical Systems in Buildings. (2-0) Cr. 2. F.S. *Prereq: Phys 222 and credit or enrollment in 352.* Comprehensive coverage of building electrical systems including power, lighting, fire alarm, security and communications. Analysis techniques and design principles for each system. Required comprehensive design project for a major building project.

Con E 380. Engineering Law. (3-0) Cr. 3. F.S. *Prereq: Junior classification.* Introduction to law and judicial procedure as they relate to the practicing engineer. Contracts, professional liability, professional ethics, licensing, bidding procedures, intellectual property, products liability, risk analysis. Emphasis on development of critical thinking process, abstract problem analysis and evaluation. Nonmajor graduate credit.

Con E 381. Bidding Construction Projects I. (0-3) Cr. 1. F. *Prereq: Permission from the instructor.* Team development of construction process designs and cost estimates for transportation construction projects under closely simulated conditions. Examine project sites, consult with construction industry mentors, obtain subcontractor and supplier quotations, and submit bids. Offered in the following specialities:
A. Heavy and Highway
B. Building
C. Mechanical
D. Electrical
E. Mechanical and Electrical
F. Miscellaneous

Con E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period. Students must register for this course before commencing work.

Con E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* Professional work period, one semester maximum per academic year. Students must register for this course before commencing work.

Con E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

Con E 421. Construction Estimating. (2-3) Cr. 3. F.S. *Prereq: 241, Junior classification.* Conceptual estimating. Bid preparation for buildings, highways, heavy, mechanical trades. Estimating costs for material, labor, equipment, overhead, and profit. Quantity surveys, unit costs, production rates, and pricing methods. Subcontract bid analysis and bid procedure. Cost analysis and cost control. Electronic quantity take off methods. Nonmajor graduate credit.

Con E 441. Construction Planning, Scheduling, and Control. (2-2) Cr. 3. F.S. *Prereq: Credit or enrollment in 421.* Integration of previous construction coursework into the planning, scheduling, and management of time, costs, and other resources. Emphasis on preparation and analysis of network schedules. Comprehensive planning and scheduling project. Computer project management applications. Nonmajor graduate credit.

Con E 481. Bidding Construction Projects II. (0-3) Cr. 1. F. *Prereq: Permission from the instructor.* Similar to Con E 381, except students with previous experience attempt projects with larger scope or lead students with less experience.
A. Heavy and Highway
B. Building
C. Mechanical
D. Electrical
E. Mechanical and Electrical
F. Miscellaneous

Con E 487. Construction Engineering Design I. (1-2) Cr. 2. F.S. *Prereq: Con E 340 (B, H), 352 (B, E, M), 353 (B, E, M), 421, 441. Student must be within two semesters of graduation.* The integrated delivery of project services including preliminary engineering design process, constructability review, interaction with the client, identification of engineering problems, developments of a proposal, identification of design criteria, cost estimating, planning and scheduling, application of codes and standards, development of feasible alternatives, selection of best alternative, and delivery of oral presentations.

Con E 488. Construction Engineering Design II. (1-5) Cr. 3. F.S. *Prereq: Con E 380. Coreq: 487.* Application of team design concepts to a construction engineering project. Project planning. Detailed analysis. Advanced cost and schedule applications. Contract negotiation. Development of a complete project history. Technical presentations (oral and written).

Con E 490. Independent Study. Cr. 1-5. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Individual study in any phase of construction engineering. Preenrollment contract required.

Con E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Criminal Justice Studies

(Interdepartmental Undergraduate Program)

Matthew J. DeLisi, Program Coordinator

The criminal justice studies minor, a cross-disciplinary course of study in the College of Liberal Arts and Sciences, offers an opportunity for students to learn about the components of the criminal and juvenile justice systems, to become acquainted with the issues and problems affecting these systems, to apply theoretical concepts to real world problems, and to plan a career in criminal or juvenile justice.

Students who declare a minor in criminal justice studies are required to complete 15 credits of course work. Students must take five of the following six courses: CJ St 240, 241, 320, 332, 340 or 341. Students are also required to complete a minimum of 3 credits of internship experience (CJ St 460). Completion of the minor requires 18 total credits.

Courses primarily for undergraduate students

CJ St 240. Introduction to the U.S. Criminal Justice System. (3-0) Cr. 3. F. Provides systematic overview of law, police organization and behavior, prosecution and defense, sentencing, the judiciary, community corrections, penology, and capital punishment. The course demonstrates the role of discretion in all of these agencies as well as the Sociological influences of age, race, gender, and social class on criminal justice system processes.

CJ St 241. Youth and Crime. (Cross-listed with Soc). (3-0) Cr. 3. F. *Prereq: Soc 130 or 134.* An examination of delinquency that focuses on the relationship between youth as victims and as offenders, social and etiological features of delinquency, the role of the criminal justice system, delinquents' rights, and traditional and alternative ways of dealing with juvenile crime.

CJ St 320. American Judicial Process. (Cross-listed with Pol S). (3-0) Cr. 3. S. *Prereq: Pol S 215.* An overview of the American judicial process. Emphasis on specific topics such as application of constitutional rights to the states (particularly the Fourth, Fifth, Sixth, and Fourteenth Amendments), mechanics of judicial opinions, constitutional Philosophies of Supreme Court Justices, decisions of first impression, and the value and scope of precedent.

CJ St 332. Philosophy of Law. (Cross-listed with Phil). (3-0) Cr. 3. F.S. *Prereq: Phil 201 or 230.* Extent of our obligation to obey the law; what constitutes just punishment; how much of the immoral should be made illegal? Relation of these questions to major theories of law and the state. Discussion of such concepts as coercion, equality, and responsibility. Nonmajor graduate credit.

CJ St 340. Deviant and Criminal Behavior. (Cross-listed with Soc). (3-0) Cr. 3. S.SS. *Prereq: Soc 130 or 134.* Theory and research on the etiology of types of social deviance; issues relating to crime, antisocial behavior and social policies designed to control deviant behavior.

CJ St 341. Criminology. (Cross-listed with Soc). (3-0) Cr. 3. F. *Prereq: Soc 130 or 134.* The nature of crime and criminology; the concept of crime; Statistics and theories of criminality; major forms of crime; official responses to crime and control of crime.

CJ St 351. Police and Society. (Cross-listed with Soc). (3-0) Cr. 3. F.S.SS. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of law enforcement in the United States. Theory and research on police history, function, and organization; constitutional issues of policing; and critical topics, such as community policing, officer discretion and decision-making, corruption, use of force, and racial profiling. The course illustrates the interconnections between communities, police organizations, citizens, and criminal offenders.

CJ St 352. Punishment, Corrections, and Society. (Cross-listed with Soc). (3-0) Cr. 3. F.S.SS. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of corrections in the United States. Theory and research on probation, parole, intermediate sanctions, prison, inmate Society, inmate behavior and misconduct, capital punishment, recidivism, correctional treatment, rehabilitation, and offender reintegration into Society.

CJ St 402. White-Collar Crime. (Cross-listed with Soc). (3-0) Cr. 3. S.SS. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of white-collar crime as a form of deviance. Theory and research on occupational, corporate, and organizational offending; prevalence, costs, and consequences of white-collar crime; predictors and correlates of white-collar crime; and political, business, and public policy responses to white-collar crime.

CJ St 403. Criminal Offenders. (3-0) Cr. 3. F.S. *Prereq: 240 or 241.* Introduction and overview of criminal offenders. Theory and research on epidemiology, offender typologies, etiology of violence, recidivism, societal costs, correctional supervision, treatment, and prevention of serious antisocial behavior.

CJ St 460. Criminal and Juvenile Justice Practicum. (Cross-listed with Soc). Cr. arr. Repeatable. F.S.SS. *Prereq: Junior or senior classification; permission of criminal justice studies coordinator; major or minor in Sociology, or criminal justice studies minor.* Study of the criminal and juvenile justice systems and social control processes. Supervised placement in a police department, prosecutor's office, court, probation and parole department, penitentiary, juvenile correctional institution, community-based rehabilitation program, or related agency.

Cross Disciplinary Studies

The College of Liberal Arts and Sciences administers a number of Cross Disciplinary Studies, Interdepartmental Studies, and Certificate Programs which enable students to develop individual programs of study toward majors and minors in a range of disciplines. Information on the requirements for these programs is available in the Academic Advising Office, College of Liberal Arts and Sciences, located in Catt Hall. (see Index, Liberal Arts and Sciences Cross Disciplinary Studies)

Curriculum and Instruction

www.edu.ci.hs.iastate.edu

Carl Smith, Interim Chair of Department

Distinguished Professors (Emeritus): Moyer, Rasmussen

University Professor: Thompson

University Professors (Emeritus): Brown, D. Williams

Professors: Abelson, Andre, Blount, Greenbowe, Martin, G. Miller, W. Miller, Mokhtari, Owen, Phye, Smith, Stuart, Whaley

Professors (Emeritus): Barnhart, Bath, Baum, Breiter, Brun, Burkhalter, Carter, Charles, Coulson, Daly, Dilts, Downs, Duffelmeyer, Henney, Hoerner, Hunter, Keller, McCormick, Rudolph, Schneider, Shhloerke, Smith, Tanner, Thomas, Volker, Williams, Zbaracki

Associate Professors: Allen, Bloom, Caldwell, Carlson, Clough, Foegen, Fuhler, Gentzler, Hargrave, Hausafus, Leigh, Munsen, Niederhauser, Olsen, Payne, Schilling, Torrie

Associate Professors (Emeritus): Amos, Ebert

Associate Professor (Adjunct): Rosenbusch

Assistant Professors: Bang, Blumenfeld, Bruna, Correia, Drake, Esters, Lee, Norton-Meier, Schmidt, Seymour

Assistant Professors (Emeritus): Chatfield, Tartakov

Assistant Professors (Adjunct): Andreotti, McShay

Lecturers: Achter, Billings, Bossard, Breitsprecker, Coldiron, Erickson, Fairchild, Kinley, Land, Laws, Lind, Linduska, Millen, Nelson, Norris, Olson, Sheldon, Stoppel, Swenson, Taylor, Timm, Turner, Tvrdik, Vermeer, Wiebold

Missions and Goals

The mission of the Department of Curriculum and Instruction is to serve the people of Iowa, the Nation, and the World through discovery, learning, and engagement efforts that enhance and develop human potential and equity through education and that promote understanding of learning, teaching, and education as disciplines. In our discovery mission, we strive

- to conduct the highest quality research and scholarship that significantly contribute to educational theory and practice and
- to be known locally, nationally, and internationally as a department of distinction.

In our learning mission, we strive to be a recognized high quality teacher preparation department that

- prepares highly effective teachers and educational leaders;
- prepares graduate students and post doctoral professionals who become leaders in their respective fields; and
- conducts significant ongoing research and evaluation on the process of effective teacher preparation.

In our engagement mission, we strive to develop partnerships within and beyond the university that

- enhance the quality and effectiveness of education in practice and
- serve our discovery and learning missions.

Undergraduate Study

The Department of Curriculum and Instruction provides the professional education coursework that leads to licensure of pre-service teachers. Students major in early childhood education - birth through third grade or elementary education - K-6. Students who are interested in teaching at the secondary level (5-12) major in a specific discipline and complete the courses necessary for their teaching license. Early childhood education and elementary education majors must complete a professional course sequence: C I 201, 204, 332, 406 and Sp Ed 250. Secondary education students must complete a professional course sequence: C I 202, 204, 333, 406 and Sp Ed 450. Some secondary licensure areas also require C I 426.

The department offers a minor in digital learning that may be earned by completing the following courses: C I 201 or 202; Com S 107 or Com S 207 or Cpr E/Mat E 370; C I 280A; 280B; 302; 403; and 407.

The Department of Curriculum and Instruction offers courses that can lead to a reading endorsement for grades K-8 or grades 5-12. Students seeking a K-8 endorsement should see a Curriculum and Instruction academic adviser. The 5-12 endorsement is offered collaboratively with the English Department. Students seeking this endorsement should see an adviser in the English Department. Copies of transcript(s) can also be sent to the Licensure Analyst in the Student Services Office to receive a list of courses needed for an Iowa State University Reading endorsement. Prerequisites for the reading endorsement courses are listed in the catalog course descriptions.

Early Childhood Education

The curriculum in Early Childhood Education is planned for students preparing to teach young children and work with their families. This program leads to careers in working with young children who are typically developing and those with special needs from birth through age eight. Graduates in this curriculum may teach in early childhood (preschool and primary) classrooms or home based programs, with emphasis on inclusive services. Graduates may be employed by either public or private agencies or schools. This curriculum has been approved by the Iowa Department of Education and meets requirements for the early childhood education unified teacher license, which permits individuals to teach general and special education for children from birth through age eight. The program is an interdepartmental major administered by the Department of Curriculum and Instruction and the Department of Human Development and Family Studies within the College of Human Sciences.

Early Childhood Education majors must satisfy a world language requirement for graduation. For detailed information, see College of Human Sciences - Curriculum in Early Childhood Education.

Students who enroll in Early Childhood Education must make application to and be accepted into the teacher education program prior to enrolling

in advanced courses. All early childhood education students, including those seeking a double major, must meet general education requirements for teacher licensure. Iowa State University is in compliance with the Iowa Department of Education's mandate for a performance based system of teacher training. Following this same type of system, the State of Iowa has developed and implemented a competency system to evaluate the performance of all teachers. A detailed list of the eleven Iowa State University Teacher Education Standards and the eight State of Iowa Teaching Standards, along with other information about the University Teacher Education Program, can be found at www.teacher.hs. iastate.edu/, the teacher education website. information is also available from the student's academic adviser.

Students in early childhood education must meet the performance outcome standards for teacher licensure. Standards are assessed in coursework through designated performance indicators such as assignments, projects, or practicum participation. These standards assessments are based on the early childhood content standards for endorsement 100 in the State of Iowa. These include competencies in (1) child growth, development, and learning, (2) developmentally appropriate learning environment and curriculum implementation, (3) health, safety, and nutrition, (4) family and community collaboration, and (5) professionalism. Pre-student teaching field experiences and student teaching experience in at least two different settings is required. Students will receive both formative and summative evaluations of their progress toward meeting these outcomes throughout their program at Iowa State University

Elementary Education

For the undergraduate curriculum in elementary education, leading to the degree bachelor of science, see College of Human Sciences.

The curriculum in elementary education is planned for students preparing to teach at the elementary school level. This program leads to careers in working with school-aged children, kindergarten through sixth grade. Graduates in this curriculum may teach in elementary classrooms in either public or private school districts.

Endorsements in art, English/language arts, English as a Second Language (ESL), health, history, music, basic science, social studies, mathematics, special education (Instructional Strategist I: Mild/Moderate Disabilities K-8), and speech communication/theater are available for elementary education students. An endorsement for teaching world languages in elementary schools is available through the Department of World Languages and Cultures.

Elementary Education majors must satisfy a world language requirement for graduation. For detailed information, see College of Human Sciences - Curriculum in Elementary Education.

Students who enroll in elementary education must make application to and be accepted into the teacher education program prior to enrolling in advanced elementary education courses. For admission and licensure requirements, see College of Human Sciences. Every student must meet the performance outcome standards for teacher licensure. These standards will be assessed in each course. Students will receive both formative and summative evaluations of their progress toward meeting these standards throughout their program at Iowa State University. A detailed explanation of the standards and assessment process may be found on the department's website (www.ci.hs.iastate.edu/). The same information is also available from the student's academic adviser.

Graduates of the elementary education program will be able to demonstrate through professional practice their understanding of academic disciplines, teaching and learning, the nature of the student, and how to adapt instruction for diversity. More specifically, graduates will be able to demonstrate their understanding of concepts and structures of disciplines, tools of inquiry, how students learn and develop, and the effects of individual differences on learning. Graduates will be able to demonstrate a broad range of instructional strategies, including knowledge of technology applicable to instruction. In their teaching, graduates will demonstrate the ability to stimulate active inquiry with collaboration and supportive interaction among their students. In appropriate settings graduates will demonstrate their ability to develop professional relationships with colleagues, parents, and agencies that support students and their learning.

Secondary Education

For specific requirements for each area of specialization, see Teacher Education and curricula for the college in which the chosen degree major is sought.

Students seeking recommendations for a license to teach in the secondary schools must be admitted to the teacher education program and pursue a program that includes the professional core: C I 202, 204, 333, 406, 426, and Sp Ed 450; special methods; and student teaching in the area of specialization. Note: Students seeking licensure in agriculture and science do not take C I 426. Students seeking a teaching license in physical education must see an advisor in the Department of Kinesiology in the College of Human Sciences. All students who are recommended by Iowa State University for teacher licensure must meet the requirements of the teacher education program and be recommended by the College of Human Sciences. Each student must meet the performance outcome standards for teacher licensure. Each standard will be assessed in every major. Students will receive both formative and summative evaluations of their progress toward meeting these outcomes throughout their program at Iowa State University. A detailed explanation of the standards and assessment process may be found at www.teacher.hs.iastate.edu. For more information, students should contact the academic advisers in their major. Each student will be enrolled in the department in which he or she plans to major, and must meet the graduation requirements of that department and the college in which it is located.

Graduate Study

The Department of Curriculum and Instruction offers work for the degrees Master of Science, Master of Education, and Doctor of Philosophy with a major in education and minor work to students taking major work in other departments. Within the education major in the Department of Curriculum and Instruction a student may earn an education degree with no area of specialization (master's and doctorate) or specialize in elementary education (master's only), historical, philosophical, and comparative studies in education (master's only), special education (master's only), or curriculum and instructional technology (master's and doctorate). The specialization in elementary education (advanced study for licensed teachers) is designed to prepare candidates for teaching and curricular leadership positions in elementary settings. The specialization in historical, philosophical, and comparative studies in education is designed to provide graduate students experiences in analyzing educational problems and issues, critiquing policies that affect education in Society, and making connections between educational practice and learning. The special education specialization is designed to prepare candidates as practitioners and researchers in the field of mild/moderate disabilities or behavioral disorders/learning disabilities. The specialization in curriculum and instructional technology is designed to prepare candidates as researchers and practitioners in the fields of curriculum and instructional technology.

Students may also opt not to select an area of specialization. These students are asked to select a focus area for their graduate study. Focus areas include educational psychology, world language education, literacy education, mathematics education, multicultural education and international curriculum studies, and science education. See the Curriculum and Instruction web site at http://www.ci.hs.iastate.edu/for more information on these focus areas.

A minor is available in curriculum and instructional technology at both the master's and doctoral level. Information about the minors can be found on the web at http://www.ci.hs.iastate.edu/prspstud/grad/Grad2/Degrees.php.

A Master of Arts in Teaching degree program leading to teacher licensure (science only) is available to students who currently have a bachelor's degree in science (or a closely related field). A teacher licensure program in mathematics education is also available to graduate students (Department of Curriculum and Instruction). Teacher licensure at the graduate level is also offered in agricultural education (College of Agriculture and Life Sciences) and family and consumer sciences (College of Human Sciences). The Department of Curriculum and Instruction provides the professional education coursework. Students in a graduate teacher licensure program must complete Sp Ed 501, C I 505, 506, 529, and HPC 504. Mathematics licensure students also take C I 526.

Graduate level teaching endorsements are offered through the Department of Curriculum and Instruction. Graduate students who seek a teaching endorsement in special education, but do not wish to pursue a master's degree can incorporate those courses from a professional certificate program. Endorsement programs include Instructional Strategist I: Mild/Moderate Disabilities (K-8 or 5-12), or Instructional Strategist II: Behavior Disorders/Learning Disabilities, and special education consultant. A graduate level reading endorsement is also available.

Prerequisite to major graduate work in education is preparation substantially equivalent to the completion of one of the undergraduate curricula in education offered at Iowa State University, or graduate preparation in a discipline to be used as a teaching field in a community college or university, and adequate proof that the student ranks above average in scholastic ability and promise of professional competence.

The world language requirement, if any, for the Ph.D. degree will be determined by the student's program of study committee. If no world language is required, the total program must consist of a minimum of 78 semester credits, at least 12 of which must be earned outside the education major, and at least 16 of which must be earned outside the area of specialization. Statistics and research methods may not be included in the 16 credits. Should world language be included, the program of study committee may adjust the minimum program requirement downward, but in no instance may the program of study be less than 72 semester credits. Students whose native language is not English may substitute competence

in English. All applicants for the Ph.D. must submit Graduate Record Examination (GRE) scores.

Other graduate programs related to education (including General Graduate Studies) may be planned for students on the basis of previous education and experiences as well as future plans and needs. Students should refer to Agricultural Education and Studies, Family and Consumer Sciences Education, Kinesiology, Educational Leadership and Policy Studies, and General Graduate Studies or to graduate level course offerings within other departments.

Curriculum and Instruction (C I)

Courses primarily for undergraduate students

C I 115. First Year Orientation. Cr. R. F. Overview of elementary education curricular opportunities, transitions to college and community life, and university procedures. Required of all first-semester freshmen majoring in elementary education.

C I 201. Digital Learning in the PK-6 Classroom. (2-2) Cr. 3. F.S.Alt. SS., offered 2011. Overview of ways to use instructional technologies to support instruction in PK-6 settings. Focus on pedagogical approaches that integrate technologies to support learning in the content areas. Laboratory experiences include development of activities to use tool software, interactive multimedia, webpage development, digital video and other technologies to facilitate learning and teaching.

C I 202. Digital Learning in the 7-12 Classroom. (2-2) Cr. 3. F.S.Alt. SS., offered 2010. Overview of ways to use instructional technologies to support instruction in 7-12 settings. Focus on pedagogical approaches that integrate technologies to support learning in the content areas. Laboratory experiences include development of activities to use tool software, interactive multimedia, webpage development, digital video and other technologies to facilitate learning and teaching.

C I 204. Social Foundations of American Education. (3-0) Cr. 3. F.S.SS. Goals of schooling, including the roles of teachers today; historical development of schools; educational reforms and alternative forms; and current Philosophical issues. Human relations aspects of teaching and discussions about teaching as a career.

C I 208. Early Childhood Education Orientation. (Cross-listed with HD FS). Cr. 1. F.S. Overview of early childhood education (birth-grade 3) teacher licensure requirements. Program planning and university procedures. Required of all students majoring in early childhood education. Satisfactory-fail only.

C I 215. Sophomore Orientation. Cr. R. F.S. Review of elementary education requirements. Program planning. Required of all sophomores majoring in elementary education.

C I 219. Orientation to Teacher Education for Mathematics, Science and History/Social Sciences Majors. Cr. R. F.S. *Prereq: Students seeking teacher licensure in mathematics, science or history/social sciences in grades 7-12.* Overview of Mathematics, science, and history/social sciences secondary education (grades 7-12), teacher licensure requirements in Iowa and other states. Program and career planning.

C I 245. Strategies in Teaching. (2-0) Cr. 2. F.S. *Prereq: 204; HD FS 220 or 221 or 226 (or concurrent enrollment in one of these courses); concurrent enrollment in C I 268; eligibility for admission to teacher education program.* Introduction to elementary education teaching strategies, classroom management, and curriculum organization. Open to students in the elementary education curriculum or the early childhood education curriculum.

C I 268. Strategies Practicum. (0-2) Cr. 1. F.S. *Prereq: 204.* Clinical experience, to be taken concurrently with 245. Satisfactory-fail only.

C I 280. Pre-Student Teaching Experience. (1-8) Cr. arr. Repeatable. F.S.SS. *Prereq: 280A may be taken alone. For enrollment in 280B-I, 280A must be either a prerequisite or taken concurrently.* Field experience in area educational settings. 2 1/2-hour blocks of time needed for field experience. C I 280 may be taken more than once for credit toward graduation.
A. Teacher Aide. Cr. 1 or 2
B. Educational Computing. Cr. 1 or 2 (2 credits by permission only)
C. Native American Tutoring. Cr. 1
D. Museum Education. Cr. 1
E. Multicultural Youth Experience. Cr. 1 or 2
F. International Student. Cr. 1 or 2 (Permission of instructor required)
I. Mild/Moderate Disabilities. Cr. 1 (concurrent with Sp Ed 330).
L. Early Field Experience. Cr. .5
M. Secondary Science. Cr. 1 or 2
N. CoHort Field Experience. Cr. 1 (permission of department required)
O. Art Education Field Experience. Cr. 1 (Permission of department required)

C I 290. Independent Study. Cr. arr. *Prereq: 6 credits in education, permission of department chair.*

C I 302. Principles and Practices of Digital Learning. (2-2) Cr. 3. F.S. *Prereq: 201 or 202, 245, 268.* Advanced integration of educational technologies into K-12 teaching and learning; designing classroom applications for tool software; implementing technology-based lessons with K-12 students; issues and trends in classroom technology use.

C I 315. Transfer Orientation. Cr. 1. F.S. Overview of elementary education requirements, curricular opportunities, and university procedures. Program planning. Required of all transfer students majoring in elementary education. Satisfactory-fail only.

C I 332. Educational Psychology of Young Learners. (3-0) Cr. 3. F.S. *Prereq: Psych 230 or HD FS 102, open only to majors in Early Childhood Education or Elementary Education.* Psychological theory relevant to classroom learning, cognition, motivation, classroom management and assessment for children from birth to grade 6. Implications of theory for teaching children and for assessing learning in educational settings with young and grade school aged children.

C I 333. Educational Psychology. (Cross-listed with Psych). (3-0) Cr. 3. F.S. *Prereq: Psych 230 or HD FS 102, application to the teacher education program or major in psychology.* Classroom learning with emphasis on theories of learning and cognition, and instructional techniques. Major emphasis on measurement theory and the classroom assessment of learning outcomes.

C I 347. Nature of Science. (Dual-listed with 547). (3-0) Cr. 3. *Prereq: 280M; concurrent enrollment in 418 or instructor permission.* The intersection of issues in the history, philosophy Sociology, and psychology of science and their application to and impact on science teaching and learning, science teacher education, and science education research.

C I 377. The Teaching of Reading and Language Arts in the Primary Grades (K-3). (4-0) Cr. 4. F.S.SS. *Prereq: admission to teacher education program, C I 245, Sp Ed 250, HD FS 240, 226 (El Ed majors) or 221 (ECE majors); concurrent enrollment in 448, 468A, 468C (El Ed majors) or 438, 468F, 468G, Sp Ed 368, HD FS 343 (ECE majors).* Theories, teaching strategies, and instructional materials pertinent to teaching reading, writing, listening, and speaking to children in kindergarten through third grade.

C I 378. The Teaching of Reading and Language Arts in the Intermediate Grades (4-6). (4-0) Cr. 4. F.S.SS. *Prereq: 377; concurrent enrollment in 449, 468B, 468D.* Theories and processes of literacy. Application through reading and writing across the curriculum, integration of language arts, literature-based instruction, and metacognitive strategies.

C I 395. Teaching Reading in Middle and Secondary Schools. (Dual-listed with 595). (3-0) Cr. 3. F. *Prereq: 204 and junior standing.* Analysis and application of strategies to enhance students' literacy development in middle and secondary school settings.

C I 401. Middle School Student Growth and Development. (3-0) Cr. 3. *Prereq: Psych 230.* Study of the physical, emotional, intellectual, and social development of 10 to 15 year old middle school students, with emphasis on implications for schools and teachers. Includes strategies for classroom management and working with parents. Issues of risk, resiliency, substance abuse, suicide, and sexuality will also be examined.

C I 402. Middle School Curriculum Design. (3-0) Cr. 3. *Prereq: 401, admission to teacher education.* Emphasis on the middle school components of interdisciplinary teaming, curriculum frameworks, teacher-based guidance and assessment.

C I 403. Design and Development of Digital Learning Environments. (2-2) Cr. 3. F.S. *Prereq: 302.* Application of principles of instructional design and cognitive theories to development of digital learning environments. Development of expertise with contemporary technologies and approaches to learning. Analysis and discussion of research related to effective use of multimedia in education.

C I 406. Multicultural Foundations of School and Society: Introduction. (3-0) Cr. 3. F.S.SS. *Prereq: 201 or 202, 332 or 333, junior classification, admission to teacher education program.* Awareness and nature of cultural pluralism; need for multicultural education; multicultural concepts and theories; cultural groups - their perceptions, needs, and contributions; problems and issues regarding ethnocentrism, prejudice, and discrimination based on race, ethnicity, socioeconomic class, sex/gender, sexual identity, and language in the school environment; curriculum infusion and transformation, multicultural interaction, design and execution of teaching strategies.

C I 407. Principles and Practices of Distance Learning. (Dual-listed with 507). (2-2) Cr. 3. F.SS. *Prereq: 201 or 202; convenient access to the Web.* Review of flexible and distance learning (FDL) cases in a variety of contexts and pedagogic styles, research into relevant topics. Identification of underlying principles and frameworks for best practice in this field. Offered in FDL modes, utilizing telecommunications and the Internet.

C I 416. Supervised Student Teaching - Elementary. Cr. arr. F.S. *Prereq: GPA 2.5; full admission to teacher education; senior classification; 378, 443, 448, 449; reservation required.* Supervised teaching experience in the elementary grades.
A. Primary grades (K-3).
B. Intermediate grades (4-6).
C. World Language.
D. International Student Teaching - Primary grades.
E. International Student Teaching - Intermediate grades.

C I 417. Student Teaching. (Dual-listed with 517). (Cross-listed with Engl, WLC, Music). Cr. arr. F.S. *Prereq: GPA 2.5; Admission to teacher education, approval of coordinator during semester before student teaching.* Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.
A. Social Studies-Middle School
B. Physical Sciences
C. Mathematics
D. Biological Sciences
E. English and Literature (Same as Engl 417E)
G. World Language (Same as WLC 417G)
J. Earth Sciences
K. Music-Secondary (Same as Music 417K)
L. Music-Elementary (Same as Music 417L)
M. Science-Basic
N. International Student Teaching
P. Social Studies-High School

C I 418. Secondary Science Methods I: A Research-Based Framework for Teaching Science. (Dual-listed with 518). (2-0) Cr. 2. F. *Prereq: 280M; concurrent enrollment in 347 and 468J.* Development of a research-based framework for teaching science that includes student goals, congruent student actions, the character and role of science inquiry, teaching

behaviors and strategies, contemporary learning theories, and self evaluation.

C I 419. Secondary Science Methods II. (Dual-listed with 519). (2-0) Cr. 2. S. *Prereq: 418 or 518, undergraduate students must register concurrently for 468K.* Advancing a research-based framework for teaching science in a variety of school settings, emphasizing the teacher's role, the development and revision of science curriculum, exceptional learners, content area reading strategies, management strategies, technology and student assessment.

C I 420. Bilingualism, Bilingual Education, and U.S. Mexican Youth. (Dual-listed with 520). (3-0) Cr. 3. F. *Prereq: 406.* Introduction to research on bilingualism and examination of the social, historical, and political contexts of bilingual education in U.S. schools. Attention to policy environment, school program structure, mode of classroom instruction, family and community context, and attainment of bilingualism and biculturalism for U.S. Mexican youth.

C I 426. Principles of Secondary Education. (Dual-listed with 526). (3-0) Cr. 3. F.S.SS. *Prereq: 202, senior classification, admission to teacher education program.* The curriculum, human relations, student evaluation, support services, classroom management, organization of schools, legal aspects of schools, professionalism, and career planning.

C I 433. Teaching Social Studies in the Primary Grades. (2-0) Cr. 2. F.S. *Prereq: 377, HD FS 221; concurrent enrollment in 438, 439, Sp Ed 355, 455.* Study, development, and application of current methods for providing appropriate social studies learning experiences for primary grade children. Instructional strategies, curriculum content, and formal and informal assessment strategies for diverse learners.

C I 438. Teaching Mathematics in the Primary Grades. (2-0) Cr. 2. F.S. *Prereq: HD FS 221; Math 195; concurrent enrollment in 377, 433, 439, 468A, 468G, Sp Ed 355, 455.* Study, development, and application of current methods for providing appropriate Mathematics learning experiences for primary grade children. Formal and informal assessment strategies and instructional methods for diverse learners.

C I 439. Teaching Science in the Primary Grades. (2-0) Cr. 2. F.S. *Prereq: 377, HD FS 221; concurrent enrollment in 433, 438, 468I, Sp Ed 355, 455.* Study, development, and application of current methods for providing appropriate science learning experiences and processes for primary grade children. Formal and informal assessment strategies and instructional methods for diverse learners.

C I 443. The Teaching of social Studies. (3-0) Cr. 3. F.S.SS. *Prereq: 377.* Study, development, and application of current methods, curriculum materials, and assessment strategies for providing appropriate social studies learning experiences for primary and intermediate grade children.

C I 448. Teaching Children Mathematics. (3-0) Cr. 3. F.S. *Prereq: Math 195, 196; concurrent enrollment in 377, 468A, 468C.* Study, development, and application of current methods for providing appropriate Mathematical learning experiences for primary and intermediate children. Includes critical examination of factors related to the teaching and learning of Mathematics.

C I 449. The Teaching of Science. (3-0) Cr. 3. F.S. *Prereq: 377, concurrent enrollment in 378, 468B, 468D, junior classification.* Procedures for teaching science to children. Emphasis on developmental implications, teaching processes and methods, current programs, and assessment of learning in science.

C I 450. Ethnicity and Learning. (Dual-listed with 550). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 332 or 333, 406.* Examination of cultural relevance in education. Development and application of strategies and techniques for implementing multicultural goals and multiethnic perspectives in PreK-12 school classroom settings.

C I 452. Corrective Reading. (Dual-listed with 552). (3-0) Cr. 3. F.S.SS. *Prereq: 378 or equivalent; undergraduate students must register concurrently for Sp Ed 365, 436; graduate students must have a teaching license.* Identification, analysis and correction of reading problems in five areas: print knowledge, integration of print knowledge, oral reading fluency, vocabulary, and comprehension

C I 456. Integrating Technology into the Reading and Language Arts Curriculum. (Dual-listed with 556). (3-0) Cr. 3. F.SS. *Prereq: 201 or 202, 377.* Methods and strategies used to integrate technology into the reading and language arts curriculum. Use and evaluation of reading and language arts software for elementary classrooms.

C I 468. Supervised Practicum in Teaching. Cr. arr. F.S.SS. *Prereq: Admission to teacher education program.* Observation, application of current methods, and instructional experiences with children in a supervised elementary classroom while engaged in other elementary methods courses.
A. Primary Grades, Reading & Language Arts. Cr. 1
B. Intermediate Grades, Reading & Language Arts. Cr. 1
C. Mathematics. Cr. 1
D. Science. Cr. 1
E. World Language. Cr. 1
F. Primary Grades, Literacy, Inclusive. Cr. 1
G. Primary Grades, Mathematics, Inclusive. Cr. 1
I. Primary Grades, Science, Inclusive. Cr. 1
J. Secondary Science I. Cr. 2
K. Secondary Science II. Cr. 2.
R. Reading Endorsement (Permission of department required; concurrent enrollment in 378) Cr. 1.

C I 480. Field Experience for Secondary Teaching Preparation. (Cross-listed with MUSIC). Cr. arr. Repeatable. F.S. *Prereq: Permission of area coordinator required prior to enrollment.* Observation and participation in a variety of school settings after admission to the teacher preparation program. (S/F grading may be used in some offerings of some sections.)
A. History/Social Sciences
C. Mathematics
K. Music (Same as Music 480K)

C I 486. Methods in Elementary School World Language Instruction. (Cross-listed with WLC, Ling). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language.* Current educational methods and their application in the elementary school classroom. Special emphasis on planning, evaluation, and teaching strategies. Nonmajor graduate credit.

C I 487. Methods in Secondary School World Language Instruction. (Cross-listed with WLC, Ling). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language, admission to the teacher education program.* Theories and principles of contemporary world language learning and teaching. Special emphasis on designing instruction and assessments for active learning.

C I 490. Independent Study. Cr. arr. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester.*
A. Music Education. (Same as Music 490A.)
B. Vocational and Educational Guidance
C. Curriculum Construction
D. Principles of Education
E. Methods of Teaching
F. Educational Psychology
G. Instructional Technology
H. Honors
I. Foundations of Educational Statistics
J. Multicultural Education
K. History/Social Sciences
L. Literacy Education
M. Mathematics Education
N. World Language
O. Foundations of Education

C I 494. Practice and Theory of Teaching Literature in the Secondary Schools. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Engl 310, 397, 9 other credits in English beyond 250, Psych 333, admission to teacher education program.* Portfolio review. Current theories and practices in the teaching of literature to secondary school students. Integrating literary study and writing. Preparation and selection of materials. Classroom presentation. Unit planning. (Taken concurrently with C I 280, Cr. 2, and Sp Ed 450)

C I 495B. Teaching Speech. (Cross-listed with Sp Cm). (3-0) Cr. 3. F. *Prereq: Sp Cm 313; 9 credits in speech communication; minimum grade point average of 2.5 in speech communication courses.* Problems, methods, and materials related to teaching speech, theatre, and media in secondary schools.

C I 497. Teaching Secondary School Mathematics. (Cross-listed with Math). (3-0) Cr. 3. F. *Prereq: 15 credits in college Mathematics; if in a teacher licensure program, concurrent enrollment in C I 426 or 526.* Theory and methods for teaching Mathematics in grades 7-12. Includes critical examination of instructional strategies, curriculum materials, learning tools, assessment methods, National Standards in Mathematics Education, and equity issues.

C I 498. Methods of Teaching History/Social Sciences. (3-0) Cr. 3. F.S. *Prereq: Concurrent enrollment in 480A; Admission to teacher education and 30 credits in subject-matter field.* Theories and processes of teaching and learning secondary history/social sciences. Emphasis on development and enactment of current methods, assessments, and curriculum materials for providing appropriate learning experiences.

Courses primarily for graduate students, open to qualified undergraduate students

C I 501. Foundations of Digital Learning. (3-0) Cr. 3. F.SS. *Prereq: Graduate classification.* Educational Philosophies and theories of instructional technology. Application of research to the production and use of instructional technology for learning and teaching. Equipment operation.

C I 503. Designing Effective Learning Environments. (3-0) Cr. 3. F. *Prereq: 501.* Introduction to theories and models of instructional design. Design decision-making based on the analysis of performance problems and instructional inputs. Practical experience with the design and development of instructional strategies and evaluation principles.

C I 504. Evaluating Digital Learning Environments. (Cross-listed with HCI). (3-0) Cr. 3. S. *Prereq: 501.* Principles and procedures for analysis, review, and assessment of instructional technology interventions in education and corporate settings. Evaluation methods for planning, organizing, and conducting evaluative studies are applied.

C I 505. Using Technology in Learning and Teaching. (3-0) Cr. 3. F.S.SS. *Prereq: Graduate classification.* Teaching and learning using computers. Selection and evaluation of software and hardware for teaching and learning. Research on computers. Tool software. Telecommunications. Trends in computer-based instruction.

C I 506. Multicultural Foundations of School and Society: Advanced. (3-0) Cr. 3. F.S.SS. *Prereq: 6 graduate credits in education.* Theories, legal bases, and principles of multicultural education. Pluralism and contributing cultures in the United States; presence and contributions of cultural group diversity with implications for educational programs, curriculum development, classroom instruction, materials utilization and development; problems and issues regarding ethnocentrism, prejudice, and discrimination based on race, ethnicity, socioeconomic class, sex/gender, sexual identity, and language in the school environment; curriculum infusion and transformation, multicultural interaction, design and execution of teaching strategies and techniques; inquiry and research on multicultural education issues.

C I 507. Principles and Practices of Distance Learning. (Dual-listed with 407). (2-2) Cr. 3. F.SS. *Prereq: 501, convenient access to the Web.* Review of flexible and distance learning (FDL) cases in a variety of contexts and pedagogic styles, research into relevant topics. Identification of underlying principles and frameworks for best practice in this field. Offered in FDL modes, utilizing telecommunications and the Internet.

C I 508. Algebra in the K-12 Classrooms. (3-0) Cr. 3. F. *Prereq: 448, 497, or graduate Status.* Focus on Algebraic concept explorations and associated procedures. Use of research-based strategies and appropriate technologies to apply fundamental ideas of patterning, coordinate graphing, and relationships among variables into K-12 classrooms. Additional topics facilitate critical examination of K-12 curriculum, pedagogy, and assessment.

C I 509. Geometry in the K-12 Classrooms. (3-0) Cr. 3. S. *Prereq: 448, 497, or graduate Status.* Euclidean and non-Euclidean geometry explorations with a focus on pedagogical issues in the K-12 classroom. Use of research-based strategies and appropriate technologies to teach geometry in K-12 classrooms. Additional topics from discrete Mathematics, history and Philosophy of geometry and fractal geometries.

C I 511. Technology Diffusion, Leadership and Change. (3-0) Cr. 3. S. *Prereq: Admission to graduate study, 501 or equivalent and 505 or equivalent.* Introduction to practices and principles of technology diffusion, leadership and strategic change in education. Frameworks and strategies for professional development and organizational change; current issues such as the digital divide.

C I 512. Research Trends in Digital Learning. (3-0) Cr. 3. F. *Prereq: Admission to graduate study and at least two courses in research and foundations of instructional technology.* Critical review of current research trends to uncover underlying educational technology. Engagement with current projects' techniques and analyses for qualitative and quantitative approaches, including the application of technology for the dissemination of scholarship. Designed as a capstone course to consolidate graduate students' knowledge of current research in curriculum and instructional technology for students in M.S. and Ph.D. programs.

C I 513. Mathematical Problem Solving in K-12 Classrooms. (3-0) Cr. 3. F. *Prereq: 6 credits of Mathematics, 448 or 497 or 597 or permission of instructor.* Strategies for improving problem solving skills across all strands of Mathematics (e.g., geometry, algebra, number theory) will be emphasized. Issues surrounding the appropriate role of problem solving in K-12 Mathematics classrooms will also be discussed, including distinctions among teaching "about," "for," and "through" problem solving.

C I 514. Introduction to the Purposes and Complexities of Science Teaching. (1-2) Cr. 2. SS. *Prereq: Admission to M.A.T. program.* Introduction to critical issues facing science education, science education goals reflecting contemporary purposes of schooling, and how people learn science.

C I 515. Action Research in Education. (3-0) Cr. 3. S. *Prereq: Admission to graduate study, one course in research methods, educational inquiry, statistics, educational psychology, or instructional design.* Philosophy and methods of conducting and communicating action research. Current issues in action research. Use of action research to improve education. Designed primarily for individuals involved in teaching or development of educational materials or student in M.Ed. programs.

C I 516. Antiracist Curriculum Development and Implementation. (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 9 credits in education.* Introduction to historical, sociological, philosophical and pedagogical foundations of antiracist/multicultural education. Examination of causes of racism, other forms of discrimination, and intergroup conflict from different theoretical perspectives and experiential exercises.

C I 517. Student Teaching. (Dual-listed with 417). Cr. arr. F.S. *Prereq: Full admission to teacher education, approval of coordinator during semester before student teaching.* Supervised student teaching in the liberal arts at the secondary level.
B. Physical Sciences
C. Mathematics
D. Biological Sciences
J. Earth Sciences
M. Science - Basic

C I 518. Science Methods I: A Research-Based Framework for Teaching Science. (Dual-listed with 418). (2-0) Cr. 2. F. *Prereq: 514; concurrent enrollment in 547 and 591D.* Development of a research-based framework for teaching science that includes student goals, congruent student actions, the character and role of science inquiry, teaching behaviors and strategies, contemporary learning theories, and self-evaluation.

C I 519. Secondary Science Methods II. (Dual-listed with 419). (2-0) Cr. 2. S. *Prereq: 418 or 518, concurrent enrollment in 591D.* Advancing a research-based framework for teaching science in a variety of school settings; emphasizing the teacher's role, the development and revision of science curriculum, exceptional learners, content area reading strategies, management strategies, technology, and student assessment.

C I 520. Bilingualism, Bilingual Education, and U.S. Mexican Youth. (Dual-listed with 420). (3-0) Cr. 3. F. *Prereq: 506.* Introduction to research on bilingualism and examination of the social, historical, and political contexts of bilingual education in U.S. schools. Attention to policy environment, school program structure, mode of classroom instruction, family and community context, and attainment of bilingualism and biculturalism for U.S. Mexican youth.

C I 523. Teaching Mathematics to Struggling Elementary Learners. (3-0) Cr. 3. SS. *Prereq: 438 or 448.* Instructional methods and assessment techniques for elementary students struggling to learn Mathematics. Emphasis on current research and practices for at-risk students and students with disabilities.

C I 524. Design and Development of Media. (2-0) Cr. 2. S. *Prereq: 501; graduate classification.* Principles of the design and production of instructional media; visual development and the creation of various traditional media and emerging technologies. Laboratory experiences in the production of several instructional media.

C I 526. Principles of Secondary Education. (Dual-listed with 426). (3-0) Cr. 3. F.S.SS. *Prereq: 6 credits in education.* The curriculum, human relations, student evaluation, support services, classroom management, organization of schools, legal aspects of schools, professionalism and career planning.

C I 529. Educational Psychology and the Secondary Classroom. (3-0) Cr. 3. SS. *Prereq: Bachelor's degree; admission into a graduate level teacher licensure program.* Analysis of psychological research theory related to learning, cognition, motivation, individual differences, and teaching techniques. Student and classroom assessment to facilitate positive learning outcomes. Adaption and differentiation of instruction to meet individual learners' needs. This course can only be used for teacher licensure programs. It is not acceptable for use in meeting the non-licensure M.Ed., M.S. or Ph.D. requirements.

C I 533. Educational Psychology of Learning, Cognition, and Memory. (Cross-listed with Psych). (3-0) Cr. 3. F. *Prereq: 333 or teacher licensure.* Learning, cognition, and memory in educational/training settings.

C I 541. How People Learn: Implications for Teaching Science. (3-0) Cr. 3. *Prereq: Bachelor's degree.* Current learning theories within science education and their application to science classrooms. Examination of models which assist the implementation of these theories of learning.

C I 546. Advanced Pedagogy in Science Education. (3-0) Cr. 3. S.SS. *Prereq: Bachelor's degree.* Critical examination of pedagogy, emphasizing teacher behaviors and strategies, methods of self-assessment, action research, and current issues and trends in science education.

C I 547. Nature of Science. (Dual-listed with 347). (3-0) Cr. 3. F. *Prereq: Concurrent enrollment in 518 or permission of instructor.* The intersection of issues in the history, philosophy, sociology, and psychology of science and their application to and impact on science teaching and learning, science teacher education, and science education research.

C I 548. Restructuring Science Activities. (3-0) Cr. 3. S.SS. *Prereq: Admission to teacher education or teaching license.* Modification of laboratory activities and other everyday science activities so they are more congruent with how students learn, the nature of science, and the National Science Education Standards.

C I 550. Ethnicity and Learning. (Dual-listed with 450). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification and completion of 506 or permission of instructor.* Examination of cultural relevance in education. Development and application of strategies and techniques for implementing multicultural goals and multiethnic perspectives in PreK-12 school classroom settings.

C I 551. Foundations of Reading and Language Arts. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Teaching license.* Analyzing, discussing, and researching the theory and practice of current literacy issues.

C I 552. Corrective Reading. (Dual-listed with 452). (3-0) Cr. 3. F.S.SS. *Prereq: 378 or equivalent; undergraduate students must register concurrently for Sp Ed 365, 436; graduate students must have a teaching license.* Identification, analysis, and correction of reading problems in five areas: print knowledge, integration of print knowledge, oral reading fluency, vocabulary, and comprehension.

C I 553. Reading for Adolescents with Mild/Moderate Disabilities. (3-0) Cr. 3. SS. *Prereq: Teaching license.* Instructional strategies for enhancing the comprehension and retention of students with mild/moderate disabilities, in conjunction with content-area reading material.

C I 554. Reading and Responding to Children's Literature. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Senior Status or teaching license.* Research and discussion of issues surrounding the classroom use of literature for children and young adults including censorship, diversity, selection, and the influences of technology.

C I 556. Integrating Technology into the Reading and Language Arts Curriculum. (Dual-listed with 456). (3-0) Cr. 3. F.SS. *Prereq: Teaching license.* Methods and strategies used to integrate technology into the reading and language arts curriculum. Use and evaluation of reading and language arts software for elementary classrooms.

C I 567. Teaching Mathematics to Struggling Secondary Learners. (Cross-listed with Sp Ed). (3-0) Cr. 3. *Prereq: Secondary teaching experience.* Instructional methods and assessment techniques for secondary students struggling to learn Mathematics. Particular emphasis on current research, practices, and trends in mathematics interventions for at-risk students and students with disabilities.

C I 570. Toying with Technology for Practicing Teachers. (Cross-listed with M S E). (2-0) Cr. 2. SS. *Prereq: C I 201 or 202, non-engineering major.* A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Other technological advances with K-12 applications will be explored. K-12 teachers will leave the course with complete lesson plans for use in their classrooms.

C I 578. Pedagogy, Equality of Opportunity, and the Education of Blacks in the United States. (3-0) Cr. 3. *Prereq: Graduate or senior level Status or permission of instructor.* This course takes a nonlinear, reflective view of the historical, social, economic, political, and legal contexts of the education of African Americans in the U.S. Educational theories and Philosophies, Critical Race Theory and Black Feminist Thought form the framework for investigating broad-based, multiple issues of education for African Americans in the U.S. as they are situated in the prevailing dominant views.

C I 588. Supervised Tutoring in Reading. (2-2) Cr. 3. F.S.SS. *Prereq: Graduate Status, teaching license and concurrent enrollment in or completion of one course*

in corrective reading; diagnosis and correction of reading problems. Using formal and informal diagnostic procedures to plan and implement individualized reading instruction. Field experience in tutoring and a related research project.

C I 590. Special Topics. Cr. arr. F.S. *Prereq: 9 graduate credits in education.*
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

C I 591. Supervised Field Experience. (0-2) Cr. arr. F.S.SS. *Prereq: 15 graduate credits in special area.* Supervised on-the-job field experience in special area.
B. World Language Education
C. Elementary Education
D. Secondary Education
F. Multicultural Education

C I 593. Workshops. Cr. arr. F.S. *Prereq: 9 graduate credits in education.*
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

C I 594. Contemporary Curriculum Theory and Principles. (3-0) Cr. 3. F. *Prereq: Graduate standing.* Theoretical and historical perspectives of contemporary curriculum; social, cultural, and epistemological aspects of curriculum theory; political, critical-race, feminist, economic, and postmodernist approaches to understanding curriculum and schooling in the U.S.

C I 595. Teaching Reading in Middle and Secondary Schools. (Dual-listed with 395). (3-0) Cr. 3. F. *Prereq: Graduate Status and teaching license.* Analysis and application of strategies to enhance students' literacy development in middle and secondary school settings. Research paper related to a course topic.

C I 596. Curriculum Problems and Inquiry. (3-0) Cr. 3. S. *Prereq: Graduate standing.* Analysis of contemporary problems of schooling and curriculum; use of qualitative inquiry to study diverse school policies and social problems influencing public education. Emphasis on strategies for teaching for social justice.

C I 597. Teaching Secondary School Mathematics. (3-0) Cr. 3. F. *Prereq: 15 credits in college Mathematics; if in a teacher licensure program, concurrent enrollment in C I 426 or 526.* Theory and methods for teaching Mathematics in grades 7-12. Includes critical examination of instructional strategies, curriculum materials, learning tools, assessment methods, National Standards in Mathematics Education, and equity issues.

C I 599. Creative Component. Cr. arr. F.S.SS. *Prereq: 9 graduate credits in education.*
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

Courses for graduate students

C I 603. Advanced Learning Environments Design. (Cross-listed with HCI). (3-0) Cr. 3. S. *Prereq: 503.* Exploration of advanced aspects of the instructional design process. Application of analysis, design, development and production, evaluation, implementation, and project management principles. Focus on the production and use of instructional technology with an emphasis on the instructional design consulting process. Theory and research in instructional technology provides the foundation for design decisions.

C I 610. Digital Learning in Teacher Education. (2-0) Cr. 2. F. *Prereq: 505.* Research on using technology in teacher education programs. Application examples studied. Field component involving relating material from class to a teacher education situation.

C I 611. Philosophical Foundations of Digital Learning. (3-0) Cr. 3. *Prereq: 12 graduate credits in curriculum and instruction.* Exploration of Philosophies of science that serve as foundations for research and practice in instructional technology, including positivism, post-positivism, interpretivism/constructivism, and critical theory. The roles of language, nature of truth and reality, and acceptable ways of knowing are explored in terms of their implications for instructional technology design, delivery, research, and scholarship.

C I 612. Socio-psychological Foundations of Digital Learning. (3-0) Cr. 3. *Prereq: 12 graduate credits in curriculum and instruction.* Exploration of theories of learning and associated instructional models that are the foundation for research and practice in education and educational technology, including behaviorism, information processing theory, and cognitive science. Emphasis on cognitive and social constructivist paradigms and the creation and use of constructivist learning environments supported by technology.

C I 615. Seminar. (0-2) Cr. 1. F.S. Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

C I 671. Discourse in Classrooms. (Cross-listed with Ling). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: graduate classification.* Explores both foundational and current literature on discourse in K-12 classrooms; focuses on both discourse as a classroom phenomenon and discourse as an analytic tool for doing research in classrooms; and provides a close look at enacted and hidden curricula through an examination of interactions and communication patterns.

C I 690. Advanced Special Topics. Cr. arr. Repeatable. *Prereq: 9 graduate credits in education.*
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

C I 699. Research. Cr. arr. Repeatable. *Prereq: 9 graduate credits in education.*
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

Historical, Philosophical, and Comparative Studies in Education (H P C)

David Owen, Program Coordinator

This program provides graduate experiences in historical, philosophical, and comparative studies in education. Students develop facility in analyzing educational problems and issues, critiquing policies that affect education in Society, and making connections between educational practice and learning.

Work is offered toward the master of science with thesis or nonthesis option, and the master of education. These degree programs and classes are of benefit to classroom teachers, educational theorists, administrators, university personnel, youth workers, religious educators, and others who seek to understand better the numerous bases of contemporary systems of education. Study in this field also complements work in other areas of specialization in education.

Courses primarily for graduate students, open to qualified undergraduate students

H P C 504. Studies in the Foundations of American Education. (3-0) Cr. 3. F. *Prereq: Admission to graduate licensure program in teacher education or permission of instructor.* An exploration of the social, historical, and Philosophical context of American education today. Emphasis is given to reflection on the varying perspectives on the goals of schooling, roles of teachers, curricular and pedagogical issues, and educational policy and reform proposals. Note: This course does not meet the requirements of the M.Ed., M.S., or Ph.D. core.

H P C 581. Philosophy of Education. (3-0) Cr. 3. SS. *Prereq: Graduate classification.* The bases of American educational theory and practice. Philosophical analysis of the viewpoints on education of selected individuals and groups.

H P C 584. Classics of Educational Philosophy. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Intensive study of influential statements of educational purpose, organization, curriculum, practice, and problems in the development of Western education.

H P C 585. Comparative Education: Traditions. (3-0) Cr. 3. *Prereq: Graduate classification.* Analysis of the cultural traditions of education outside the United States. Emphasis is given to an examination of the principles upon which selected national educational systems have been built. Special attention given to noneuropean traditions.

H P C 588. History of American Education. (3-0) Cr. 3. *Prereq: Graduate classification.* Historical analysis of selected educational policies, such as equal educational opportunity, governance, discipline, and teacher education. Biographies, school records, and government reports are examined. Antecedents to current issues are stressed.

H P C 590. Special Topics. Cr. arr. F.S. *Prereq: 9 graduate credits in education.*
A. History of Education
B. Philosophy of Education
C. Comparative Education

H P C 591. Supervised Field Experience. Cr. arr. *Prereq: 6 graduate credits in special area.* Supervised on-the-job field experience in special areas.

H P C 599. Creative Component. Cr. arr. F.S.

H P C 615. Seminar. (1-3) Cr. arr. Repeatable.
B. Philosophy of Education
C. Comparative Education

H P C 690. Advanced Special Topics. Cr. arr. Repeatable. F.S. Advanced special topics

H P C 699. Research. Cr. arr. Repeatable.

Special Education (Sp Ed)

Courses primarily for undergraduate students

Sp Ed 250. Education of the Exceptional Learner in a Diverse Society. (3-0) Cr. 3. F.S. *Prereq: C I 204.* An overview of students with diverse learning needs. Emphasis on early identification, educational services and strategies in inclusive settings, and preparation for community living in a heterogeneous Society.

Sp Ed 330. Introduction to Instruction for Students with Mild/Moderate Disabilities. (3-0) Cr. 3. F. *Prereq: 250, concurrent enrollment in C I 280I, 377.* Educational services and programming for students with mild/moderate disabilities examined from an historical perspective. Current trends, issues, impact of federal and state laws, and identification procedures. Characteristics of students with mild/moderate disabilities.

Sp Ed 339. Collaborative Partnerships in Special Education. (3-0) Cr. 3. F. *Prereq: Concurrent enrollment in 330.* Collaborative skills used in education of students with mild/moderate disabilities. Includes collaboration between general and special education teachers, parents, paraeducators, and other education professionals and agencies.

Sp Ed 355. Classroom Assessment in Inclusive Primary Settings. (2-0) Cr. 2. F.S. *Prereq: Concurrent enrollment in 455; C I 433, 438, 439, 468G, 468I.* Examination and application of strategies for determining special educational needs, planning and evaluating instructional programs, and monitoring student progress.

Sp Ed 365. Classroom Assessment for Special Education. (3-0) Cr. 3. S. *Prereq: 330. Form*al and informal diagnostic instruments. Determination of special education needs. Planning, adaptation, and formative evaluation of instructional programs for students with mild/moderate disabilities.

Sp Ed 368. Teaching in Inclusive Primary Settings. (1-0) Cr. 1. F.S. *Prereq: Concurrent enrollment in C I 377, 468F.* Federal and state law. Service delivery models. Issues related to providing instruction that meets the needs of diverse learners in inclusive primary settings.

Sp Ed 415. Supervised Student Teaching. Cr. arr. F.S. *Prereq: Full admission to teacher education, senior classification, 355, 455.* Reservation required. Student teaching experience in inclusive primary grade classrooms.

Sp Ed 416. Supervised Student Teaching. Cr. arr. F.S. *Prereq: Full admission to teacher education, senior classification, student in elementary education section. 330, 365, 436, 439, 457; C I 280, 478.* Reservation required.

Sp Ed 436. Instructional Methods for Students with Mild/Moderate Disabilities. (3-0) Cr. 3. S. *Prereq: C I 245, concurrent enrollment in 365.* Evidence-based instructional strategies/techniques in academic areas and materials for individual instruction and classroom management for elementary students with mild/moderate disabilities.

Sp Ed 450. Teaching Secondary Students with Exceptionalities in the General Education Classroom. (2-2) Cr. 3. F.S. Overview of characteristics and needs of exceptional youth and appropriate service delivery options. Legal foundations for special education. Emphasis on co-teaching models, differentiated instruction, accommodations for instruction and assessment, and collaboration among professionals and parents.

Sp Ed 455. Instructional Methods for Inclusive Primary Settings. (2-0) Cr. 2. F.S. *Prereq: Concurrent enrollment in 355; C I 433, 438, 439, 468G, 468I.* Evidence-based instructional strategies and techniques in academic areas that support the learning of students with diverse learning needs. Emphasis on accommodations and alternative teaching strategies to meet individual student needs.

Sp Ed 457. Teaching Exceptional Learners in the General Classroom. (3-0) Cr. 3. F. *Prereq: 250, C I 245.* Evidence-based teaching strategies and instructional accommodations for inclusive education. Emphasis on managing challenging behavior. Nonmajor graduate credit. Nonmajor graduate credit.

Sp Ed 459. Field Experience and Practicum-Students with Mild/Moderate Disabilities. (0-2) Cr. 1. *Prereq: 365, 436, concurrent enrollment in 460.* Observation and involvement with students with mild/moderate disabilities in a resource room program. Satisfactory-fail only.

Sp Ed 460. Special Education Capstone. (1-0) Cr. 1. F. *Prereq: 436, concurrent enrollment in 459.* Discussion and application of evidence-based instructional strategies/techniques in academic and behavioral areas with students who have mild/moderate disabilities. Discussion of issues related to education of students with mild/moderate disabilities.

Sp Ed 490. Independent Study. Cr. arr. F.S. *Prereq: 12 credits in elementary education, permission of department chair.*

Courses primarily for graduate students, open to qualified undergraduate students

Sp Ed 501. Teaching Students with Exceptionalities in General Education. (3-0) Cr. 3. SS. *Prereq: Baccalaureate degree.* Overview of characteristics and needs of exceptional children/youth and appropriate service delivery options. Emphasis on accommodations and modifications for instruction and assessment and collaboration among professionals and parents.

Sp Ed 510. Foundations in Mild/Moderate Disabilities. (3-0) Cr. 3. S. *Prereq: 501 or equivalent.* Historical and legal foundations for special education. Characteristics, prevalence, and etiology of mild/moderate disabilities. Historical and contemporary models of programming for students with disabilities.

Sp Ed 511. Foundations of Behavioral Disorders and Learning Disabilities. (3-0) Cr. 3. S. Study of theory, interventions and special education service delivery models to students with moderate/severe behavior/learning disabilities in the public schools and residential settings.

Sp Ed 515. Assessment of Children and Youth with Disabilities. (3-0) Cr. 3. F. *Prereq: 510 or 511. Form*al and informal methods of assessment for identification/eligibility. IEP development, and progress monitoring. Formative evaluation of academic and behavioral skills, including curriculum-based measurement and functional behavioral assessment.

Sp Ed 517. Research in Special Education. (2-0) Cr. 2. SS. *Prereq: 510, 515.* Critical review of recent literature in education and related behavioral sciences as applied to education of students with disabilities.

Sp Ed 520. Instructional Methods for Mild/Moderate Disabilities. (3-0) Cr. 3. *Prereq: 510, 515.* Evidence-based instructional methods for meeting the academic and behavioral needs of students with mild/moderate disabilities. Includes methods, strategies, and behavior management techniques appropriate for students with mild or moderate disabilities.

Sp Ed 530. Evidence-based Practices in Behavior Disorders. (3-0) Cr. 3. S. *Prereq: 511, 515.* Current research on evidence-based interventions designed to improve the behavior and social skills of students with moderate/severe behavior disorders. Particular emphasis on positive behavioral supports and behavior change strategies.

Sp Ed 540. Evidence-based Practices in Learning Disabilities. (3-0) Cr. 3. S. *Prereq: 511, 515.* Current research on evidence-based interventions designed to improve the academic performance of students with moderate/severe learning disabilities. Particular emphasis on methods for improving reading, written expression, and mathematics, as well as performance in content-area instruction.

Sp Ed 553. Reading for Adolescents with Mild/Moderate Disabilities. (Cross-listed with C I). (3-0) Cr. 3. SS. *Prereq: Teaching license.* Instructional strategies for enhancing the comprehension and retention of students with mild/moderate disabilities, in conjunction with content-area reading material.

Sp Ed 555. Career Education and Transition for Youth with Disabilities. (2-0) Cr. 2. SS. *Prereq: 510 or 511.* Examination of the academic, personal, social, employability, and daily living skills needed for a satisfactory adult life. Exploration of curricula, programs, and services to meet these needs.

Sp Ed 560. Classroom Management/Behavioral Support. (3-0) Cr. 3. F. *Prereq: Teaching license.* Emphasis on positive behavioral supports and understanding behavior and its context through a functional behavioral approach. Design and development of carefully planned behavioral intervention programs for groups and individual students in general and special education settings.

Sp Ed 564. Collaborative Consultation. (3-0) Cr. 3. F. *Prereq: 510, 515, 520 or 530 or 540.* Models of consultation. Characteristics and methods to promote effective collaboration with families, paraprofessionals, other school personnel, and representatives of other agencies. Includes specific attention to IEP development as a collaborative process.

Sp Ed 565. Role of the Consultant. (1-0) Cr. 1. *Prereq: 564.* Explore role of the educational consultant in different settings (State department, area education agency, school district, private). Examine roles in relationship to models (mental health, collaborative, organization).

Sp Ed 567. Teaching Mathematics to Struggling Secondary Learners. (Cross-listed with C I). (3-0) Cr. 3. *Prereq: Secondary teaching experience.* Instructional methods and assessment techniques for secondary students struggling to learn mathematics. Particular emphasis on current research, practices, and trends in mathematics interventions for at-risk students and students with disabilities.

Sp Ed 570. Systems-Level Services for Youth with Behavioral and Learning Disabilities. (3-0) Cr. 3. SS. *Prereq: 511.* Overview of systems (education, juvenile justice, mental health, families, communities) that serve students with special education needs. Emphasis on how these systems work to provide needed programs and services for youth with behavioral and learning disabilities.

Sp Ed 590. Special Topics. Cr. arr. F.S. *Prereq: 15 credits in education, permission of department chair.*

Sp Ed 591. Supervised Field Experience. (0-2) Cr. arr. F.S. *Prereq: 15 graduate credits in special area, admission to the graduate program in special education.* Supervised on-the-job field experience in special areas.
G. Mild/Moderate Disabilities, K-6;
H. Mild/Moderate Disabilities, 7-12;
K. Behavior Disorders/Learning Disabilities, K-12

Sp Ed 599. Creative Component. Cr. arr. F.S.SS. *Prereq: 15 credits in education.*

Courses for graduate students

Sp Ed 615. Seminar. (1-0) Cr. 1. Repeatable. Selected topics in special education. Analysis of current special education research potential. Evaluation of impact upon the profession. Implications for additional research.

Sp Ed 699. Research. Cr. arr. *Prereq: 15 credits in education.*

Design Studies

(Interdepartmental Undergraduate Program)

Kate Schwennsen, Program Coordinator

The Design Studies program brings together courses that deal with the integrated study of the conceptualization, production, visible form, uses, and history of artifacts, buildings, and environments as well as the common qualities and connections among the design fields. Students in any college may elect to take a minor in Design Studies.

Core Design Program

Several Design Studies courses are part of the Core Design Program, which is required for all undergraduate students in the College of Design.

Minor—Design Studies

The undergraduate minor in Design Studies is constructed to facilitate design awareness among interested students and to provide a vehicle for interdisciplinary study within the College of Design. This minor is open to all undergraduate students at Iowa State University.

Additional information is available in the Student Programs and Services Office, 297 College of Design.

Minor—Digital Media

To familiarize students with the use of digital media in the design process, the College of Design offers an undergraduate Minor in Digital Media. This minor is open only to undergraduate students in the College of Design.

Detailed information is available in the Student Programs and Services Office, 297 College of Design.

Courses primarily for undergraduate students

Dsn S 102. Design Studio I. (1-6) Cr. 4. F.S. A core design studio course exploring the interaction of two-and three-dimensional design. Emphasis on fundamental skills and ideas shared across design disciplines. Investigation of creative process, visual order and materials, and development of critical thinking through studio projects and lectures. Includes study of precedents, contemporary design practices and disciplines in their cultural contexts.

Dsn S 110. Design Exchange Seminar I. (0-2) Cr. 1. F. *Prereq: Member of Design Exchange Learning Community.* Orientation to the College of Design. Introduction to the design disciplines and studio pedagogy. Satisfactory-fail only.

Dsn S 111. Design Exchange Seminar II. (0-2) Cr. 1. S. *Prereq: Member of the Design Exchange Learning Community.* Development and clarification of career and academic plans. Satisfactory-fail only.

Dsn S 115. Design Collaborative Seminar. (1-0) Cr. 0.5. *Prereq: Member of Design Collaborative Learning Community.* Orientation to the College of Design. Introduction to the design disciplines and studio pedagogy. Satisfactory-fail only.

Dsn S 131. Design Representation. (1-6) Cr. 4. F.S. An introduction to drawing through lecture and studio experiences. Focus on creative problem solving and communication in order to give visual form to ideas. Emphasis on perceptual, conceptual, and evaluative abilities through experiences that build eye, brain, and hand coordination. Explorations include drawing from observation and memory, working at various scales and duration, and using a variety of media and processes.

Dsn S 181. Origins and Evolution of Modern Design. (Cross-listed with Art H). (3-0) Cr. 3. F.S. History of designed artifacts, their creators, and their cultural environments in Western Europe and America from the beginning of the Industrial Revolution to the present.

Dsn S 183. Design Cultures. (3-0) Cr. 3. F.S. A broad-based exploration of the dynamic relationship between design and culture, employing case study method to investigate particular examples of cultural production in contemporary Society. Design processes and design works are presented as culturally, economically, environmentally, historically, ideologically, politically, and socially grounded events and artifacts.

Dsn S 221. History of Western Architecture I. (Cross-listed with Arch). (3-0) Cr. 3. F. Introductory survey with emphasis on the cultural, visual, natural, and constructed context. Ancient through Renaissance.

Dsn S 222. History of Western Architecture II. (Cross-listed with Arch). (3-0) Cr. 3. S. Introductory survey with emphasis on the cultural, visual, natural, and constructed context. Renaissance to present.

Dsn S 270. Forces Shaping Our Metropolitan Environment. (Cross-listed with C R P). (3-0) Cr. 3. S. Must be taken prior to completing 9 credits in C R P. Introduction to the social, political, physical, and economic forces as they shape metropolitan areas. A comprehensive picture of metropolitan development showing important roles other urban disciplines play in the planning process and the interrelationships of the disciplines.

Dsn S 274. The Social and Behavioral Landscape. (Cross-listed with L A). (3-0) Cr. 3. S. Exploration of social and behavioral factors pertinent to design of the domestic, civic, and commercial landscape. Focus on working familiarity with design principles as they relate to the behavior and activities of people across a broad demographic and cultural spectrum; application of these principles to design of outdoor environments. Lectures and discussions, including group exercises and field trips.

Dsn S 280. History of Art I. (Cross-listed with Art H). (3-0) Cr. 3. F. Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts; from prehistoric through Gothic. H. Honors. Cr. 4.

Dsn S 281. History of Art II. (Cross-listed with Art H). (3-0) Cr. 3. S. Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts; from the Renaissance to the twentieth century. H. Honors. Cr. 4.

Dsn S 291. World Cities and Globalization. (Cross-listed with C R P). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Sophomore classification.* World cities and globalization in developed and developing countries. Topics include globalization, world cities and regions, uneven economic development, the international division of labor, multinational corporations, international environmentalism, tourism, popular culture and place-based identity.

Dsn S 292. Introduction to Visual Culture Studies. (Cross-listed with ART). (3-0) Cr. 3. F.S. *Prereq: Open to all majors.* An introduction to various topics in visual culture studies. The lecture course will provide students with a creative and intellectual context in which to study historical and contemporary instances of the visual in culture. Individual lectures examine significant trends in the visual arts, mass media, scientific imagery, visual communications, and other areas related to visual literacy and visual representation in local and global contexts. Cross cultural viewpoints and issues of diversity will be presented in relation to visual culture and related fields.

Dsn S 293. Environmental Planning. (Cross-listed with C R P, Env S). (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Comprehensive overview of the field of environmental relationships and the efforts being made to organize, control, and coordinate environmental, aesthetic, and cultural characteristics of land, air, and water.

Dsn S 301. Study Abroad Preparation Seminar. (1-0) Cr. 1. Repeatable. F.S. Cultural introduction to host country, introduction to faculty sponsor and program of study, the particulars of traveling and living abroad, and financial and logistical preparations. Guest lectures. Required of all students planning to participate in a College of Design study abroad program for 9 or more credits. Satisfactory-fail only.

Dsn S 302. Design Leadership Seminar. (1-2) Cr. 2. Repeatable. *Prereq: Selection as a peer mentor for the Core Design program. For students* serving as peer mentors for the Core Design Program, under faculty supervision. Development of teaching and leadership skills within the context of design education experiences. Satisfactory-fail only.

Dsn S 303. Design Ambassadors. (1-2) Cr. arr. Repeatable. *Prereq: Admittance into one of the professional programs in the College of Design.* Opportunity to strengthen leadership, communication and presentation skills. Introduction to student development theory. Students participate in collaborative projects focused on prospective design students. Satisfactory-fail only.

Dsn S 310. Practical Experience. Cr. R. *Prereq: Permission of adviser or Coordinator of Design Studies.* Independent educational enrichment through practical experience. Students must register for this course prior to commencing each term. Available only to students taking course loads of eleven credits or less.

Dsn S 320. Urban form. (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: C R P 253 or 270, or permission of instructor.* Examines how urban form is shaped, what constitutes good urban form, and what are the trends in emerging urban forms. Descriptive, explanatory and normative theories of urban form, and the relationships between urban form and social, economic, political, cultural, and institutional forms.

Dsn S 351. Solar Home Design. (Cross-listed with Arch). (3-0) Cr. 3. S. *Prereq: Arch 202.* Architectural design and technical analysis of residential structures with emphasis on energy construction and solar energy utilization.

Dsn S 371. Landscape Architectural History: 1750 to Present. (Cross-listed with L A). (3-0) Cr. 3. S. Investigation of landscape design concepts and trends as observed over time, from approximately 1750 to the present, with emphasis on the United States and Europe. Examination of significant figures and outstanding works (sites, gardens, landscapes, monuments, subdivisions, city plans, etc.) of varied geographic regions. Analysis of the social, economic, political, and technical forces contributing to the development of landscape design styles, vocabulary, and literature. Lectures, readings, projects, research papers.

Dsn S 373. Landscape Architectural History: Pre-history to 1750. (Cross-listed with L A). (3-0) Cr. 3. F. Investigation of international landscape design concepts and trends as observed over time, from pre-history to the mid 18th century. Examination of significant figures and outstanding works (sites, gardens, landscapes, monuments, subdivisions, city plans, etc.) of varied geographic regions. Analysis of the social, economic, political, and technical forces contributing to the development of landscape design styles, vocabulary, and literature. Lectures, readings, projects, research papers.

Dsn S 382. Art and Architecture of Asia. (Dual-listed with 582). (Cross-listed with Art H). (3-0) Cr. 3. Introduction to the history of art and architecture in China, Korea, and Japan before the modern era. Visual materials selected based on important themes that are critical in understanding East Asian culture and art tradition. Museum field trip expenses to be paid by students. Nonmajor graduate credit.

Dsn S 383. Greek and Roman Art. (Dual-listed with 583). (Cross-listed with Art H, Cl St). (3-0) Cr. 3. Greek art from Neolithic and Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West. Nonmajor graduate credit.

Dsn S 385. Renaissance Art. (Dual-listed with 585). (Cross-listed with Art H). (3-0) Cr. 3. European art including painting, sculpture, architecture, and crafts;

thirteenth through sixteenth centuries. Nonmajor graduate credit.

Dsn S 394. Women/Gender in Art. (Dual-listed with 594). (Cross-listed with Art H, W S). (3-0) Cr. 3. Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture. Nonmajor graduate credit.

Dsn S 397. Internship Search Seminar. (1-0) Cr. 1. F. *Prereq: Sophomore classification or above in one of the College of Design degree programs.* A structured environment to set realistic learning goals, research potential sites, develop a strategy, develop essential job search materials and skills for finding an internship. Successfully obtaining an internship either for credit or non credit is encouraged but not required. Satisfactory-fail only.

Dsn S 404. Advanced Landscape Architectural Design. (Cross-listed with L A). (1-15) Cr. 6. Repeatable. S. *Prereq: L A 401.* Advanced forum for the demonstration of sophistication in landscape architectural design. Experimentation and innovation are encouraged.

Dsn S 417. Urban Revitalization. (Dual-listed with 517). (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: C R P 253 or 270.* Planning methods available to further revitalization and preservation efforts, with particular attention to housing and neighborhoods. Relationship between neighborhood change and urban development process; public policy implications.

Dsn S 425. Growth Management. (Dual-listed with 525). (Cross-listed with C R P). (3-0) Cr. 3. F. *Prereq: Junior classification.* Review of techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban, suburban and rural relationships; and land preservation.

Dsn S 426. Topics in Native American Architecture. (Cross-listed with Am In, Arch). (3-0) Cr. 3. Repeatable. F.S. *Prereq: Junior classification.* History, theory, and principles of Native American/American Indian Architecture, landscape Architecture and planning considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 426 may be applied to degree program. Nonmajor graduate credit.

Dsn S 429. International Planning. (Dual-listed with 529). (Cross-listed with C R P). (3-0) Cr. 3. S. *Prereq: Junior classification.* Introduction to issues in planning and governance in an international setting. Problems and strategies may include population movement and change, economic globalization, urban growth, rural development, and housing.

Dsn S 442. Site Development. (Dual-listed with 542). (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: C R P 253, 272.* Introduction to site analysis using landscape Architecture and environmental principles, drawing also on basic engineering concepts. Work will evolve from analysis to land development design.

Dsn S 446. Interdisciplinary Design Studio. (Dual-listed with 546). (0-12) Cr. arr. Repeatable. *Prereq: Junior classification in a curriculum in the College of Design and permission of instructor.* Advanced interdisciplinary design projects.

Dsn S 478. Topical Studies in Landscape Architecture. (Dual-listed with 578). (Cross-listed with L A). Cr. arr. Repeatable. F.S.SS. *Prereq: L A 371 or senior classification or graduate standing.* Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.
A. Landscape Design
B. Planting Design
C. Construction
D. History, Theory, Criticism
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social, Behavioral
N. Natural Resources

Dsn S 481. Art and Architecture of India. (Dual-listed with 581). (Cross-listed with Art H). (3-0) Cr. 3. Survey of Indian-style art and Architecture through history. Examine how art and Architecture developed in the Indian world has come to define the Indian identity religiously, culturally, socially, and politically. Nonmajor graduate credit.

Dsn S 484. Sustainable Communities. (Dual-listed with 584). (Cross-listed with C R P, Env S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Senior classification.* The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

Dsn S 487. Nineteenth Century Art. (Dual-listed with 587). (Cross-listed with Art H). (3-0) Cr. 3. European and American art and Architecture from 1780 to 1900 focusing on the major movements of western Europe: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism. Nonmajor graduate credit.

Dsn S 488. Modern and Contemporary Art and Theory I. (Dual-listed with 588). (Cross-listed with Art H). (3-0) Cr. 3. F. Visual arts and critical theory from Impressionism to Abstract Expressionism. Nonmajor graduate credit.

Dsn S 489. Sequential Art. (Dual-listed with 589). (Cross-listed with Art H). (3-0) Cr. 3. F.SS. An art-historical survey of comic strips, comic books, and graphic novels from their origins in the 19th century to the present.

Dsn S 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on required form prior to semester of enrollment.* Independent investigation of a topic of special interest to the student.
A. History
B. Technology
C. Communications
D. Design
E. Entrepreneurship
F. Social/Behavioral
H. Honors

Dsn S 491. Environmental Law and Planning. (Dual-listed with 591). (Cross-listed with C R P, Env S). (3-0) Cr. 3. S. *Prereq: 6 credits in natural sciences.* Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

Dsn S 492. Special Topics: Italian Culture. Cr. 1. Repeatable. F.S.SS. *Prereq: Enrollment in the College of Design Rome Study Abroad Program or in Dsn S 301.* Introduction to Italian contemporary culture, including language, fashion, politics, media, and social mores. Taught the semester prior and during study in Rome for students in the College of Design Rome program.

Dsn S 495. Modern and Contemporary Art and Theory II. (Dual-listed with 595). (Cross-listed with Art H). (3-0) Cr. 3. Visual arts and critical theory from Abstract Expressionism to the present. Nonmajor graduate credit.

Dsn S 496. History of Photography. (Dual-listed with 596). (Cross-listed with Art H). (3-0) Cr. 3. Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an Art Historical perspective, emphasizing causative factors, cultural influences, and major masters and schools. Nonmajor graduate credit.

Dsn S 498. Selected Topics in Art History. (Dual-listed with 598). (Cross-listed with Art H). (3-0) Cr. 3. Repeatable. Specialized study in the history or criticism of art and design. Course primarily for graduate students open to qualified undergraduate students.

Courses primarily for graduate students, open to qualified undergraduate students

Dsn S 504. Why Change Anything?. (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Introduction to a range of approaches to justifying innovations, changes, and interventions proposed by designers, planners, and artists. Reasons for change and their bases in social, philosophical, and design reasoning; and their usefulness in justifying change to different audiences. Investigation of fallacies, ideologies, and contemporary problems in justifications.

Dsn S 517. Urban Revitalization. (Dual-listed with 417). (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate Classification.* Planning methods available to further revitalization and preservation efforts, with particular attention to housing and neighborhoods. Relationship between neighborhood change and urban development process; public policy implications.

Dsn S 525. Growth Management. (Dual-listed with 425). (Cross-listed with C R P). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Graduate classification.* Review of techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban, suburban, rural relationships; and land preservation.

Dsn S 528. Topical Studies in Architecture. (Cross-listed with Arch). (3-0) Cr. arr. Repeatable. F.S.SS. *Prereq: Arch 221, 222 or senior classification or graduate standing.*
A. Studies in Architecture and Culture
B. Technology
C. Communications
D. Design
E. Practice

Dsn S 529. International Planning. (Dual-listed with 429). (Cross-listed with C R P). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Introduction to issues in planning and governance in an international setting. Problems and strategies may include population movement and change, economic globalization, urban growth, rural development, and housing.

Dsn S 542. Site Development. (Dual-listed with 442). (Cross-listed with C R P). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Introduction to site analysis using landscape Architecture and environmental principles, but drawing also on basic engineering concepts. Work will evolve from analysis to land development design based on that analysis.

Dsn S 546. Interdisciplinary Design Studio. (Dual-listed with 446). (0-12) Cr. arr. Repeatable. *Prereq: Admission to a graduate program in the College of Design and permission of instructor.* Advanced interdisciplinary design projects.

Dsn S 558. Sustainability and Green Architecture. (Cross-listed with Arch). (3-0) Cr. 3. F. *Prereq: Graduate standing.* Issues of Sustainability as related to living patterns and city design, population, pollution and use and availability of natural resources for the built environment; Issues of Green Architecture as it relates to building material selection, systems of building materials, the environment of the United States and the World, Architects and examples of buildings with green or sustainable designations.

Dsn S 567. Preservation, Restoration, and Rehabilitation. (Cross-listed with Arch). (3-0) Cr. 3. S. *Prereq: Senior classification.* Construction standards and procedures for preserving, restoring, reconstructing, and rehabilitating existing buildings following the guidelines of the National Park Service and the

National Trust for Historic Preservation. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Dsn S 571. Design for All People. (Cross-listed with Arch, Geron). (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Principles and procedures of universal design in response to the varying ability level of users. Assessment and analysis of existing buildings and sites with respect to standards and details of accessibility for all people, including visually impaired, mentally impaired, and mobility restricted users. Design is neither a prerequisite nor a required part of the course. Enrollment open to students majoring in related disciplines. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Dsn S 575. Contemporary Urban Design Theory. (Cross-listed with Arch). (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Current urban design theory and its application to urban problems. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Dsn S 578. Topical Studies in Landscape Architecture. (Dual-listed with 478). (Cross-listed with L A). (3-0) Cr. arr. Repeatable. F.S.SS. *Prereq: Senior Classification or graduate standing.* Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.
A. Landscape Design
B. Planting Design
C. Construction
D. History, Theory, Criticism
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social/Behavioral
N. Natural Resources

Dsn S 581. Art and Architecture of India. (Dual-listed with 481). (Cross-listed with Art H). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Survey of Indian-style art and Architecture through history. Examine how art and Architecture developed in the Indian world has come to define the Indian identity religiously, culturally, socially, and politically.

Dsn S 582. Art and Architecture of Asia. (Dual-listed with 382). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Introduction to the history of art and Architecture in China, Korea, and Japan before the modern era. Visual materials selected based on important themes that are critical in understanding East Asian culture and art tradition. Museum field trip expenses to be paid by students.

Dsn S 583. Greek and Roman Art. (Dual-listed with 383). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Greek art from Neolithic and Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West.

Dsn S 584. Sustainable Communities. (Dual-listed with 484). (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate classification.* The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

Dsn S 585. Renaissance Art. (Dual-listed with 385). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* European art including painting, sculpture, Architecture, and crafts; thirteenth through sixteenth centuries.

Dsn S 587. Nineteenth Century Art. (Dual-listed with 487). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* European and American art and Architecture from 1780 to 1900, focusing on the major movements of western Europe: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism.

Dsn S 588. Modern and Contemporary Art and Theory I. (Dual-listed with 488). (Cross-listed with Art H). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Visual arts and critical theory from Impressionism to Abstract Expressionism.

Dsn S 589. Sequential Art. (Dual-listed with 489). (Cross-listed with Art H). (3-0) Cr. 3. F.SS. *Prereq: Graduate classification, permission of instructor.* An art-historical survey of comic strips, comic books, and graphic novels from their origins in the 19th century to the present.

Dsn S 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on required form prior to semester of enrollment.* Independent investigation of a topic of special interest to the student.

Dsn S 591. Environmental Law and Planning. (Dual-listed with 491). (Cross-listed with C R P, L A). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Environmental law and policy as applied in planning at the local and State levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

Dsn S 594. Women/Gender in Art. (Dual-listed with 394). (Cross-listed with Art H, W S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture.

Dsn S 595. Modern and Contemporary Art and Theory II. (Dual-listed with 495). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Visual arts and critical theory from Abstract Expressionism to the present.

Dsn S 596. History of Photography. (Dual-listed with 496). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an Art Historical perspective, emphasizing causative factors, cultural influences, and major masters and schools.

Dsn S 598. Selected Topics in Art History. (Dual-listed with 498). (Cross-listed with Art H). (3-0) Cr. 3. Repeatable. *Prereq: Graduate classification, permission of instructor.* Specialized study in the history or criticism of art and/or design.

Dietetics

(Interinstitution Graduate program)

Participating faculty:
Iowa State University:

Colorado State University: Mary Harris

Kansas State University: Deborah D. Canter

Michigan State University: Shoerr

Montana State University: Christina Campbell

North Dakota State University: Ardith Brunt

Oklahoma State University: Nancy Betts

South Dakota State University: Kendra Kattelmann

University of Kansas Medical Center: Linda Griffith

University of Nebraska: Marilyn Schnepf

"Dietetics" is an interinstitutional distance education program offered through the Web. The student selects a home institution, which grants the degree. After admission at tht home institution, the student takes courses from each of the ten institutions: Iowa State University, Colorado State University, Kansas State University,Michigan State University, Montana State University, North Dakota State University, Oklahoma State University, South Dakota State University: Kendra Kattelman, University of Kansas Medical Center, and University of Nebraska.

At Iowa State University, Dietetics is a specialization within the Master of Family and Consumer Sciences degree program (MFCS-Diet) that consists of 36 credits. This is a non-thesis option and a special project or creative component is required. Students typically complete the program in 6-8 semesters while employed full-time. Admission is limited to those who are Registered Dietitians or Registration-eligible Dietitians. A computer with minimum specifications, web access, and an email address are required for completing the program.

Admission procedures: Admission to the MFCS-Diet program requires exactly the same procedures as admission to the Graduate College. See. Graduate College section of this catalog.

Registration: Students choosing to receive their degree from Iowa State University complete all the admissions, registration and fee payment processes through ISU.

The department cooperates in the interinstitution Master of Family and Consumer Sciences program to offer a specialization in Dietetics. The Master of Family and Consumer Sciences-Dietetics is designed for the Registered Dietitian or Registration-eligible Dietitian. The 36 credit program is non-thesis and seeks to develop research skills, stimulate independent thought, and provide up-to-date knowledge in foods, nutrition, and foodservice/ business management. This program prepares individuals to integrate and apply the principles from the biomedical sciences, human behavior, and management to design and lead effective food and nutrition programs in a variety of settings. Students may build a program of study from offerings of the partner institutions such as human nutrition, nutrient metabolism, biostatistics, health promotion/disease prevention, foodservice systems management, food science, lifespan nutrition, wellness, entrepreneurship, nutrition education, nutritional assessment and food safety. The online program is tailored for credentialed, practicing dietetics professionals who seek to enhance their knowledge in a specific area of dietetics practice or retool for new career opportunities in dietetics practice.

Diet 511. Research Methods. (3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* An overview of diverse research approaches focusing on methods for collecting and analyzing quantitative and qualitative data. www only. Only one of Diet 511 or FCEdS 511 may count toward graduation.

Diet 530. Nutrition in Wellness. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Addresses wellness promotion through nutrition. Nutritional risk and protective factors will be examined in relation to public health and individual nutrition. www only.

Diet 532. Maternal and Child Nutrition. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Critical examination of behavioral, physiological, and public health issues impacting dietary and nutritional factors that support normal growth and development. Content focuses on early stages of the life cycle: gestation, lactation, infancy, preschool, school age, and adolescence. www only.

Diet 534. Nutrition Education in the Community. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Principles and practices of teaching individuals and groups to translate nutrition knowledge into action. Emphasis on research in and evaluation of nutrition education. www only.

Diet 538. Nutrition: A Focus on Life Stages. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Explores influence of normal physiological stresses on nutritional needs throughout the life span. Evaluates dietary intake and identification of appropriate community nutrition services in on-line discussions. Specific considerations, such as the influence of age and cultural heritage, are incorporated. www only.

Diet 540. Nutrition and Physical Activity in Aging. (Cross-listed with Geron). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* WWW only. Basic physiologic changes during aging and their impacts in health and disease. The focus will be on successful aging with special emphasis on physical activity and nutrition. Practical application to community settings is addressed.

Diet 544. Pediatric Clinical Nutrition. (3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Examines the physiological, biochemical and nutritional aspects of disease processes relevant to infants and children up to 18 years of age. Discussion of medical nutrition therapy for a variety of medical conditions in this population including inborn errors of metabolism, food hypersensitivity, obesity, and diseases of the major organ Systems. www only.

Diet 546. Phytochemicals. (3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Overview of phytochemicals (non-nutritive biologically active compounds) from fruits, vegetables, cereals and oilseeds. Covers recent findings of chemistry, physiological functions, and potential health implications of phytochemicals. www only.

Diet 548. Professional Development Assessment. (Cross-listed with FS HN). (1-0) Cr. 1. F.S.SS. *Prereq: Enrollment in GPIDEA MFCS in Dietetics.* Web-based course providing information and practice for student to assess and evaluate own professional development and continuing professional education needs. Completion of professional 5-year plan. Satisfactory-fail only.

Diet 550. Finance and Cost Controls. (3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Overview of the fundamental knowledge of hospitality managerial accounting, cost controls, and financial management. Important topics include financial statement analysis, cost concepts, cost-volume-profit analysis, calculating and controlling food and beverage costs, pricing, and capital budgeting. www only.

Diet 554. Statistics. (3-0) Cr. 3. S.SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Tools used to make statistical decisions. Major emphasis on explanation and understanding of important concepts involved; basic theme is understanding of data and methods used to analyze such data. www only. Only one of Diet 554 or Stat 401, 495, 542 may count toward graduation.

Diet 556. Advanced Nutrition: Micronutrients. (3-0) Cr. 3. S. *Prereq: BBMB 404 or BBMB 420 or equivalent; enrollment in GP-IDEA MFCS in Dietetics.* Integration of the molecular, cellular and physiological aspects of vitamins and minerals in mammalian systems. Interactions among nutrients, metabolic consequences of deficiencies or excesses, relevant polymorphisms, major research methodologies, and current topics related to micronutrients and non-nutrient components. www only. Only one of Diet 556 or NutrS 502 may count toward graduation.

Diet 558. Advanced Nutrition: Macronutrients. (3-0) Cr. 3. F. *Prereq: BBMB 404 or BBMB 420 or equivalent; enrollment in GP-IDEA MFCS in Dietetics.* Integration of the molecular, cellular and physiological aspects of macronutrients and energy metabolism in mammalian systems. Dietary energy, carbohydrates, fiber, lipids, proteins, their interactions, metabolic consequences, and major research methodologies. www only. Only one of Diet 558 or NutrS 501 may count toward graduation.

Diet 560. Medical Nutrition and Disease. (3-0) Cr. 3. F.S.SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Pathophysiology of selected acute and chronic disease states and their associated medical problems. Specific attention directed to medical nutrition needs of patients in the treatment of each disease state. www only. Only two of Diet 560 or NutrS 561, 564 may count toward graduation.

Diet 565. Malnutrition in Low-Income Countries. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Identification and assessment of malnutrition in low-income countries. Social, cultural, political, economic, and geographic determinants of malnutrition. Protein-energy malnutrition, vitamin and mineral deficiencies. Intervention approaches; international efforts and local sustainability. www only.

Diet 566. Nutrition Counseling and Education Methods. (2-2) Cr. 3. F.S. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Dual listed with FS HN 466. Application of counseling and learning theories with individuals and groups in community and clinical settings. Includes discussion and experience in building rapport, assessment, diagnosis, intervention, monitoring, evaluation, and documentation. Literature review of specific counseling and learning theories. www only.

Diet 567. Nutrition for Dietitians. (Cross-listed with FS HN). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 360; BBMB 301, undergraduate course in physiology; enrollment in GP-IDEA MFCS in Dietetics.* Study of the current scientific literature to evaluate current trends and issues in nutrition science and Dietetic practice. Emerging areas of research investigating the role of nutrients in health and disease in humans will be explored. Emphasis on the impact of emerging research on nutrition recommendations and interventions designed to promote human health. www only.

Diet 568. Entrepreneurship in Dietetics. (3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Definition and discussion of entrepreneurship and its importance to economic and business environment. www only.

Diet 570. Nutrition and Human Performance. (3-0) Cr. 3. S. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Develop an understanding of nutrition based on knowledge of the biochemical and physiological process and functions of specific nutrients in meeting nutritional requirements. Emphasis on the relationship of optimal nutrition and physical efficiency and performance. www only.

Diet 572. Environmental Scanning and Analysis of Current Issues in Dietetics. (3-0) Cr. 3. S. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Overview of current topics, issues, and trends in Dietetics practice. www only.

Diet 573. Administration of Health Care Organizations. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* A comprehensive review of today's health care institutions and their response to the economics, social, ethical, political, legal, technological, and ecological environments. www only.

Diet 595. Proposal and Grant Writing for the Working Professional. (Cross-listed with FS HN). (1-0) Cr. 1. Alt. F., offered 2009. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Grant proposal preparation experiences including writing and critiquing of proposals and budget planning. Designed for the working professional. www only. Satisfactory-fail only.

Ecology and Evolutionary Biology

www.grad-college.iastate.edu/EEB/

(Interdepartmental Graduate Major)

Supervisory Committee: G.Courtney, Chair; A. Bronikowski; J. Dekker; J. Downing; J. Nason; D. Otis

The ecology and evolutionary biology (EEB) interdepartmental major is offered through a faculty housed in ten departments of the university. Faculty from the departments of Agronomy, Anthropology; Ecology, Evolution and Organismal Biology; Entomology; Geological and Atmospheric Sciences; Horticulture; Mathematics; Natural Resource Ecology and Management; Plant Pathology; and Statistics cooperate to offer courses and research opportunities leading to the M.S. and Ph.D. degrees with a major in ecology and evolutionary biology.

Applicants should have completed an undergraduate or master of science or arts degree in one of the biological, physical, or Mathematical sciences. Applicants also should have taken undergraduate courses in both basic ecology and evolution.

The EEB major is designed for students interested in the study of mechanisms controlling the composition, structure, and functional processes of ecological systems and the mechanisms that regulate the pattern and rate of evolutionary change within and among species.

Cooperating departments offer courses and research opportunities in population, community, and ecosystems ecology; landscape ecology, modeling, and spatial dynamics; systematics, biodiversity, and biogeography; physiological and behavioral ecology; conservation and restoration ecology; agroecology; natural resources ecology and management; evolutionary ecology; population, quantitative and evolutionary genetics; and environmental Statistics, stochastic modeling, and quantitative ecology and evolution. In addition, interdisciplinary courses in ecology and evolution are offered, including a special topics course, a seminar, and an extended field trip.

Students majoring in EEB may prepare themselves for careers focused on basic or applied ecology and evolutionary biology in a variety of settings, including academia, government, industry, and private organizations. Graduates have a broad understanding of ecology and evolutionary biology, experience designing and conducting research, writing grant proposals, and communicating effectively with scientific colleagues at meetings and through publications. All graduates become aware of Societal and ethical issues that surround the discipline.

Information on application procedures, research interests of the faculty, and specific requirements of the major may be obtained from the EEB web site www.grad-college.iastate.edu/EEB/, or by contacting eeboffice@iastate.edu.

Courses for graduate students

EEB 511. Conceptual Foundations in Ecology and Evolutionary Biology. (3-2) Cr. 4. F. *Prereq: Graduate classification.* Introduction to key figures and ideas that have shaped the development of ecology and evolutionary biology. Covers major developments in ecology and evolutionary biology at five levels of biological organization: Genome, Organism, Population, Community, and Ecosystem. Impacts of these developments on current approaches to investigation and argument formulation. Effects of technological advances on the direction of scientific investigations. Introduction to analytical skills important for critical thinking in ecology and evolutionary biology and the impact of accepted lines of scientific reasoning on the objectives and conduct of research, such as explanation and prediction, design of studies as experimentation, and structured or unstructured observation.

EEB 585. Extended Field Trip. (0-6) Cr. 2. Repeatable. S. *Prereq: Graduate classification.* Annual field trip to a region of North America to study the major terrestrial and aquatic ecosystem types of the region. Report required.

EEB 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification and permission of instructor. For students* wishing to conduct in-depth study of a particular topic in ecology and evolutionary biology.

EEB 698. Seminar. (1-0) Cr. 1. Repeatable. F.S. Reports and discussion of recent research and literature.

EEB 699. Research. Cr. arr. Repeatable. F.S.SS. Thesis and dissertation research.

Courses Offered by the Organization for Tropical Studies

ISU graduate students can take courses through the widely recognized Organization for Tropical Studies (OTS) at field sites in Central and South America. Students register for OTS courses and upon successful completion, receive credit from University of Costa Rica which transfers as either OTS 510 or OTS 515. For further information about OTS courses, see www.ots.duke.edu.

For information regarding OTS course offerings, please contact the EEB Program Office at eeboffice@iastate.edu.

OTS 510. Tropical Biology: An Ecological Approach. Cr. 8. This course is designed for students in the early stages of graduate study in biology or a related field, with the goal of training graduate students in research methods by providing intensive field experience in diverse tropical ecosystems.

OTS 515. Topics in Tropical Biology. Cr. 1-8. This course is designated for students enrolled in graduate course offerings through OTS (excluding OTS 510). Examples of graduate courses offered by OTS include Tropical Plant Systematics, Tropical Ecology and Conservation, Molecular Methods in Tropical Ecology, and Tropical Agroecology.

Ecology, Evolution, and Organismal Biology

www.eeob.iastate.edu

Jonathan Wendel, Chair of Department

Distinguished Professors (Emeritus): Tiffany, Ulmer

University Professor: Horner

Professors: Ackerman, L. Clark, W. Clark, Courtney, Danielson, Debinski, Downing, Janzen, Nason, Van der valk, Vleck, Wendel

Professors (Emeritus): Brown, Buttrey, D. Farrar, Jeska, Lersten, Mutchmor, Redmond

Professor (Collaborator): Otis

Associate Professors: Adams, Colbert, Crumpton, Jurik, Moloney, Raich, Wallace, Wilsey

Associate Professors (Emeritus): E. Farrar, Shaw

Associate Professors (Collaborators): Newton, Rosburg

Assistant Professors: Bronikowski, Harpole, Hofmockel, Kelly, Lavrov, Serb, Valenzuela-Castro

Assistant Professors (Adjunct): Bowen, B. Pleasants, J. Pleasants, Roe

Assistant Professors (Collaborators): Koford, Pierce

Lecturers: Folinsbee, Spalding

Undergraduate Study

Within the Biological Sciences, studies of ecology, evolution, and organismal biology are essential in understanding the complex relationships of life on Planet Earth. Ecology focuses on the interactions among organisms as well as the interactions between organisms and their physical environments. Evolutionary theory addresses the origins and interrelationships of species. Organismal biology studies both the diversity of biological organisms and the structure and function of individual organisms.

The EEOB Department offers several undergraduate majors with other departments. Students interested in the areas of ecology, evolution, and organismal biology should major in Biology, Environmental Science, or Genetics. The Biology Major is administered and offered jointly by the EEOB and GDCB departments. The faculty of EEOB, together with those in GDCB and BBMB, administer and offer the Genetics Major. Faculty in EEOB, in cooperation with faculty from other departments on campus, administer and offer the Environmental Science Major. Each of these majors is available through the College of Liberal Arts and Sciences or through the College of Agriculture and Life Sciences. Faculty in the EEOB Department also teach undergraduate courses at Iowa Lakeside Laboratory (see the I*owa Lakeside Laboratory* listing).

The Biology Major, the Environmental Science Major, and the Genetics Major prepare students for a wide range of careers in biological sciences. Some of these careers include conservation of natural resources and biodiversity, human and veterinary medicine, and life science education. These majors are also excellent preparation for graduate study in systematics, ecology, biological diversity, physiology, and related fields. Faculty members in EEOB contribute to the undergraduate courses listed below. The titles and descriptions of these courses are in the Biology section of the catalog.

Biol 101, 110, 111, 155, 173, 204, 211, 211=-L, 212, 212L, 255, 255L, 256, 256L, 258, 265, 307, 312, 313, 313L, 315, 335, 336, 351, 352, 353, 354, 355, 356, 364, 365, 366, 371, 381, 382, 393, 394, 434, 439, 454, 455, 456, 457, 458, 459, 462, 465, 471, 472, 474, 476, 483, 486, 486L, 487, 488, 489, 490, 491, 494, 495, and 498.

Graduate Study

The department offers graduate work leading to both Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees. EEOB graduate students major in one of several interdepartmental majors including Bioinformatics and Computational Biology, Ecology and Evolutionary Biology, Environmental Science, Genetics, Interdisciplinary Graduate Studies, Neuroscience, and Toxicology. The EEOB faculty members are active in the interdepartmental graduate majors and teach a wide range of graduate courses. Faculty research programs cover a wide range of specializations including physiology and physiological ecology; Microbiology; animal behavior; evolutionary genetics of plants and animals; modeling of evolutionary and ecological processes; plant and animal systematics; neurobiology; developmental biology; aquatic and wetland ecology; functional, population, community, landscape, and ecosystem ecology; and conservation biology. For further information on faculty research interests check the EEOB web site (www.eeob.iastate.edu). Some EEOB faculty teach graduate courses at Iowa Lakeside Laboratory. Field Station courses are also available through the Gulf Coast Marine Laboratory and the Organization for Tropical Studies (see the *Biology* listing).

Prospective graduate students need a sound background in the physical and biological sciences, as well as in mathematics and English. Interested students should check the Graduate Program link from the EEOB web site for specific admission procedures and updates. The department and majors require submission of Graduate Record Examination (GRE) aptitude test scores. Subject area GRE scores are recommended. International students whose native language is other than English must also submit TOEFL or IELTS scores with their application.

Students who are enrolled in the interdepartmental graduate majors with EEOB affiliation are required to participate in departmental seminars, to participate in research activities, and to show adequate progress and professional development while pursuing their degree. For both the M.S. and Ph.D. degrees, it is expected that research conducted by the student will culminate in the writing and presentation of a thesis or dissertation. Requirements and guidelines for study are provided by the Graduate College, the EEOB faculty, and the individual student's major professor and Program of Study Committee. General information about graduate study requirements can be found at the web site for the Graduate College and requirements for the interdepartmental majors can be found by following the links from the EEOB web site above. Although not a formal requirement, the EEOB faculty recommends that students pursuing the Ph.D. include teaching experience in their graduate training.

Courses primarily for graduate students, open to qualified undergraduate students

EEOB 501l. Freshwater Algae. (Cross-listed with Ia LL). Cr. 4. SS. Structure and taxonomy of freshwater algae based on field collected material; emphasis on genus-level identifications, habitats visited include lakes, fens, streams, and rivers; algal ecology.

EEOB 507. Advanced Animal Behavior. (3-0) Cr. 3. S. *Prereq: Graduate standing, Biol 354, or permission of instructor.* Analysis of current research in animal behavior. Topics covered may include behavioral ecology, mechanisms of behavior, evolution of behavior, applications of animal behavior to conservation biology, and applications of animal behavior to wild animals in captivity.

EEOB 514. Evolutionary Ecology. (3-0) Cr. 3. F. *Prereq: 589, Biol 315; graduate standing.* Evolution of ecological adaptations at the individual, population, community and landscape levels. Emphasis is on evolutionary mechanisms and adaptive strategies; units and mechanisms of evolution, life history strategies, species interactions and organization of communities, behavior, and patterns of distribution, speciation and macroevolution.

EEOB 531. Conservation Biology. (Cross-listed with A Ecl). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Biol 312; Biol 313 or graduate standing.* Examination of conservation issues from a population and a community perspective. Population-level analysis will focus on the role of genetics, demography, and environment in determining population viability. Community perspectives will focus on topics such as habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology.

EEOB 531l. Conservation Biology. (Cross-listed with Ia LL, A Ecl). Cr. 4. Alt. SS., offered 2010. *Prereq: Ia LL 312l.* Population-and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

EEOB 534. General and Comparative Endocrinology. (3-3) Cr. arr. S. *Prereq: Biol 314.* Dual-listed with Biol 434. Graduate study in conjunction with Biol 434. Chemical integration of vertebrate organisms. The structure, development, and evolution of the endocrine glands and the function and structure of their hormones. Laboratory techniques for studying hormonal phenomena.

EEOB 535. Restoration Ecology. (Cross-listed with EnSci, NREM). (2-3) Cr. 3. F. *Prereq: Biol 366 or 474 or graduate standing.* Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies.

EEOB 535l. Restoration Ecology. (Cross-listed with Ia LL, A Ecl, EnSci). Cr. 4. Alt. SS., offered 2010. *Prereq: A course in ecology.* Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

EEOB 537. Plant Stress Biology. (Cross-listed with Hort, Agron). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 330A or equivalent and BBMB 404-405.* Physiology and molecular biology of plant responses to environmental stress. Emphasis on the role of hormones and hormone interactions in governing stress responses. Lectures are prepared from journal papers that elucidate key mechanisms controlling responses to drought, flooding, salt, nutrient deficiencies, freezing, pathogens and herbivores. Plants studied include genetic model systems and crops of Horticultural and Agronomic value.

EEOB 539. Environmental Physiology. (3-3) Cr. arr. Alt. S., offered 2010. *Prereq: Biol 335 or A Ecl 311, physics recommended.* Dual-listed with Biol 439. Graduate study in conjunction with Biol 439. Physiological adaptations to the environment with emphasis on vertebrates.

EEOB 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BBMB, BCB, B M S, FS HN, Hort, NutrS, VDPAM, NREM, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

EEOB 552. Pteridology. (1-3) Cr. 2. *Prereq: 10 credits in biological sciences.* Morphology, taxonomy, and ecology of the lower vascular plants, with emphasis on ferns.

EEOB 553. Agrostology. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: Biol 366.* Structure, identification, classification, phylogeny, and economic aspects of grasses and related families.

EEOB 555. Bryophyte and Lichen Biodiversity. (Dual-listed with Biol 455.) Cr. 3. Prereq: Biol 212, Biol 212L. Introduction to the biology and ecology of mosses, liverworts, and lichens. Emphasis on identification and diversity of local representatives of these three groups of organisms. Required field trips and service-learning. Nonmajor graduate credit.

EEOB 557. Herpetology. (Cross-listed with A Ecl). (2-3) Cr. 3. F. *Prereq: A Ecl 365, Biol 351.* Dual-listed with Biol 457. Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodilians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

EEOB 558. Ornithology. (Cross-listed with A Ecl). (2-3) Cr. 3. S. *Prereq: A Ecl 365 or Biol 351.* Dual-listed with Biol 458. Biology, ecology, evolution, and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation. Laboratory exercises complement lecture topics, emphasize identification and distribution of Midwest birds, and include field trips.

EEOB 559. Mammalogy. (Cross-listed with A Ecl). (2-3) Cr. 3. S. *Prereq: Biol 351 or A Ecl 365.* Dual-listed with Biol 459. Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. Laboratory focus on identification, distribution, habits, and habitats of mammals.

EEOB 560. Resource Ecology. (2-3) Cr. 3. Alt. S., offered 2010. *Prereq: Biol 212, 212L, 312; Stat 101 or 104 or graduate standing.* Ecological and economical management of sustainable biological resources. Unifying current management concepts and models in wildlife, fisheries, water quality, forestry, recreation, and agriculture. Research problems.

EEOB 561. Plant Diversity and Evolution. (2-6) Cr. 4. *Prereq: 10 credits in biological sciences.* Current concepts of plant phylogeny from the origin of land plants through the origin of angiosperms, with emphasis on morphology, reproduction and evolutionary trends in bryophytes, pteridophytes, and gymnosperms.

EEOB 562. Evolutionary Genetics. (3-0) Cr. 3. Alt. S., offered 2011.*Prereq: Permission of instructor.* Seminar/discussion course covering the genetic basis of evolutionary processes in multicellular organisms.

EEOB 563. Molecular Phylogenetics. (2-3) Cr. 3. F. *Prereq: Biol 313 and 315.* An overview of the theory underlying phylogenetic analysis and the application of phylogenetic methods to molecular datasets. The course emphasizes a hands-on approach to molecular phylogenetics and combines lecture presentations with computer exercises and discussion of original scientific literature.

EEOB 564. Wetland Ecology. (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: 15 credits in biological sciences.* Ecology, classification, creation and restoration, and management of wetlands. Emphasis on North American temperate wetlands.

EEOB 564l. Wetland Ecology. (Cross-listed with Ia LL, EnSci). Cr. 4. SS. *Prereq: Ia LL 312l.* Ecology, classification, creation, restoration, and management of wetlands. Field studies will examine the composition, structure and functions of local natural wetlands and restored prairie pothole wetlands. Individual or group projects.

EEOB 565. Morphometric Analysis. (3-2) Cr. 4. Alt. S., offered 2010. *Prereq: Stat 401.* Dual-listed with Biol 465. A comprehensive overview of the theory and methods for the analysis of biological shape with emphasis on data acquisition, standardization, statistical analysis, and visualization of results. Methods for both landmark and outline data will be discussed.

EEOB 566. Molecular Evolution. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Permission of instructor.* Seminar/discussion course covering the fundamentals of molecular evolution. Emphasis is placed on original scientific literature and current topics, including rates and patterns of genetic divergence; nucleotide and allelic diversity; molecular clocks; gene duplications; genome structure; organellar genomes; polyploidy; transposable elements; and modes and mechanisms of gene and genome evolution.

EEOB 567. Empirical Population Genetics. (3-0) Cr. 3. F. *Prereq: Permission of instructor.* An overview of fundamental population genetic theory and the ecological and evolutionary factors underlying the distribution of genetic variation within and among natural populations. Emphasis on the analysis of inbreeding, breeding systems, parentage, relatedness, spatial autocorrelation, effective population size, hierarchial population models, and phylogeography.

EEOB 568. Advanced Systematics. (Cross-listed with Ent). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Permission of instructor.* Principles and practice of systematic biology; taxonomy, nomenclature and classification of plants and animals; sources and interpretation of systematic data; speciation; fundamentals of phylogenetic systematics.

EEOB 569. Biogeography. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 315 or equivalent; permission of instructor.* Principles underlying the geographic distribution of organisms throughout the world; biological influences of geological history and tectonic movements; role of climate, migration, dispersal, habitat, and phylogeny on past and present organismal distribution patterns; biogeographic methods.

EEOB 570. Landscape Ecology. (Cross-listed with A Ecl). (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: Permission of instructor; EEOB 588; a course in calculus.* The study of ecological and evolutionary processes within a spatial context with emphasis on behavior, population, and community dynamics.

EEOB 573. Techniques for Biology Teaching. (Cross-listed with Ia LL, A Ecl). Cr. arr. Repeatable. SS. The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.
A. Animal Biology (Same as A Ecl 573A)
B. Plant Biology
C. Fungi and Lichens
D. Aquatic Ecology
E. Prairie Ecology
F. Wetland Ecology
G. Limnology (Same as A Ecl 573G)
H. Animal Behavior (Same as A Ecl 573H)
I. Insect Ecology
J. Biology of Invertebrates
K. Non-invasive Use of Living Organisms
W. Project WET (Same as A Ecl 573W)

EEOB 575. Field Mycology. (2-6) Cr. 4. Repeatable. SS. *Prereq: 5 credits in biology.* Collection and identification of fungi and relation of their occurrence to environmental factors. Field trips.

EEOB 575l. Field Mycology. (Cross-listed with Ia LL). Cr. 4. Alt. SS., offered 2010. Identification and classification of the common fungi; techniques for identification, preservation, and culture practiced with members of the various fungi groups.

EEOB 576. Functional Ecology. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312.* Dual-listed with Biol 476. The nature of adaptations to physical and biotic environments. Biophysical, biomechanical, and physiological bases of the structure, form, growth, distribution, and abundance of organisms.

EEOB 580l. Ecology and Systematics of Diatoms. (Cross-listed with Ia LL). Cr. 4. SS. Field and laboratory study of freshwater diatoms; techniques in collection, preparation, and identification of diatom samples; study of environmental factors affecting growth, distribution, taxonomic characters; project design and execution including construction of reference and voucher collections and data organization and analysis.

EEOB 581. Environmental Systems I: Introduction to Environmental Systems. (Cross-listed with EnSci). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including biology and chemistry.* Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

EEOB 584. Ecosystem Ecology. (Cross-listed with EnSci). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Combined 12 credits in biology and chemistry.* Introduction to the study of ecosystems and the factors that influence their properties and dynamics. Conceptual foundations for ecosystem studies. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems.

EEOB 585. Advanced Community Ecology. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: Biol 312.* Factors controlling species diversity, species abundance,

and the structure and function of communities in space and time. Relationships between species diversity and ecosystem process rates and community stability.

EEOB 586. Aquatic Ecology. (Cross-listed with EnSci). (3-0) Cr. 3. F. *Prereq: EnSci 301 or 312 or 381 or 402.* (Dual-listed with Biol 486.) Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine and wetland ecology.

EEOB 586L. Aquatic Ecology Laboratory. (Cross-listed with EnSci). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in 586.* (Dual-listed with Biol 486L.) Field trips and laboratory exercises to accompany 586. Hands-on experience with aquatic research and monitoring techniques and concepts.

EEOB 587. Microbial Ecology. (Cross-listed with EnSci, Micro). (3-0) Cr. 3. *Prereq: 6 credits in biology* and six credits in chemistry. Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

EEOB 589. Population Ecology. (Cross-listed with A Ecl). (2-2) Cr. 3. F. *Prereq: Biol 312, Stat 101 or 104, a course in calculus, or graduate standing.* (Dual-listed with Biol 489.) Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

EEOB 590. Special Topics. Cr. arr. Repeatable. *Prereq: 10 credits in biology, permission of instructor.*
A. Current Topics in Ecology
B. Current Topics in Evolutionary Biology
C. Current Topics in Organismal Biology
I. Iowa Lakeside Laboratory (Cross-listed with Ia LL 590I, A Ecl 590I, Anthr 590I.)

EEOB 596. Ecology and Society. (Cross-listed with Phil). (3-0) Cr. 3. *Prereq: Graduate classification in biological or environmental sciences/studies with at least one course in ecology.* Analysis of conceptual and methodological debates in ecology. Historical development of competing research traditions and Philosophies. Topics include i) methodological issues in ecological science, ii) conceptual issues in theoretical ecology, iii) conceptual issues in applied ecology, iv) relation of ecology to environmental and social issues.

EEOB 599. Creative Component. Cr. arr. Research toward nonthesis master's degree.

Courses for graduate students

EEOB 611. Analysis of Populations. (Cross-listed with A Ecl). (2-2) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 312; Stat 401; a course in calculus.* Quantitative techniques for analyzing vertebrate population data to estimate parameters such as density and survival. Emphasis on Statistical inference and computing.

EEOB 641. General Mycology. (2-6) Cr. 4. F. *Prereq: Pl P 407.* First semester of a full-year course. Taxonomy, morphology, ecology, and phylogeny of slime molds and fungi (ooymcetes, chytridiomycetes, zygomycetes, ascomycetes, basidiomycetes, and fungi imperfecti).

EEOB 642. General Mycology. (2-6) Cr. 4. S. *Prereq: 641.* Continuation of 641. Taxonomy, morphology, ecology, and phylogeny of slime molds and fungi (oomycetes, chytridiomycetes, zygomycetes, ascomycetes, basidiomycetes, and fungi imperfecti).

EEOB 679. Light Microscopy. (Cross-listed with GDCB, Micro). (2-9) Cr. 5. Alt. F., offered 2010. *Prereq: Permission of instructor.* Current theories encompassing light optics and their applications for specimen preservation, paraffin and resin sectioning, general staining, histochemistry, cytophotometry, immunocytochemistry, autoradiography, image digitization, processing and presentation, and digital macro- and micrography. Limit of 10 students.

EEOB 680. Scanning Electron Microscopy. (Cross-listed with GDCB, Micro). (2-9) Cr. 5. Alt. F., offered 2009. *Prereq: Permission of instructor.* Current theories encompassing scanning electron optics and their applications for high and low vacuum microscopy, specimen chemical and cryopreservation methods, x-ray microanalysis, backscattered and topographic imaging, image digitization, processing and presentation. Limit of 10 students.

EEOB 681. Transmission Electron Microscopy. (Cross-listed with GDCB, Micro). (2-9) Cr. 5. Alt. S., offered 2011. *Prereq: GDCB 679 and permission of instructor.* Current theories encompassing electron optics and their applications for chemical and physical specimen preservation, ultramicrotomy, general staining and cytochemistry, immunocytochemistry, autoradiography, negative staining and shadowing, x-ray microanalysis, image digitization, processing and presentation.

EEOB 698. Seminar. Cr. 1. Repeatable. Meetings of graduate students and faculty to discuss recent literature and problems under investigation.

EEOB 699. Research. Cr. arr. Repeatable. Research for thesis or dissertation. Satisfactory-fail only.
I. Iowa Lakeside Laboratory. (Cross-listed with Ia LL 699I)

Economics

www.econ.iastate.edu

J. Arne Hallam, Chair of Department

Distinguished Professor: W. Huffman

Distinguished Professors (Emeritus): Baumel, Fuller, Harl, Johnson, Ladd, Luckett

University Professors: Lapan, Orazem

University Professor (Emeritus): Wisner

Professors: Babcock, Beghin, Choi, Deiter, Duffy, Edelman, Edwards, Garasky, Ginder, Hallam, Hayes, D. Hennessy, Herriges, Hoffman, Jensen, Jolly, Kliebenstein, Kling, Lawrence, Lence, MacDonald, Miranowski, Moschini, Otto, Schroeter, Tesfatsion, Wang

Professors (Emeritus): J. Adams, R. Adams, Faden, Falk, Fletcher, Hayenga, Julius, Kolmer, Mattila, Meyer, Meyers, Paulsen, Prescott, Starleaf, Stephenson, Stone, Vandewetering

Associate Professors: Bhattacharya, Bunzel, Frankel, Gallagher, Kreider, Quirmbach, Rosenblat, Singh, Weninger, Zheng

Associate Professor (Emeritus): Doak

Assistant Professors: Hart, Oviedo, Zhylyevskyy

Assistant Professors (Adjunct): H. Hennessy, S. Huffman

Senior Lecturers: Alexander, Luvaga

Lecturers: McCullough, Rajan, Roy, Wohlgemuth

Undergraduate Study

The department offers work for the degrees of bachelor of science with a major in agricultural business, bachelor of science with a major in business economics, and bachelor of science with a major in economics. For further discussion of programs in agricultural business, see the statement below under College of Agriculture. For programs in business economics, see the statement below under College of Business. For programs in economics, see the statement below under College of Liberal Arts and Sciences. Visit our web site at www.econ.iastate.edu.

Graduates of the Department of Economics have unique skills that distinguish them from other graduates. They have the ability to think and reason clearly, and can address complex issues using tools and decision making models of economics, mathematics, statistics, as well as concepts from the biological, physical, and social sciences. Graduates develop human relations skills that are essential in the work place and the community. They are able to communicate economic and business concepts to other professionals, collective organizations, governments, and the general public using a variety of means. Graduates understand the interaction of technology, human activity, and the environment. They are able to apply concepts associated with making "optimal" choices among economic alternatives. Graduates are prepared for graduate work in law, economics, and business, as well as the world of work, having learned tools of critical analysis and skills essential to getting and keeping meaningful employment.

College of Agriculture

For the undergraduate curriculum in agricultural business, see *College of Agriculture, Curricula.*

The agricultural business curriculum prepares students for advanced studies and for careers in agricultural finance, management in agricultural supply and marketing industries, commodity merchandising and research, business research and management, farm and ranch operations, commercial farm management and appraisal, agricultural sales and marketing, agricultural reporting and public relations, agricultural extension, international activities, and government service. A major in agricultural business with a minor in economics is not permitted; however, a double major in agricultural business and economics is permitted. A minor in agricultural business will be offered pending administrative approval.

College of Business

For the undergraduate curriculum in business economics, see *College of Business, Curricula.*

The major in business economics provides a high-quality education with a balanced emphasis in both business and economics. Graduates from the business economics major possess a unique mix of analytical and applied business skills well-suited for employment in upper level management and public service positions. Graduates also have solid preparation for graduate studies in law, economics, and in Master of Business Administration (MBA) programs. A double major in business economics and agricultural business is not permitted; a double major in business economics and economics is not permitted, either. A major in business economics with a minor in economics is not permitted.

College of Liberal Arts and Sciences

Candidates for the bachelor of science degree with a major in economics must fulfill requirements established by the College of Liberal Arts and Sciences. (For details of undergraduate curricula in liberal arts and sciences, see *College of Liberal Arts and Sciences, Curriculum.*) The economics curriculum prepares students for advanced studies, professional degrees such as law and business administration, and for careers in finance, business and economic research, management, insurance, brokerage, real estate, labor relations, international development, and government service.

Students majoring in economics are required to take either Math 165 and 166 or Math 165 and Econ 207 or Math 160 and Econ 207 within the mathematical and natural sciences group. Students who plan to take postgraduate work in economics should take Math 165 and 166 for the above sequence. Additional requirements are Stat 226 and 326. Twenty-eight credits in economics are required for the bachelor of science degree. Students must complete the following courses in economics: Econ 101, 102, 301, 302, 371, three Econ courses numbered 400-489, plus one additional Econ course selected from an approved departmental list. Economics majors must maintain a C average in 101, 102, 301, and 302, with no grade lower than a C-.

Optimal progress for an economics major would be to complete the principles sequence, Econ 101 and 102, in the freshman year. Math 165, 166, or Math 165, Econ 207, or Math 160, Econ 207 should also be completed in the freshman year, followed by the intermediate theory sequence, Econ 301 and 302, in the sophomore year. Stat 226 and 326 are recommended in the sophomore year.

A minor in economics is offered. Courses to be included in the minimum of 15 hours are Econ 101, 102, and 301.

Communication Proficiency Requirement: The major in economics requires a grade of C or better in each of the following English courses: 150, 250 (or 250H), and 314.

The department participates in the interdepartmental programs in international studies and women's studies.

Learner Outcome Goals

In general, our goal is that all Department of Economics graduates at Iowa State are able to use economic reasoning to think critically; to make decisions and to communicate effectively; to be ethical; to respect the environment, and to be multi-culturally and internationally aware.

Specifically, with respect to:

1. Critical Thinking, all graduates of the Department of Economics are able to:
   a) distinguish factual statements from opinions or value judgements
   b) use scientific methods to analyze and interpret data
   c) distinguish causal relationships from correlations
   d) determine the accuracy of statements
   e) understand the usefulness of abstractions and models
   f) distinguish simplifying and critical assumptions from unnecessary details
   g) objectively critique competing viewpoints to make reasoned judgements
2. Economic Reasoning:
   a) distinguish positive (what is) and normative (what should be) economics
   b) determine the opportunity cost of alternatives
   c) apply the concepts of comparative advantage, specialization, and exchange to analyze resource allocation issues
   d) identify the conditions under which markets allocate resources efficiently or markets fail
   e) apply marginal economic analysis to solve problems
   f) conduct comparative static analyses
   g) pose and test hypotheses
3. Decision Making/Problem Solving:
   a) work effectively alone and in teams to solve problems
   b) use scientific methods to identify optimal choices among economic alternatives
   c) identify decision-makers, objectives, choice variables, incentives, and constraints
   d) identify and apply the solution technique best suited for the specific problem
   e) understand how conclusions depend on assumptions
4. Communications:
   a) communicate economic and business concepts to professionals, organizations, governments, and the general public
   b) obtain information by accessing electronic or traditional media, listening, or by observation
   c) use computer and statistical methods to organize and analyze data
   d) write clearly and effectively
   e) speak clearly and persuasively
   f) prepare and present visual information effectively
5. Ethics:
   a) develop ethical perspectives and sense of moral responsibility and values
   b) discuss contemporary ethical and moral issues in professional and private life
   c) critically evaluate their own arguments and those of others
6. Environment Awareness:
   a) understand the physical and biological properties of the environment and ecological systems
   b) understand how economic activity, such as business or agriculture, impacts the environment
7. International/Multi-Cultural Awareness:
   a) understand cultural diversity within our own nation
   b) understand cultural diversity around the world
   c) know the different economic or agricultural systems in other countries
   d) have human relation skills essential in the work place and the community

Graduate Study

The department offers work toward the degrees master of science and doctor of philosophy with majors in economics and agricultural economics. The department also offers minors to students with majors in other departments.

Students do not need to have an undergraduate major in economics or agricultural economics in order to qualify for graduate work in the department. However, students must have completed undergraduate coursework in macroeconomics, microeconomics, statistics, calculus, and matrix algebra. Some background in Math courses emphasizing logic and proofs is preferred, particularly for the Ph.D.

Candidates for the degree master of science (thesis option) are required to complete satisfactorily 30 credits of acceptable graduate work, including preparation of a thesis.

Candidates for the degree master of science (non-thesis option) may fulfill requirements by satisfactorily completing 32 credits of coursework, including preparation of a creative component.

Programs of study for the doctorate are organized by each student in consultation with the major professor and the individual's committee. Students may select fields of concentration from the following: agricultural economics, financial economics, industrial organization, international economics, human resources, macroeconomics, and environmental and resource economics.

Each student must complete advanced courses in microeconomic and macroeconomic theory, quantitative methods and econometrics, and two fields from the list above. Students must demonstrate competence in theory by passing qualifying examinations. Students must also participate in workshops.

With the cooperation of the College of Law at Drake University, a joint degree consisting of doctor of jurisprudence and master of science in agricultural economics or economics may be pursued concurrently. Other cooperative programs of study may be arranged with the University of Iowa College of Law or other recognized institutions.

The department cooperates in the interdepartmental graduate majors in transportation and sustainable agriculture, and the interdepartmental minor in gerontology.

Courses primarily for undergraduate students

Econ 101. Principles of Microeconomics. (3-0) Cr. arr. F.S.SS. Resource allocation, opportunity cost, comparative and absolute advantage. Supply and demand. Marginal analysis. Theories of production and consumption, pricing, and the market system. Perfect and imperfect competition and strategic behavior. Factor markets. Present discounted value. Recitation section required for 4 credits.

Econ 101H. Principles of Microeconomics. (3-0) Cr. 3. F. Resource allocation, opportunity cost, comparative and absolute advantage. Supply and demand. Marginal analysis. Theories of production and consumption, pricing, and the market system. Perfect and imperfect competition and strategic behavior. Factor markets. Present discounted value. Open only to honors students.

Econ 101L. Laboratory in Principles of Microeconomics. (0-2) Cr. 1. F. *Prereq: Concurrent enrollment in the appropriate section of 101.* Discussion of material typically covered in Econ 101. Application of economic principles to real world problems. Economic principles and basic business management concepts applied to decision-making in agribusiness operations.

Econ 102. Principles of Macroeconomics. (3-0) Cr. 3. F.S.SS. *Prereq: 101 recommended.* Measurement of macro variables and general macro identities. Classical models of full employment. Production and growth. Savings and investment. Employment and unemployment. Money, inflation, and price levels. Operation of the U.S. banking system. Fiscal and monetary policy. Elements of international finance.

Econ 102H. Principles of Macroeconomics. (3-0) Cr. 3. S. *Prereq: 101.* Measurement of macro variables and general macro identities. Classical models of full employment. Production and growth. Savings and investment. Employment and unemployment. Money, inflation, and price levels. Operation of the U.S. banking system. Fiscal and monetary policy. Elements of international finance. Open only to honors students.

Econ 110. Orientation in Agricultural Business. (1-0) Cr. 0.5. F. Orientation course for freshman and new transfer students in agricultural business. Satisfactory-fail only.

Econ 207. Applied Economic Optimization. (2-2) Cr. 3. S. *Prereq: Math 151, 160, 165 or equivalent.* Application of linear algebra, calculus and unconstrained and constrained optimization techniques to economic problems. Learning outcomes include the ability to (i) identify the objective, decision variables and constraints in economic decision problems, (ii) represent elements of an economic problem in simple mathematical models, (iii) identify and apply mathematical tools that can be used to solve the problems, (iv) identify the strengths and limitations of the solution method, and (v) interpret the economic meaning and implications of the solution.

Econ 230. Farm Business Management. (2-2) Cr. 3. F.S. *Prereq: 101; Acct 284.* Business and economic principles applied to decision making and problem solving in the management of a farm business. Cash flow, partial, enterprise, and whole farm budgeting. Information systems for farm accounting, analysis, and control. Obtaining and managing land, capital, and labor resources. Alternatives for farm business organization and risk management.

Econ 235. Introduction to Agricultural Markets. (3-0) Cr. 3. F.S. *Prereq: 101.* Basic concepts and economics principles related to markets for agricultural inputs and products. Overview of current marketing problems faced by farms and agribusinesses, farm and retail price behavior, structure of markets, food marketing channels, food quality and food safety, and the role of agriculture in the general economy. The implications of consumer preferences at the farm level. Introduction to hedging, futures, and other risk management tools.

Econ 292. Career Seminar. (1-0) Cr. 1. F. *Prereq: Classification in economics or agricultural business.* Career opportunities in the various industries and

government institutions. Required training and skills needed to perform successfully in different types of careers. Factors important in finding and obtaining employment either before or after graduation including personal resumes, interviewing, and letter writing.

Econ 297. Internship. Cr. 2. Repeatable. F. *Prereq: Permission of instructor and classification in agricultural business or economics.* Students complete a research report, based on their internship or approved work experience, that examines chosen topics in management, marketing or finance. No more than 4 credits of Econ 297 may be applied toward graduation. Satisfactory-fail only.

Econ 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Econ 301. Intermediate Microeconomics. (3-0) Cr. arr. F.S.SS. *Prereq: 101; Math 160 or 165.* Theory of consumer and business behavior; optimal consumption choices and demand; theory of firm behavior; costs, production, and supply; competitive and imperfectly competitive markets; theory of demand for and supply of factors of production; general equilibrium analysis. Recitation required for 4 credits. Nonmajor graduate credit.

Econ 302. Intermediate Macroeconomics. (3-0) Cr. 3. F.S. *Prereq: 101, 102; Math 160 or 165.* Theory of income, employment, interest rates, and the price level; fiscal and monetary policy; budget and trade deficits; money and capital inflows, interest rates, and inflation. Nonmajor graduate credit.

Econ 308. Agent-Based Computational Economics. (3-0) Cr. 3. *Prereq: 101.* Computational study of economies as evolving systems of autonomous interacting agents. Key ideas from game theory and complex adaptive systems theory for modeling the adaptation, learning, and co-evolution of economic agents in decentralized market economies. Evolution of behavioral norms and interaction networks. Building agent-based computational laboratories for the experimental study of market protocols and agent learning processes. Illustrative economic applications (e.g., financial markets, labor markets, agricultural markets, electricity markets, auction markets, automated internet markets, collective usage of common-pool resources). Nonmajor graduate credit.

Econ 312. History of Economic Thought. (3-0) Cr. 3. S. *Prereq: 101.* The logic and explanatory value of received economic doctrines since the middle of the eighteenth century. The reflection of past economic doctrines in contemporary theory and policy. Discussion of major works by Smith, Ricardo, Mill, Marx, Marshall, Walras, Wicksell, and Keynes.

Econ 320. Labor Economics. (3-0) Cr. 3. F. *Prereq: 101.* Survey of contemporary labor market problems and public policy toward labor. Economic analysis of topics such as labor supply and demand, work incentives and compensation, transfer programs, education and training, mobility, minimum wages, unions, working conditions, benefits, discrimination, unemployment, wage differentials across regions, and labor markets in other countries. Nonmajor graduate credit.

Econ 321. Economics of Discrimination. (Cross-listed with W S). (3-0) Cr. 3. F. *Prereq: 101.* Economic theories of discrimination. Analysis of the economic problems of women and minorities in such areas as earnings, occupations, and unemployment. Public policy concerning discrimination. Poverty measurement and antipoverty programs in the U.S. Nonmajor graduate credit.

Econ 325. Biorenewable Systems. (Cross-listed with A E, An S, TSM, Agron, BusAd). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing. Counts as a general elective course for majors in agricultural business, economics, and business economics.

Econ 332. Cooperatives. (3-0) Cr. 3. S. *Prereq: 101.* Survey of cooperative activities with emphasis on agricultural cooperatives, types of cooperatives, methods of organization and operation, principles, legal and tax aspects, cooperative finance, economic possibilities, and limitations of cooperation. Students will learn how to work together in teams to solve problems while role playing directors of cooperative boards. Nonmajor graduate credit.

Econ 333. Advanced Farm Business Management. (3-2) Cr. 3-4. F. *Prereq: 230.* Effective use of strategic planning, decision methods, and computer assistance for solving farm problems. Applications of economic and management theory to analyze farm business decisions using efficiency measures to assess current resource use and direct the farm business analysis, planning, and tax process. Computers as aids in the decision process. Three credits available only to students enrolled in AgPAQ. Laboratory required for 4 credits. Nonmajor graduate credit.

Econ 334. Entrepreneurship in Agriculture. (3-0) Cr. 3. *Prereq: 101.* Introduction to the process of entrepreneurship within the agricultural and food sectors. Emphasis on opportunity recognition and assessment, resource acquisition and feasibility analysis for both private and social enterprises. Students will develop a comprehensive feasibility study for a new business or non-profit organization.

Econ 336. Agricultural Selling. (3-0) Cr. 3. F. *Prereq: 101.* Principles of selling with application to agricultural and food related businesses. Attitudes, value systems, and behavioral patterns that relate to agricultural sales. Electronic marketing, selling strategies, preparing for sales calls, making sales presentations, handling objections, and closing sales. Analysis of the buying or purchasing process. Evaluation of agri-selling as a possible career choice.

Econ 338. Topics in Agricultural Marketing. Cr. arr. *Prereq: 101, 235 recommended for topics B and C.* A given topic can be taken only once. A hands-on application of economic concepts and principles to agricultural commodity markets, marketing methods, risk management, and related agribusiness decisions.
A. Dairy marketing. 2 cr.
B. Livestock marketing. 1 cr.
C. Grain marketing. 1 cr.

Econ 344. Public Finance. (3-0) Cr. 3. S. *Prereq: 101.* The economic role of governments in market economies. Public goods, externalities, income distribution, and income maintenance programs. The effect of taxes on economic behavior, descriptions of the structure of the principal U.S. taxes, and current reform proposals. Nonmajor graduate credit.

Econ 353. Money, Banking, and Financial Institutions. (3-0) Cr. 3. F.S.SS. *Prereq: 101, 102.* Theoretical and applied analysis of money, banking, and financial markets; interest rates and portfolio choice; the banking industry in transition; the money supply process; the Federal Reserve System and the conduct of monetary policy; macro implications of monetary policy; international finance.

Econ 355. International Trade and Finance. (3-0) Cr. 3. F.S. *Prereq: 101, 102.* Explanations of causes of international trade and the impact of trade on welfare and employment patterns. Analysis of government policies towards trade, such as tariffs, quotas, and free trade areas. Theory of balance of payments and exchange rate determination, and the role of government policies. Examination of alternative international monetary arrangements. Nonmajor graduate credit.

Econ 362. Applied Ethics in Agriculture. (Cross-listed with Soc). (3-0) Cr. 3. F. *Prereq: Econ 101 or Soc 130 or Soc 134, junior or senior status in the College of Agriculture and Life Sciences.* Identify major ethical issues and dilemmas in the conduct of agricultural and agribusiness management and decision making. Discuss and debate proper ethical behavior in these issues and situations and the relationship between business and personal ethical behavior.

Econ 370. Comparative Capitalism and Economic Transitions. (3-0) Cr. 3. F. *Prereq: 101, 102.* Theories of capitalism and the economics of transition from a planned to a market economy; the role and the creation of economic institutions supporting different economic systems. An examination of recent experiences of Eastern European countries, the former Soviet Union, China, the European Union, and the United States.

Econ 371. Introductory Econometrics. (4-0) Cr. 4. F.S. *Prereq: 301, 302 or 353, Stat 326.* Introduction to the models and methods used to estimate relationships and test hypotheses pertaining to economic variables. Simple and multiple regression analysis; stochastic regressors; heteroskedasticity; autocorrelation; measurement error; simultaneous equations. Nonmajor graduate credit.

Econ 376. Rural, Urban and Regional Economics. (Cross-listed with C R P). (3-0) Cr. 3. F.S. *Prereq: 101.* Firm location with respect to regional resources, transport, scale economies, externalities, and policies. Measures of local comparative advantage and specialization. Spatial markets. Population location considering jobs, wages, commuting, and local amenities. Business, residential, and farm land use and value. Migration. Other topics may include market failure, regulation, the product cycle, theories of rural and urban development, developmental policy, firm recruiting, local public goods and public finance, schools, poverty, segregation, and crime. Nonmajor graduate credit.

Econ 378. Economics of Aging. (Cross-listed with HD FS, Geron). (3-0) Cr. 3. S. *Prereq: 3 credits in principles of economics and 3 credits in human development and family studies.* Economic status of the aging, retirement planning and the retirement decision, role of Social Security, public transfer programs for the elderly, intrafamily transfers to/from the elderly, private pensions, financing medical care and housing for the elderly, prospects and issues for the future.

Econ 380. Environmental and Resource Economics. (Cross-listed with Env S). (3-0) Cr. 3. F. *Prereq: 101.* Natural resource availability, use, conservation, and government policy, including energy issues. Environmental quality and pollution control policies.

Econ 385. Economic Development. (3-0) Cr. 3. S. *Prereq: 101, 102.* Current problems of developing countries, theories of economic development, agriculture, and economic development, measurement and prediction of economic performance of developing countries, alternative policies and reforms required for satisfying basic needs of Third World countries, interrelationships between industrialized countries and the developing countries, including foreign aid. Nonmajor graduate credit.

Econ 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Econ 401. Topics in Microeconomics. (3-0) Cr. 3. *Prereq: 301, Stat 226.* Advanced treatment of selected topics from one or more of the following areas: household production models, factor markets, game theory and imperfect competition, general equilibrium, intertemporal choice, asset markets, income distribution, externalities and public goods, etc. Nonmajor graduate credit.

Econ 402. Topics in Macroeconomics. (3-0) Cr. 3. *Prereq: 301, 302, Stat 226.* Advanced treatment of selected topics from one or more of the following areas: business cycle theory, growth theory, fiscal and monetary policy, coordination issues, open economy macroeconomics, and financial economics. Nonmajor graduate credit.

Econ 415. Firms, Markets and Industry Structure. (2-2) Cr. 3. F.S. *Prereq: 301.* The theory of the firm; determinants of firm boundaries; firm behavior; perfectly competitive markets; welfare and market efficiency;

monopoly and monopsony; price discrimination; oligopoly and oligopsony; strategic market behavior. Nonmajor graduate credit.

Econ 416. Industrial Organization. (3-0) Cr. 3. F. *Prereq: 301, 415.* Game theoretic approaches to competition and strategizing; spatial competition; research and development; entry deterrence; the economics of regulation. Nonmajor graduate credit.

Econ 431. Managerial Economics. (3-0) Cr. 3. S. *Prereq: 301.* Theory of the firm; organizational incentives and efficiency; moral hazard; role of information and decision making under uncertainty; ownership and control; business investment. Nonmajor graduate credit.

Econ 437. Commodity Marketing and Risk Management. (3-0) Cr. 3. S. *Prereq: 235, 301, Stat 326.* The purpose and performance of commodity markets. How commodity marketing institutions function. Merchandising arrangements. Distinguishing features of agricultural commodities. Hedging, arbitrage, and speculation in commodity spot, forward, futures, and options markets. Valuation theory. Nonmajor graduate credit.

Econ 455. International Trade. (3-0) Cr. 3. S. *Prereq: 301.* Rigorous treatment of theories of international trade and international factor movements. Examination of the impact of trade and labor migration on domestic and world welfare and on the distribution of income. Theoretical analysis of government policies towards trade and factor movements, including quotas, tariffs, free trade areas and immigration restrictions. Discussion of contemporary issues and controversies concerning globalization, including multinational firms and labor migration. Nonmajor graduate credit.

Econ 457. International Finance. (3-0) Cr. 3. F. *Prereq: 302.* National income accounting and balance of payments; foreign exchange rates and exchange rate markets; money, interest rates, and exchange rate determination; prices, exchange rates, and output in the short run; international monetary arrangements; fixed versus flexible exchange rates; optimal currency areas; international capital flows; currency and financial crises in emerging markets. Nonmajor graduate credit.

Econ 458. Economic Systems for Electric Power Planning. (Cross-listed with E E). (3-0) Cr. 3. *Prereq: E E 303 or Econ 301.* Evolution of electric power industry. Power system operation and planning and related information systems. Linear and integer optimization methods. Short-term electricity markets and locational marginal prices. Risk management and financial derivatives. Basics of public good economics. Cost recovery models including tax treatment for transmission investments. Nonmajor graduate credit.

Econ 460. Agricultural, Food, and Trade Policy. (Dual-listed with 560). (3-0) Cr. 3. S. *Prereq: 301 or 501.* Description and analysis of economic problems of U.S. agriculture. Explanation and economic analysis of government policies and programs to develop agriculture, conserve agricultural resources, address consumer food concerns, stabilize farm prices, and raise farm incomes. The influence of macropolicy, world economy, and international trade on U.S. agriculture. Nonmajor graduate credit.

Econ 466. Agricultural Finance. (3-0) Cr. 3. S. *Prereq: 301, Stat 226, Fin 301 and Econ 353 (recommended).* Financial analysis of agricultural businesses; liquidity, capital structure, and growth and risk of agricultural firms; capital budgeting methods; analysis of land investments, leasing, and costs of credit; financial intermediation and major financial institutions for agriculture; borrower-lender relationships, and asset-liability management techniques by financial intermediaries; public policies affecting agricultural credit markets. Nonmajor graduate credit.

Econ 480. Intermediate Environmental and Resource Economics. (Dual-listed with 580). (3-0) Cr. 3. *Prereq: 301.* Theories of natural resource utilization and allocation. Externalities, public goods, and environmental quality. Planning natural resource use and environmental quality. Methodologies for analyzing natural resource and environmental problems. Nonmajor graduate credit.

Econ 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or senior classification, 14 credits in economics.* No more than 9 credits of Econ 490 may be used toward graduation. Satisfactory-fail only.
E. Entrepreneurship
H. Honors

Econ 492. Graduating Senior Survey. (1-0) Cr. R. F.S. *Prereq: Graduating senior.* Final preparations for graduation. The final stages of job searching, interviewing, letter writing, and resume preparation. Outcomes assessment information from graduating seniors including opinion surveys, instructor/advisor/course evaluations, exit interviews, student accomplishment surveys, job placement surveys, and comprehensive skills examinations. Departmental recognition of graduating seniors. Life as an alumnus - expectations and obligations. Convocation and commencement information. Satisfactory-fail only.

Econ 496. Economics Travel Course. Cr. arr. Repeatable. *Prereq: Sophomore status; permission of instructor.* Tour and study of international agricultural and/or nonagricultural economies, markets, and institutions. Locations and duration of tours will vary. Limited enrollment.

Econ 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

Econ 500. Quantitative Methods in Economic Analysis I. (4-0) Cr. 4. F. *Prereq: 301, 1 year of calculus, Stat 401, and permission of Director of Graduate Education.* Economic applications of selected mathematical and statistical concepts: linear models and matrix algebra; differential calculus and optimization; integral calculus and economic dynamics; probability distributions, estimation, and hypothesis testing in the analysis of economic data.

Econ 501. Microeconomics. (4-0) Cr. 4. F. *Prereq: 301, credit or enrollment in 500 or equivalent background in calculus and statistics.* The theory of the consumer, theory of the firm, perfect and imperfect competition, welfare economics, and selected topics in general equilibrium and uncertainty. This is a Master's level course.

Econ 502. Macroeconomics. (4-0) Cr. 4. F. *Prereq: 302, credit or enrollment in 500 or equivalent background in calculus and statistics.* Models of aggregate supply and demand, theories of consumption and investment, money supply and demand, inflation, rational expectations, stabilization policy, financial markets, and international finance. This is a Master's level course.

Econ 509. Applied Numerical Methods in Economics. (2-2) Cr. 3. *Prereq: 500, 501; or 600, 601.* Use of numerical techniques to solve economic problems. Numerical differentiation and integration numeric solutions of systems of equations, static and dynamic optimization problems including unconstrained optimization, maximum likelihood methods, general nonlinear programming methods, dynamic programming and optimal control, numerical methods for solving functional equations.

Econ 520. Labor Supply and Human Capital formation. (3-0) Cr. 3. *Prereq: 501 or 601.* Labor supply decisions and empirical analysis for agricultural operators and other self-employed and wage-earning households; multiple job holding; resource allocation in productive households; human capital formation by households, firms, and public institutions, which includes schooling, on-the-job training, migration, health, research, raising of children, and implications for household income and welfare; applications to problems in rural areas of developing and developed countries.

Econ 521. Labor Markets. (3-0) Cr. 3. *Prereq: 501 or 601.* Analysis of labor demand and market determination of wages and employment; analysis of distortions in labor markets due to non-competitive forces, legislation, and discrimination; wage inequality, compensation and work incentives; compensating differentials; microeconomic analysis of unemployment and job search.

Econ 530. Advanced Farm Management. (2-0) Cr. 2. *Prereq: 6 credits in Economics.* Offered off campus as demand warrants. Risk management principles applied to agriculture. Sources of risk and uncertainty. Attitudes toward risk. Techniques for analyzing and controlling production, marketing, financial, legal and human risk. Designed for master of agriculture program only.

Econ 532. Business Economics. (3-0) Cr. 3. *Prereq: 101 and enrollment in MBA or BAS program; not for economics majors.* Applications of microeconomic theory and decision analysis. Demand analysis, production and cost analysis, forecasting, pricing, market structures and strategy, capital investment analysis, decision-making under uncertainty, government and business.

Econ 533. Economic and Business Decision Tools. (Cross-listed with BusAd). (3-0) Cr. 3. *Prereq: Econ 501 or 532.* Team taught by faculty in the Department of Economics and the College of Business, this course focuses on applied economic and business tools for decision making. The topics include: Monte Carlo analysis with applications to option pricing and insurance mechanism design, portfolio analysis using existing standard spreadsheet software and add-ons, dynamic programming tools for inventory management and sequential decisions, discrete choice modeling and statistical bootstrapping, and financial performance evaluation using commercially available software.

Econ 535. Applied Agricultural Marketing. (2-0) Cr. 2. *Prereq: 6 credits in economics.* Off campus. Offered as demand warrants. Market structure and performance in the food and agricultural sector. Vertical coordination systems and pricing systems in agriculture. Market information and price forecasting. Alternative marketing methods and strategies for major Iowa agricultural commodities including the use of futures and options markets. Designed for master of agriculture program only.

Econ 537. Commodity Markets: Analysis and Strategy. (3-0) Cr. 3. *Prereq: 501 or 532 or 601, Econ 571 or Stat 326.* Analysis of exchange-traded and over-the-counter commodity markets, their functions and performance. Evaluation of hedging, speculation, and arbitrage strategies. Valuation of derivatives and comparison with derivatives on financial assets. Efficiency and the role of information in commodity markets. Market regulation.

Econ 545. Public Economics. (3-0) Cr. 3. *Prereq: 501 or 601.* Optimal taxation; excess burden; partial and general equilibrium analysis of tax incidence; social insurance; effects of taxation on labor supply and savings; economics of the health sector.

Econ 553. Applied Research in Monetary and Macroeconomics. (3-0) Cr. 3. *Prereq: 502, 571.* Application of economic theory to the analysis of contemporary issues in macroeconomics, monetary economics, and financial economics. This is a Master's level course.

Econ 555. Issues in International Economics. (3-0) Cr. 3. *Prereq: 501, 502.* Theories of international trade and finance. Emphasis on current policy issues in international economics. This is a Master's level course.

Econ 560. Agricultural, Food, and Trade Policy. (Dual-listed with 460). (3-0) Cr. 3. S. *Prereq: 301 or 501.* Description and analysis of economic problems of U.S. agriculture. Explanation and economic analysis of government policies and programs to develop agriculture, conserve agricultural resources, address consumer food concerns, stabilize farm prices, and raise farm incomes. The influence of macroeconomic policy, world economy, and international trade on U.S. agriculture.

Econ 563. Issues in Government Policy Affecting Agriculture. (2-0) Cr. 2. *Prereq: 101.* Off campus. Offered as demand warrants. Government policy and the policy-making process as it affects food, agriculture, and trade. Description and analysis of government policies and programs designed to address production agriculture problems and consumer food concerns. Evaluation of the interaction of agriculture and world trade as affected by U.S. and foreign government policies. Designed for master of agriculture program only.

Econ 571. Intermediate Econometrics. (3-0) Cr. 3. S. *Prereq: 500.* Single and multiple equation regression models; dummy explanatory variables; serial correlation; heteroskedasticity; distributed lags; qualitative dependent variables; simultaneity. Use of econometric models for tests of economic theories and forecasting.

Econ 576. Spatial Economics. (3-0) Cr. 3. *Prereq: 501.* Analysis of location choice by firms, employees, and households emphasizing the role of spatial variations in agglomeration economies, economies of scale, distance, transport, endowments, amenities, and local government. Models of land use, urban form, spatial competition, central place theory, and migration. Techniques of discrete choice analysis, statistical analysis of categorical data, urban system modeling, and interregional computable general equilibrium.

Econ 580. Intermediate Environmental and Resource Economics. (Dual-listed with 480). (3-0) Cr. 3. *Prereq: 301.* Theories of natural resource utilization and allocation. Externalities, public goods, and environmental quality. Planning natural resource use and environmental quality. Methodologies for analyzing natural resource and environmental problems.

Econ 581. Advanced Environmental Economics. (3-0) Cr. 3. *Prereq: 501 or 601.* Interrelationships of natural resource use and the environment. Applied welfare and benefit-cost analyses. Externalities and pollution abatement. Nonmarket valuation of resources. Property rights. Legal and social constraints. Policy approaches.

Econ 590. Special Topics. Cr. arr. Repeatable. Satisfactory-fail only.

Econ 599. Creative Component. Cr. arr. Satisfactory-fail only.

Courses for graduate students

Econ 600. Quantitative Methods in Economic Analysis II. (4-1) Cr. 4. F. *Prereq: 500 and linear algebra.* Unconstrained and equality- and inequality-constrained optimization; the Kuhn-Tucker formulation; abstract spaces; dynamic programming; dynamical systems.

Econ 601. Microeconomic Analysis I. (4-1) Cr. 4. F. *Prereq: 301, previous or concurrent enrollment in 600 and permission of Director of Graduate Education.* Economic theory and methodology; theory of consumer behavior, theory of the competitive firm, supply and factor demand; duality relations in consumer and producer theory, welfare change measures; partial equilibrium analysis, perfect competition, monopoly; choice under uncertainty, the expected utility model, risk aversion; insurance, portfolio and production decisions under risk.

Econ 602. Macroeconomic Analysis. (4-1) Cr. 4. S. *Prereq: 301, 302, previous or concurrent enrollment in 600 and permission of Director of Graduate Education.* Neoclassical aggregate growth models; the overlapping generations model; endogenous growth models; equilibrium business cycle theories; equilibrium job search and matching; models of money; fiscal and monetary policy; income and wealth distribution.

Econ 603. Microeconomic Analysis II. (4-1) Cr. 4. S. *Prereq: 601, 602 and permission of Director of Graduate Education.* General equilibrium analysis, efficiency, and welfare; market failures, externalities, and the theory of the second best; introduction to game theory; adverse selection, signaling, screening and moral hazard.

Econ 604. Advanced Macroeconomic Analysis. (4-1) Cr. 4. F. *Prereq: 601, 602 and permission of Director of Graduate Education.* Topics will be selected from: new Keynesian approaches to business cycle theory; endogenously generated business cycles; models of credit and financial intermediation; mechanism design and time inconsistency issues; political economy models; heterogeneous-agent models with strategic interaction; path dependence, network effects, and lock-in; economies as evolving self-organizing systems.

Econ 605. Advanced Topics in Microeconomics. (3-0) Cr. 3. *Prereq: 603.* Selected topics in microeconomic theory of current significance to the profession.

Econ 606. Advanced Topics in Macroeconomics. (3-0) Cr. 3. *Prereq: 603, and credit or current enrollment in 604.* Selected topics in macroeconomic theory of current significance to the profession.

Econ 615. Theoretical Industrial Organization. (3-0) Cr. 3. *Prereq: 603.* Theoretical analysis of traditional topics in industrial organization. Review of game theory. Monopoly and oligopoly theory, price discrimination, product differentiation, research and development, diffusion of innovation, network externalities, and asymmetric information.

Econ 616. Empirical Methods in Industrial Organization. (3-0) Cr. 3. *Prereq: 603, 671.* Empirical methods in industrial organization. Measurement of market power. Discrete choice models of product differentiation. Empirical studies of price dynamics, entry, collusion, price discrimination, technology adoption, asymmetric information, and auctions.

Econ 618. Game Theory. (3-0) Cr. 3. *Prereq: 603, or 501 and permission of instructor.* Theoretical analysis and applications of strategic games, extensive form games, and cooperative games. Nash equilibrium, correlated equilibrium, Bayesian games, subgame perfect equilibrium, the core, evolutionary equilibrium, repeated games with finite automata, and common knowledge.

Econ 641. Agricultural Economics I. (3-0) Cr. 3. *Prereq: 603.* Advanced treatment of topics in agricultural economics with emphasis on optimization models. Part 1: Applied duality in production and demand models. Flexible representation of production and demand systems. Production efficiency and nonparametric analysis. Production models with risk. Part 2: The role of contracts in the organization and coordination of agricultural production. Distribution of asset ownership, allocation of risk among parties, and the structure of incentive systems. Rationale for cooperative efforts and information sharing. The role of information, insurance, and credit.

Econ 642. Agricultural Economics II. (3-0) Cr. 3. *Prereq: 603.* Advanced treatment of topics and models in agricultural economics with emphasis on equilibrium analysis. Part 1: Application of price theory to agricultural market analysis. Vertical market relations, product differentiation and quality in agri-food markets. Storage, futures markets and commodity prices. Part 2: Market failures and the scope for government intervention in agriculture. Applied welfare analysis of agricultural and environmental policies. Issues and models in international trade of agricultural products.

Econ 653. Financial Economics. (3-0) Cr. 3. *Prereq: 603, 672. Recommended: 674, Stat 551.* Review of decision-making under uncertainty. Portfolio theory. Theoretical foundations of asset valuation models: capital asset pricing model (CAPM), arbitrage pricing theory (APT), representative agent models, pricing of derivative securities. Complete and incomplete asset markets, credit markets, financial intermediaries, the role of government in the financial sector. Market frictions, crashes, bubbles. Applications of asset valuation models, with emphasis on their testable implications.

Econ 654. Advanced Topics in Financial Economics. (3-0) Cr. 3. Repeatable. *Prereq: 603.* Selected topics in financial economics of current significance to the profession.

Econ 655. International Trade. (3-0) Cr. 3. *Prereq: 603.* Theories of international trade; welfare and distributional aspects of trade and commercial policies. Optimal trade policies in the presence of domestic distortions; strategic trade policy; international trade and economic growth.

Econ 657. International Finance. (3-0) Cr. 3. *Prereq: 602.* The intertemporal approach to current account determination; non-traded goods and the real exchange rate; fiscal policy in the open economy; monetary approach to balance of payments and exchange rate determination; sticky price models of the open economy; exchange-rate based stabilizations; capital inflows; financial and balance of payments crises; international business cycles.

Econ 671. Econometrics I. (4-1) Cr. 4. F. *Prereq: 501 and Stat 447 or 542.* Probability and distribution theory for univariate and multivariate normal random variables, introduction to the theory of estimators for linear models, hypothesis testing and inference, introduction to large sample properties of estimators; derivation of common estimators and their properties for the classical and general multiple regression models, hypothesis testing, forecasting, implications of specification errors - missing data, left-out regressors, measurement error, stochastic regressors.

Econ 672. Econometrics II. (4-1) Cr. 4. S. *Prereq: 671.* Identification, estimation, and evaluation of systems of simultaneous equations; qualitative choice and limited dependent variable models; introduction to time series methods and applications, including alternative variance specifications.

Econ 673. Microeconometrics. (3-0) Cr. 3. *Prereq: 672, 601.* Econometric treatment of models arising in microeconometric applications. Methods are primarily concerned with the analysis of cross-section data. Topics may include: systems of demand equations in panel data settings, random utility models of discrete choices, production possibilities frontier estimation, and discrete/continuous models of participation and consumption.

Econ 674. Macroeconometrics. (3-0) Cr. 3. *Prereq: 672, 602.* Time-series econometric techniques and their application to macroeconomics and financial markets. Techniques may include GARCH and ARCH-M models, unit-root tests, nonlinear adjustment models, structural VARs, and cointegration tests.

Econ 675. Advanced Topics in Econometrics. (3-0) Cr. 3. Repeatable. *Prereq: 672 or Stat 543.* Advanced treatment of issues important in econometrics. Topics chosen from asymptotic theory, nonlinear estimation, Bayesian and robust econometrics, econometric time series, limited dependent variables and censored regression models, nonparametric and semiparametric methods, bootstrapping and Monte Carlo techniques.

Econ 680. Advanced Resource Economics. (3-0) Cr. 3. *Prereq: 603.* Dynamic allocation of scarce, exhaustible, and renewable natural resources, including minerals and energy, soil, water, forests, and fish. Social versus private decisions. Market and nonmarket considerations. Technological change. Regulation. Dynamics and uncertainty.

Econ 690. Advanced Topics. Cr. arr. Repeatable. Satisfactory-fail only.

Econ 691. Third-Year Paper. Cr. 3. Under the direction of the major professor, Ph.D. students write a formal research paper as an introduction to the dissertation research process. Satisfactory-fail only.

Econ 693. Workshops. Cr. arr. Repeatable. *Prereq: 6 graduate credits in chosen field.* Satisfactory-fail only.

Econ 699. Research for Thesis or Dissertation. Cr. arr. Repeatable. Satisfactory-fail only.

Educational Leadership and Policy Studies

(www.elps.hs.iastate.edu/elps/homepage.htm)

Laura Rendon, Chair of Department

Distinguished Professor: Schuh

Distinguished Professor (Emeritus): Warren

University Professors: Ebbers, Licklider, Robinson

University Professors (Emeritus): Manatt

Professors: Evans, Hagedorn, Rendon, Smith

Professors (Emeritus): Blake, Boyles, Bryan, Engel, Hopper, Huba, Jones, Kizer, Lagomarcino, Lawrence, Mccandless, Moore, Pellegreno, Vanast

Professors (Collaborators): Barak, Gardner, Pierce

Associate Professors: Hamrick, Laanan, Mcleod, Porter

Associate Professor (Emeritus): Thielen

Associate Professor (Adjunct): Tesfagiorgis

Assistant Professors: Gildersleeve, Marshall, Osei-Kofi, Patton, Starobin

Assistant Professors (Adjunct): Arthur, Gruenewald, Hill, Jackson, Payne

Senior Clinician: Scharff

Lecturers: Bradley, Cooper, Coppernoll, Drake, Duree, Englin, Forsythe, Gansemer-Topf, Holcomb, Kimpston, Saunders, Shahjahan, Steven

Clinician: Book, Ratigan, Westerman-Beatty

Departmental Mission, Vision and Goals statements

Mission:

The mission of the Department of Educational Leadership and Policy Studies is to advance the quality and effectiveness of educational institutions and individuals engaged in education. The department is guided by the missions of Iowa State University and the College of Human Sciences and embodies the concepts of the land-grant tradition of teaching, research, and service. The department is dedicated to enhancing the intellectual, cultural, social, and ethical potential of students and faculty for the benefit of Iowa, the nation, and the world. Specifically, the Department of Educational Leadership and Policy Studies:

•Provides graduate degree and career preparation programs, coursework, and other learning opportunities for students and practitioners.

•Conducts and disseminates basic and applied research for the advancement of educational theory and practice.

•Provides professional service for institutions, individuals, and organizations at all levels of education.

Vision:

Research All Educational Leadership and Policy Studies faculty create and disseminate knowledge and promote educational inquiry that enhances educational practices at local, state, national, and international levels.

Teaching All Educational Leadership and Policy Studies faculty engage in teaching that is consonant with the principles of adult learning and effective teaching that help students develop critical thinking and professionally relevant skills, and that provides a foundation for the application of knowledge to practice.

Service All Educational Leadership and Policy Studies faculty, using their professional expertise, work with educators, educational institutions, and other constituent groups to solve problems.

Advising All Educational Leadership and Policy Studies faculty foster students' professional and personal growth by guiding and inspiring them to formulate and complete relevant programs of study and to conduct high quality research.

Curricula/Program The Educational Leadership and Policy Studies faculty develop and implement futuristic curricula and programs to ensure that students learn to think critically and perform their professional roles in an exemplary fashion.

General Goals:

The general goals of the department, and hence of each of its program areas and affiliated programs, are to:

•Conduct high quality graduate education programs, both on- and off-campus, for students seeking graduate degrees in a major in education and/or seeking professional licensure as school service personnel.

•Establish appropriate conditions, opportunities, and resources with which both faculty and graduate students may engage in scholarly activities.

•Assist the educational enterprise of Iowa in development by utilizing, when appropriate, the talents and expertise of the faculty and graduate student body in such activities as workshops, conferences, and consultation in small groups, both on- and off-campus.

Graduate Study

Degrees The Department of Educational Leadership and Policy Studies -- ELPS -- offers work for the degrees master of science, master of education, certificate of advanced studies, and doctor of philosophy with a major in education. ELPS also offers minor work to students majoring in other fields of study. At the master's level, students may specialize in educational administration; higher education; and research and evaluation. Interested students should consult the specific program area for master's degree information related to that program.

Students may complete the Ph.D. with a major in education and a specialization in educational leadership with emphasis in either educational administration or higher education. Specific information about the requirements of the Ph.D. degree is available from the departmental office or on the web (www.elps.hs.iastate.edu/elps/elpsdoc.htm).

The following information refers only to the Ph.D. program:

Prerequisites Prerequisite to major graduate work in educational leadership is completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence. In addition it is preferred that students complete a master's degree and 3-5 years of professional experience.

Learning Opportunities Doctoral students in Educational Leadership and Policy Studies will complete seminars, laboratory experiences, field experiences, independent research, and a capstone experience course. In addition to the common experiences noted above, students will each select an intellectual content area that will prepare them to work in the setting of their choice.

Careers Graduates of the doctoral program are prepared to serve as leaders in various educational settings, including school administration, community colleges, public and private colleges and universities, and public and private educational agencies.

Outcomes Graduates of the Ph.D. program, regardless of the emphasis chosen, possess skills and knowledge related to five core domains: leadership, educational research, communication, educational evaluation, and educational foundations. By the time of graduation, students will demonstrate the necessary skills and knowledge to:

- •Work effectively with individuals and groups.
- •Engage in ethical decision-making and management of resources to accomplish goals.
- •Engage in scholarly inquiry.
- •Express ideas clearly, both orally and in writing.
- •Articulate their values, beliefs, and Philosophy of life.
- •Relate sensitively to individuals from diverse backgrounds.
- •Use the principles of program evaluation and assessment intelligently.
- •Have a clear understanding of the foundations of education, grounding their work in theory and Philosophy.
- •Articulate the concepts, theories, and practices related to the educational content area emphasized in their studies.

Other Related Programs Other graduate programs related to education (including Interdisciplinary Graduate Studies) may be more suited to the interests of potential students on the basis of previous education and experiences as well as future plans and needs. Potential students should refer to programs in the Departments of Agricultural Education and Studies, Curriculum and Instruction, Family and Consumer Sciences Education and Studies, Kinesiology, and Interdisciplinary Graduate Studies, or to graduate level course offerings within the other departments, to determine if these offerings may be more closely matched with their career interests.

The following information refers only to the masters level programs:

Prerequisites Prerequisite to major graduate work in educational leadership is completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence.

Educational Administration (EdAdm)

Scott McLeod, Program Coordinator

Degrees and Certificates Several programs are offered: (1) master of science degree, with thesis or creative component, in elementary or secondary school administration; (2) master of education practitioner; (3) advanced study leading to principal's license; (4) certificate of advanced studies providing post-master's training for superintendency licensure; and (5) doctor of philosophy with major in education and specialization in educational leadership. Courses are scheduled with consideration for cohort-collegial teams or groups.

Emphasis The Educational Administration Program places dual emphasis on preparation of professional educational administrators and on the academic/scholarly aspects of educational leadership and management.

Prerequisites Prerequisite to major graduate work in educational leadership is completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence.

Learning Opportunities Students will complete courses, laboratory experiences, field experiences, and independent research so that they can effectively serve in leadership roles.

Careers Graduates of Master's Degree and Certificate of Advanced Study Programs in Educational Administration are prepared for leadership roles in Pre K-12 school districts and education agencies, typically as building-level principals, assistant principals, curriculum directors, and central office administrators. Doctoral graduates are prepared for PreK-12 leadership roles and academic or leadership positions in higher education.

Outcomes Graduates of the Certificate of Advanced Studies Program will possess administrative and leadership skills necessary for the superintendency and central office administration. By the time of graduation, students will demonstrate the necessary skills and knowledge to:

•Serve as visionary leaders, with effective skills in curricular and instructional leadership.
•Work effectively with individuals and groups, both within the district and community, to create and sustain a positive learning culture.
•Engage in ethical decision-making and effective management of human, material, and financial resources to accomplish district goals.
•Express ideas clearly to various publics, both orally and in writing.
•Articulate their values, beliefs, and Philosophies of education.
•Relate sensitively to individuals from diverse backgrounds.
•Access and utilize research information and technology to assist with organizational improvement.
•Translate educational administration concepts and theories into sound management and leadership practices.

Graduates of the Master's Program with a specialization in educational administration and the Principal Licensure Program possess administrative and leadership skills necessary for PreK-12 building-level leadership roles. Upon program completion, each student will possess the knowledge and skills to:

•Work effectively with all members of the school community to create a shared vision of learning, which builds upon the formation of a shared understanding of the purposes of schooling in a pluralistic Society.

•Demonstrate effective skills in collaborative instructional leadership, including an understanding of curriculum standards, principles of effective teaching practices, and effective assessment practices that lead to improved student learning.

•Implement a system of shared governance and empower faculty, staff, students, and families in the school improvement process.
•Create and sustain a safe and caring school culture that values diversity and maintains a commitment to equity in school practices.
•Engage in ethical and moral leadership practices and the effective management of human, material, and financial resources to accomplish school goals.
•Work collaboratively with internal and external stakeholders in responding to school needs and providing community resources to support the learning process.
•Access research and use data to inform teaching and learning practices and support the process of continuous improvement.
•Apply various technologies to support and enhance administrative and instructional purposes.
•Use leadership skills to transform the school into a learning community that promotes change and sustains school improvement initiatives.
•Engage all members of the school community in critical inquiry and reflection, to promote the belief that learning is a lifelong endeavor for every individual.

Graduates of the Ph.D. Program with a specialization in educational administration will possess skills and knowledge related to the six core domains: leadership, educational research, communication, educational evaluation, educational foundations, and educational technology. By the time of graduation, students will demonstrate the necessary skills and knowledge for those outcomes as listed under the ELPS Ph.D. program outcomes.

Courses primarily for graduate students, open to qualified undergraduate students

EdAdm 541. Principles of Educational Leadership. (3-0) Cr. 3. F.S.SS. *Prereq: Teacher licensure and permission of instructor.* Basic principles of educational organizations, including an understanding of organizational behavior and theoretical approaches to administration. Exploration of substantive elements related to school reform, such as leadership, the change process, current issues in education, and developing a shared vision and mission.

EdAdm 551. Supervision for Learning Environments. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Study of effective classroom instructional practices that reflect current principles of learning. Understanding and practice of supervisory techniques that support teachers in improving the teaching and learning process, including skills in observational data collection, data analysis, collaboration, and conferencing skills.

EdAdm 552. Current Issues in Site-Level Leadership. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Essential tasks of building-level leadership and management in contemporary school settings, including: curriculum and organizational structure, theory and practice of scheduling, financial management, roles and responsibilities of governance, communication and public relations skills, home/parental involvement and relationships, project and crisis management, technology integration, school climate and culture, effective student support programs such as counseling and guidance, attendance and discipline.

EdAdm 554. Leading School Reform. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Study of principles of transformational leadership and collaborative decision-making skills. Leadership activities that facilitate the development of a school culture that embraces change and school reforms that result in high quality schools dedicated to improved student achievement.

EdAdm 556. School Systems as Learning Cultures. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Practical and theoretical perspectives on school administrative problems from critical pedagogical studies and research. Exploration of related issues such as cultural literacy, forms of authority and control, and other historical problems of schools in dealing with minorities and culturally different persons.

EdAdm 557. Human Resource Development for Learning. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Leadership theory and practice that focuses on the professional development of school staff to promote improved student learning. Principles of school personnel evaluation; legal issues related to hiring, retention, and dismissal; evaluation models for professional and classified staff; and effective professional development models to support lifelong learning and reflective practice.

EdAdm 558. Diverse Learning Needs. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Learner needs will be examined from major psycho/social perspectives with stress upon developmental phases of normal growth along with common problems encountered in schools. Issues of racism, gender bias, and Socio-economic problems that influence learner responsiveness to school curricula and administrative regulations, routines, and legal requirements.

EdAdm 559. Curriculum Leadership. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Generic administrative approaches to the design and delivery of elementary and secondary school curricula including the study of the organizations for learning; cognition and learning theories; validation; concepts of balance; school goals, student assessments and reporting of progress, alignment, and professional development; development of curriculum guides; mapping; employing national standards and benchmarks.

EdAdm 575. Education Law and Ethics. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Examination of constitutional, statutory, and judicial provisions as a basis for the legal operation of educational institutions. Rights and ethical responsibilities of school leaders are examined in relation to their roles and responsibilities with boards, other school personnel, and students.

EdAdm 590. Special Topics. Cr. arr. Repeatable. *Prereq: 9 credits in education.*

EdAdm 591. Supervised Field Experience. Cr. arr. Repeatable. *Prereq: 541 and admission to program and instructor's approval.* Supervised on-the-job field experience in special areas.
A. Elementary Principal
B. Secondary Principal

EdAdm 593. Workshops. Cr. arr. *Prereq: 9 credits in education.*

EdAdm 599. Creative Component Development. Cr. arr. *Prereq: 9 credits in educational administration.*

x*Courses for graduate students*

EdAdm 601. Planning Systems, Operations and School Environments. (3-0) Cr. 3. F.SS. *Prereq: 541.* Planning and management theories, assumptions, strategies, and tactics within belief systems; development of vision and mission positions; strategic goals; objectives and operational tactics to attain them, with emphasis on facility renovation and school construction projects.

EdAdm 602. Human Resource Development and Negotiations. (3-0) Cr. 3. S.SS. *Prereq: 541.* Development and practice of collective negotiations within human resource development concepts and strategies, with emphasis on creating and implementing "win-win" approaches that enhance system productivity and performance. Specific contract language and concepts which enhance system effectiveness will be highlighted.

EdAdm 603. Personnel Evaluation and System Assessment Practices. (3-0) Cr. 3. *Prereq: 541.* Theory, strategies, and systems for supervising programs and personnel in school districts and independent schools. Focuses on the principal, cabinet level administrator, e.g., director, headmaster, or assistant superintendent for instruction.

EdAdm 604. Theories of Leadership. (3-0) Cr. 3. F.SS. *Prereq: 541.* Specific leadership theories and models will be studied with an emphasis on: organization building and constructivist strategies for teachers; developing and assessing internal and external support groups for schools; and organizational capacity building.

EdAdm 605. Current Practices of the Superintendency. (3-0) Cr. 3. S.SS. *Prereq: 541.* The historical development of the American Superintendency in public education, problems and pitfalls, and politics and tensions separating executive actions from board policy formulation; executive challenges among contemporary educational problems of resource acquisition and allocation; collaborative relationships; union/system issues; system changes and capacity building models.

EdAdm 606. The Administration of Technology Systems. (3-0) Cr. 3. F.SS. *Prereq: 541.* The design, acquisition and operations of technology in educational administration; accounting; personnel record keeping and health system interfaces; compensation practices, staff development, and instruction record keeping, maintenance and groups.

EdAdm 607. Advanced Education Law. (3-0) Cr. 3. S.SS. *Prereq: 575.* Emerging issues of school case law and litigation as it pertains to school/student safety; student/teacher relationships; administrative authority/oversight; taxation and abatement; home schooling issues; censorship of books and curricula; student clubs and religious practices.

EdAdm 608. Administrative Problems. (3-0) Cr. 3. F.SS. *Prereq: 541.* A case study approach to the resolution of problems in educational administration. Emphasis on decision-making, conflict resolution, and communication using actual situations.

EdAdm 609. Instructional Management. (3-0) Cr. 3. F.SS. *Prereq: 541.* Theories and practices of instructional management including curriculum audits, classroom observations, and analytical models assessing teacher interactions with students. Strategies of improving assessment of teacher interactions with students. Strategies of improving pupil resiliency and achievement will be highlighted. Mapping of curriculum configurations in classrooms will be applied to the use of national/international standards.

EdAdm 611. Superintendent/Board Relations. (3-0) Cr. 3. F.SS. *Prereq: 541.* An historical analysis of the development of governance systems in American public education, and contemporary issues and problems confronting effective school district governance.

EdAdm 612. School Finance and Business Management. (3-0) Cr. 3. S.SS. *Prereq: 541.* Contemporary business and risk management practices, including: financial management and banking; investment of funds; cash flow projections; accounting practices, and school budget development concepts and usage. The functions and duties of school business personnel will be related to specific business and fiduciary tasks.

EdAdm 615. Seminar. Cr. arr. Repeatable. In-depth study of administrative topics of contemporary interest and importance.
A. Client Focus
B. Research
C. Quality Improvement
D. Special Services
E. Assessment
F. Leadership

EdAdm 690. Advanced Special Topics. Cr. arr. Repeatable. *Prereq: 9 credits in educational administration.*

EdAdm 691. Internship. (Cr. 1-3. Repeatable, maximum of 3 credits. *Prereq: 541, admission to program, and instructor's approval.* Supervised on-the-job field experience in special areas.

EdAdm 699. Dissertation Research. Cr. arr. Repeatable. *Prereq: 9 credits in education.*

Educational Leadership and Policy Studies (EL PS)

Courses for graduate students

EL PS 615. Thematic Seminars. Cr. 1. F.S.SS. *Prereq: Admission to educational leadership doctoral program.*
A. Communication and Team Building
B. Governance, Politics and Policies
C. Law, Equity, Equality
D. Ethics, Justice, and Caring
E. Problem Solving and Planning
F. Critical and Creative Thinking

EL PS 616. Capstone Experience. Cr. 3. F.S. *Prereq: 4 credits of 615.* This experience is designed to explore a topic addressed in one of the thematic seminars. The product of the capstone experience is a written paper of sufficient quality to be submitted to a scholarly journal for review.

Higher Education (Hg Ed)

Frankie Laanan, Program Coordinators

Degrees Higher Education offers work for the master of science degree with thesis and master of education degree (non-thesis) and a specialization in higher education, as well as postgraduate professional development. A community college leadership certificate program and a community college teaching and learning certificate program are also offered.

The Master's Program in Higher Education

Emphasis The Higher Education program provides graduate instruction and leadership development in community college education, student affairs practice, institutional research, post-secondary curriculum, and higher education administration.

Prerequisites Prerequisite to major graduate work in educational leadership is completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence.

Learning Opportunities Master's students in Higher Education will complete courses, practical experiences, and independent research or a culminating experience that will enable them to serve as leaders in various educational settings.

Careers Master's students in Higher Education are prepared for entry level positions in student affairs administration, general institutional administration, teaching positions in community colleges, and support positions in post-secondary settings.

Outcomes Graduates of the Master's Program in Higher Education with a specialization in student affairs will demonstrate leadership in student affairs settings. By the time of graduation, students will possess the necessary skills and knowledge to:

- Demonstrate effective oral communication.
- Effectively communicate in writing.
- Work effectively with a diverse student population.
- Employ interventions designed to facilitate the development and learning of college students.
- Create, design, and implement programs and interventions.
- Effectively advise students individually and in groups.
- Organize and administrate student services in post-secondary settings.
- Conduct basic assessment, evaluation, and research.

Graduates of the Master's Program in Higher Education with a specialization in community college teaching and learning will possess teaching and learning leadership skills. By the time of graduation students will possess the necessary skills and knowledge to:

- Facilitate college student learning.
- Employ pedagogical techniques.
- Demonstrate a clear understanding of the foundations of education, grounding their work in theory and Philosophy.
- Use technology effectively in learning and organizational processes.
- Articulate the concepts, theories and practices related to the content of higher education as emphasized in their course work.
- Develop curriculum.
- Assess student learning.
- Understand the Philosophy, organization, functions, and current issues of community colleges.

Graduates of the Master's Program in Higher Education with a specialization in community college administration will demonstrate leadership in community college settings. By the time of graduation, students will possess the necessary skills and knowledge to:

- Create positive environments for community college students.
- Perform administrative functions in community college settings.
- Assist community college students with the academic and personal issues they face.
- Develop effective teaching and learning strategies.
- Work effectively with diverse student populations.
- Shape community college curricula.

The Ph.D. Program in Higher Education

Emphasis The Ph.D. in education with a specialization in educational leadership includes an emphasis on higher education. This program is designed to prepare leaders for post-secondary settings and is concerned with advanced study and independent research on various topics related to post-secondary settings. See departmental overview of the Ph.D. degree in educational leadership.

Prerequisites Prerequisite to doctoral work in educational leadership is completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence. In addition, students are expected to have completed a master's degree and 3-5 years of professional work experience in higher education.

Learning Opportunities Doctoral students will complete courses, laboratory experiences, field experiences, independent research, a capstone experience, and a dissertation so that they can Serve as leaders in various post-secondary educational settings such as colleges and universities, private and state educational agencies, and other organizations concerned with post-secondary education.

Careers Typical careers available to graduates include leadership positions in post-secondary institutions, agencies, and other organizations concerned with post-secondary education. Special experiences are available to those who are interested in a career as a faculty member in post-secondary settings.

Outcomes Graduates of the doctoral program with an emphasis in higher education will possess knowledge and skills related to five core domains: leadership, educational research, communication, educational evaluation, and educational foundations. By the time of graduation, students will demonstrate the necessary skills and knowledge for these outcomes as listed under ELPS Ph.D. program outcomes.

Courses open to community college faculty members only

Hg Ed 420. Introduction to Vocational Technical Teaching at Community Colleges. (3-0) Cr. 3. F. Examines the competencies for successful teaching in vocational technical programs; a focus on lesson planning, motivating students, teaching methods, time management, and evaluation.

Hg Ed 421. Vocational Technical Teaching Methods at Community Colleges. (3-0) Cr. 3. S. *Prereq: 420.* Develops competencies necessary to identify, develop, implement, and evaluate collaborative learning, learning to learn, and other classroom and lab/clinic teaching techniques.

Hg Ed 422. Vocational Technical Curriculum at Community Colleges. (Dual-listed with 522). (3-0) Cr. 3. F. *Prereq: 421.* With a focus on alignment and

accountability develops competencies necessary to identify, develop, implement, and evaluate outcome-based vocational technical courses and programs in community colleges.

Hg Ed 423. Vocational Technical Assessment at Community Colleges. (Dual-listed with 523). (3-0) Cr. 3. S. *Prereq: 422.* With a focus on classroom assessment develops competencies necessary to identify, develop, empower, and evaluate teaching and learning success.

Courses primarily for graduate students, open to qualified undergraduate students

Hg Ed 504. Higher Education in the United States. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Historical development of higher education; diversity, functions, and Philosophies of colleges and universities; federal and state roles; review of general, liberal, technical, graduate, and professional education.

Hg Ed 522. Vocational Technical Curriculum at Community Colleges. (Dual-listed with 422). (3-0) Cr. 3. F. *Prereq: Hg Ed 550.* With a focus on alignment and accountability develops competencies necessary to identify, develop, implement, and evaluate outcome-based vocational technical courses and programs in community colleges.

Hg Ed 523. Vocational Technical Assessment at Community College. (Dual-listed with 423). (3-0) Cr. 3. S. *Prereq: 522.* With a focus on classroom assessment develops competencies necessary to identify, develop, empower, and evaluate teaching and learning success.

Hg Ed 540. Foundations of Leadership: Learning, Ethics, Self and Interaction. (2-0) Cr. 2. F. *Prereq: permission of instructor.* Serving as an introduction to developing practicing leaders, this course will create the foundation upon which enduring understanding of leadership will be built. Specifically explored will be learning as the foundation of human enterprise, everyday leadership, determination of common good, roots of individual's actions, sensitivity to others, merits of divergent ideas, questioning the Status quo, ethics as personal responsibility and choosing to grow.

Hg Ed 541. Learning, Leadership, Ethics and Community. (2-0) Cr. 2. S. *Prereq: permission of instructor.* Serving as the second semester in a program to develop practicing leaders, this course will build upon the foundation started first semester to help students embrace the enduring understandings of leadership. Specifically explored will be team learning and the effect on individuals, skills required for a team to move forward, importance of decisions based on the good of the community, reflection as a means of enhancing learning, and interconnectedness of the individual, the community, and the world.

Hg Ed 542. Learning, Leadership, Ethics, and Teams; Knowing, Doing and Being. (2-0) Cr. 2. F. *Prereq: permission of instructor.* The overall purpose of this course is to expand the foundation started in Foundations of Leadership: Learning, Ethics, Self and Interactions and Learning, Leadership, Ethics and Community for developing practicing leadership. The focus will shift from a naive understanding of the concepts of self within a team and community to a more sophisticated understanding of knowing, being and doing leadership.

Hg Ed 543. Learning, Leadership, Ethics and Teams in Action. (2-0) Cr. 2. S. *Prereq: permission of instructor.* The purpose of this last (in a series of four) course is to allow students to put their knowledge, skills, and abilities related to leadership, learning, Ethics and Teams into practice. In addition to planning and implementing a major service learning project, the focus will be on the next wave of the study of leadership - connecting leadership to the research about the brain and human learning.

Hg Ed 544. Foundations of Leadership & Learning. (3-0) Cr. 3. F. *Prereq: graduate student classification.* First of two-course series to help leaders develop the knowledge and skills to engage the collective capacity of a group to think, learn, and achieve important purpose. The foundation for developing deep understanding about leadership, learning, and the relationships therein. Focus on application of recent knowledge about human learning in the professional practice of leadership. Relationship leadership model and relationship to other leadership models, theories, and concepts; current theories of human learning (including expert/novice and transfer of learning), and interrelationships with leadership practice; critical understanding of self; facilitating learning for others; metacognition as a habit of mind; fundamentals of group interaction theories; social interdependence, communication, trusting, trustworthy goals, decision-making, cohesion, controversy, team development; power, resources, and development of community.

Hg Ed 545. Connecting Leadership & Learning in Practice. (3-0) Cr. 3. F. *Prereq: Graduate student classification and completion of Hg Ed 544.* Second of a two-course series designed to help leaders develop the knowledge and skills to best engage the collective capacity of a group to think, learn and achieve important purpose. Builds on foundation course to support students in creating applications of the relationships between leadership and learning. Focus on developing the habits of mind and habits of practice to best use knowledge about human learning in the professional practice of leadership. Applications of relational leadership model; applications of group interaction theories; development and implementation of action plans to achieve measurable goals; application of current theories of human learning as they relate to leadership; exploration of the fundamentals of emotional intelligence and the impacts on leadership; developing critical habits of mind to practice leadership focused on learning.

Hg Ed 550. Teaching, Learning and Leadership. (3-0) Cr. 3. F. *Prereq: Teacher licensure.* Current issues and practices in community college teaching and learning, and the roles and responsibilities of teachers as leaders.

Hg Ed 561. College Teaching. (3-0) Cr. 3. *Prereq: 6 graduate credits.* Educational theories, methods and strategies for the improvement of college instruction. Assist potential college instructors in developing knowledge of protocol, assessment, and the scholarship and art of teaching. Emphasis on the unique challenge of college teaching in a changing student population environment.

Hg Ed 562. Curriculum Development in Colleges. (3-0) Cr. 3. *Prereq: Graduate classification.* Modes of curriculum design, development, and change in colleges. Development of curricular leadership and evaluation strategies.

Hg Ed 568. Global Education Policy Analysis. (3-0) Cr. 3. *Prereq: 504.* Assessment of global education policy issues in education. Analysis of policies, implementation strategies, and policy outcomes.

Hg Ed 570. Current Topics in Student Affairs. Cr. arr. *Prereq: Graduate classification.* Current issues and new directions in student affairs practice. Topics developed to the specific needs of student affairs professionals. Primarily for off-campus.
D. Residential Life
G. Student Affairs Institute
H. Student Diversity

Hg Ed 574. Student Affairs Practice in Higher Education. (3-0) Cr. 3. F. *Prereq: Graduate classification, admission to Higher Education Program.* An introduction to the field of student affairs practice with a consideration of student activities, counseling services, financial aid, admissions, student conduct, academic advising, and residential programs; includes community college programs.

Hg Ed 575. Organization and Administration of Student Affairs. (3-0) Cr. 3. S. *Prereq: Admission to Higher Education Program, 574.* Organization structures, role and function of student affairs staff; policies and decision-making for student affairs practice.

Hg Ed 576. Student Development in Higher Education. (3-0) Cr. 3. F. *Prereq: Admission to Higher Education Program.* Theories of student development and their applications in student affairs programs, services, and activities are reviewed. Emphasis is placed on psychosocial, cognitive developmental, and learning theories.

Hg Ed 577. Campus Environments and Cultures. (3-0) Cr. 3. F. *Prereq: Admission to Higher Education Program.* Study of the impact of the college environment on students and use of environmental theory to create positive learning situations for students.

Hg Ed 578. Students in American Higher Education. (3-0) Cr. 3. F. *Prereq: Admission to Higher Education Program.* The relationship between college students and characteristics from 1950 to the present. Traditional assumptions about the impact of higher education on students will be reviewed and challenged. Campus issues and concerns relative to commuters and residential life. Participants will analyze institutional responses to students through college missions, organizational development, structure, core curriculum and retention.

Hg Ed 579. Counseling and Group Dynamics in Post-secondary Settings. (3-0) Cr. 3. F. *Prereq: 574, 576.* Development of effective, basic counseling skills. Understanding of group dynamics. Ability to work effectively in groups.

Hg Ed 580. Current Topics in Community Colleges. (1-3) Cr. arr. *Prereq: Graduate classification.* Current issues and new directions in community college education. Topics developed to the specific needs of colleges for off-campus.
A. Student Needs
B. General and Liberal Education
C. Counseling and Advising
D. Adult and Continuing Education
E. Development and Remedial Education
F. Student Services
G. Faculty and Staff Evaluation
H. Organization and Administration
I. Learning and Teaching
J. Human Relations

Hg Ed 582. The Comprehensive Community College. (3-0) Cr. 3. *Prereq: Graduate classification.* The community college as a unique social and educational institution: its history, philosophy, functions, programs, faculty and student characteristics, organization and finance, trends, and issues. Reviews current research and exemplary community college practices internationally, nationally, and in Iowa.

Hg Ed 590. Special Topics. Cr. arr. *Prereq: 9 credits in education.* Independent study on specific topics arranged with an instructor.
A. Student Services
B. Community Colleges
C. Current Issues
D. International Higher Education
E. Federal and State Affairs
F. Law in Higher Education
G. Institutional Research

Hg Ed 591. Supervised Field Experience. Cr. arr. Repeatable. *Prereq: 9 credits graduate work.* Supervised on-the-job field experience.

Hg Ed 593. Workshops. Cr. arr. Repeatable. *Prereq: 15 credits in education.*

Hg Ed 598. Capstone Seminar. (3-0) Cr. 3. S. *Prereq: Completion of 30 credits in EL PS.* This course is designed to integrate the learning experiences of students completing the Master's Degree Program in higher education. Such issues as ethics, continuing professional development, career planning and leadership will be explored.

Hg Ed 599. Creative Component. Cr. arr. *Prereq: 9 credits in education.*

Courses for graduate students

Hg Ed 615. Seminars in Higher Education. Cr. arr.
A. Student Services
B. Community Colleges
C. Current Issues
D. International Higher Education
E. Federal and State Affairs
F. Law in Higher Education
G. Institutional Research
H. Research Designs in Higher Education

Hg Ed 664. College Organization and Administration. (3-0) Cr. 3. F. *Prereq: 504.* Administrative organization and behavior: communications, leadership, finance, strategic planning, and institutional governance.

Hg Ed 665. Financing Higher Education. (3-0) Cr. 3. S. *Prereq: 504.* Lectures, discussions, and individual investigation relating to financial administration in colleges and universities. Budgeting, auxiliary enterprises, administration of financial planning, fund raising, examination of theories on expenditures. Designed for persons aspiring to serve as college administrators.

Hg Ed 666. Academic Issues and Cultures. (3-0) Cr. 3. S. *Prereq: 504.* Examination of institutional culture and issues in higher education focusing on the roles and responsibilities of faculty and academic administrators.

Hg Ed 676. Student Development Theory II. (3-0) Cr. 3. S. *Prereq: 576.* Life span approaches to student development, social identity development, and spiritual development with emphasis on application of these theories in student affairs practice.

Hg Ed 690. Advanced Special Topics. Cr. arr. Repeatable. *Prereq: 9 credits in education.*

Hg Ed 699. Research. Cr. arr. Repeatable. *Prereq: 9 credits in education.*

Organizational Learning and Human Resource Development (OLHRD)

Courses primarily for graduate students, open to qualified undergraduate students

OLHRD 541. Adult Learning. (3-0) Cr. 3. Examines how adults acquire and use knowledge, skills, and attitudes within organizational settings; individual differences in learning as well as the principles and elements of the learning organization.

OLHRD 544. Performance Improvement and Change Through Learning Interventions. (3-0) Cr. 3. *Prereq: OLHRD 541, 542.* Examines the characteristics and elements of the performance improvement and change process, with special attention to the roles and responsibilities of employees, managers, and organizations when improving individual and organizational learning.

OLHRD 545. Learning Acquisition, Transfer, and Evaluation. (3-0) Cr. 3. *Prereq: OLHRD 541, 542, 544.* Critical examination of learning acquisition, transfer, and evaluation barriers, partnerships, strategies, and activities; and the roles and responsibilities of human resource development professionals, managers, employees, and organizations in the application and evaluation of learning on the job.

Research and Evaluation (ResEv)

John Schuh and Linda Serra Hagedorn, Program Co-Coordinators

Degree Research and Evaluation offers work for the Master of Science degree with thesis with a specialization in research and evaluation.

Emphasis Research and Evaluation students receive a broad foundation in the areas of quantitative and qualitative research methodology, data analysis, assessment, and evaluation. Students select one area for in-depth study.

Prerequisites Prerequisites to major graduate work in educational leadership are completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence.

Learning Opportunities Students in Research and Evaluation will complete courses, laboratory experiences, field experiences, independent research and a thesis.

Careers Graduates are prepared for professional roles in institutional research, assessment of student learning, and program evaluation in post-secondary settings, school districts, and not-for-profit organizations.

Outcomes Graduates of the master's program with a specialization in research and evaluation will be prepared for leadership roles for careers in assessment and evaluation. By the time of graduation, students will demonstrate the necessary skills and knowledge to:

- Articulate current issues and principles in research, program evaluation, and assessment.
- Implement various conceptual approaches to research, program evaluation, and assessment.
- Effectively use the principles and skills of research data analysis.
- Interpret data and prepare accurate and useful reports.

Courses primarily for graduate students, open to qualified undergraduate students

ResEv 550. Introduction to Educational Research. (3-0) Cr. 3. F.S.SS. Understanding the nature of quantitative and qualitative research; reviewing the literature; developing research problems and questions; research designs; data collection and analysis issues; evaluating research studies.

ResEv 552. Basic Educational Statistics. (3-0) Cr. 3. F. Statistical concepts and procedures for analyzing educational data; descriptive Statistics, correlation, t tests, and chi square with computer applications.

ResEv 553. Intermediate Educational Statistics. (3-0) Cr. 3. *Prereq: 552 or equivalent.* A continuation of Statistical concepts and procedures for analyzing educational data; inferential techniques including simple and multiple regression, multiple ANOVA, etc., with educational computer applications.

ResEv 554. Intermediate Research Methods. (3-0) Cr. 3. SS. *Prereq: 580, 553.* Intermediate quantitative and qualitative research methodology in preparation for carrying out thesis and dissertation research; problem formulation; design; data collection and analysis; interpreting and summarizing research findings.

ResEv 560. Assessing Student Learning. (3-0) Cr. 3. *Prereq: 550 or basic Statistical skills.* The purpose and techniques of formal and informal classroom assessment; rubrics, performance assessment, portfolios, paper and pencil tests, communicating assessment findings; emphasis on both theory and practical applications.**ResEv 570. Surveys in Educational Research.** (3-0) Cr. 3. S. *Prereq: ResEv 552 or equivalent.* Examination of survey design and administration in educational research. Designing surveys; developing, evaluating, and asking survey questions; survey sampling; measuring survey reliability and validity; administering mail and web surveys; decreasing survey nonresponse; conducting post-collection survey data processing; conducting survey research with integrity.

ResEv 580. Qualitative Research Methodology. (3-0) Cr. 3. *Prereq: 550.* Qualitative research procedures in education, particularly historical, philosophical, biographical, ethnographic, and case study; use of sources, principles of qualitative research, methods of data collection and analysis, field techniques, and writing of research results.

ResEv 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate standing.* Guided reading and in research and evaluation study on special topic.

ResEv 593. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate standing.* Intensive, concentrated exposure to a special educational research or evaluation problem.

ResEv 597. Program Assessment and Evaluation. (3-0) Cr. 3. S. *Prereq: ResEv 550.* Evaluation models and professional standards. Techniques of evaluating educational programs. Emphasis on both theory and practical applications.

Courses for graduate students

ResEv 615. Current Topics in Research and Evaluation. Cr. arr. Repeatable.

ResEv 680. Critical Issues in Interpretive Methodology. (3-0) Cr. 3. S. *Prereq: 580.* An intensive reading and discussion course focusing on contemporary methodological theory for interpretive inquiry; examines how interpretive field work is conducted, how narrative and ethnographic data are theorized and analyzed, and how interpretive texts are written.

ResEv 690. Advanced Special Topics. Cr. arr. Repeatable. *Prereq: Graduate standing.* Guided reading and/or study on special topics of an advanced nature.

ResEv 699. Research. Cr. arr. Repeatable. F.S.SS.

Electrical Engineering

ecpe.ece.iastate.edu

(Administered by the Department of Electrical and Computer Engineering)

Arun Somani, Chair of Department

Distinguished Professors: Somani, Soukoulis

Distinguished Professors (Emeritus): Brown, Fouad, Lord, Nilsson, Pohm

University Professor: Jacobson

University Professor (Emeritus): Jones

Professors: Ajjarapu, Aluru, J. Bowler, Dalal, Geiger, Kamal, Kothari, Kumar, Kushner, Liu, Luecke, Mccalley, Oliver, Rover, Shinar, Weber

Professors (Emeritus): Anderson, Basart, Brearley, Brockman, Comstock, Fanslow, Hale, Horton, Hsieh, Kopplin, Melsa, Potter, Read, Sheble, Smay, Stewart, Swift, Townsend, Venkata

Professor (Adjunct): Shinar

Professor (Emeritus Adjunct): Hillesland

Professors (Collaborators): Jiles, Lee

Associate Professors: N. Bowler, Chang, Chen, Chu, Davidson, Davis, Dickerson, Dogandzic, Elia, Govindarasu, Guan, S. Kim, Song, Tirthapura, Tuttle, Tyagi, Z. Wang

Associate Professors (Emeritus): Bond, Carlson, Coady, Mericle, Pavlat, Scott, Stephenson

Associate Professors (Adjunct): Biswas, Sosonkina

Associate Professors (Collaborators): Ashlock, Salapaka

Assistant Professors: Aliprantis, Bigelow, Chaudhary, Chung, Daniels, Dong, Fayed, Hornbuckle, Jones, J. Kim, Ma, Neihart, Nguyen, Pandey, Qiao, Ramamoorthy, Stoytchev, Vaidya, Vaswani, L. Wang, Ying, Zambreno, Zhang

Assistant Professors (Adjunct): Amin, Bode

Assistant Professors (Collaborators): Balasubramaniam

Senior Lecturer: Mina, Wiersema

Undergraduate Study

For the undergraduate curriculum in electrical engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission of ABET.

The Department of Electrical and Computer Engineering at Iowa State University provides undergraduate students with the opportunity to learn electrical and computer engineering fundamentals, to study applications of the most recent

advances in state-of-the-art technologies, and to prepare for the practice of electrical engineering. The student-faculty interaction necessary to realize this opportunity occurs within an environment that is motivated by the principle that excellence in undergraduate education is enhanced by an integrated commitment to successful, long-term research and outreach programs.

The electrical engineering curriculum offers a number of emphasis areas at the undergraduate level, including control systems, electromagnetics, microelectronics, VLSI, power systems, and communications and signal processing. Students are required to choose at least one course sequence which focuses on one of these areas; therefore graduates have substantial depth in specific areas to complement the breadth obtained in the required curriculum. Students may also take elective courses in computer networking, security, computer architecture, digital systems, and software.

The objective of the electrical engineering program at ISU is that its graduates should demonstrate expertise, engagement, learning, leadership, and teamwork within five years after graduation.

Expertise: Graduates should establish peer-recognized expertise together with the ability to articulate that expertise and use it for problem solving in at least one of the following domains of communications and signal processing, controls, electromagnetics, power and energy, electronic devices, semiconductor materials, and analog and digital circuits.

Engagement: Graduates should be engaged in the engineering profession, locally and globally, contributing through the ethical, competent, and creative practice of electrical engineering in industry, academia, or the public sector, or graduates may use the program as a foundation for interdisciplinary careers in business, law, medicine, or public service.

Learning: Graduates should demonstrate sustained learning through graduate work or professional improvement opportunities and through self study, and they should demonstrate the ability to adapt in a constantly changing field.

Leadership: Graduates should exhibit leadership and initiative to advance professional and organizational goals, facilitate the achievements of others, and obtain results.

Teamwork: Graduates should demonstrate effective teaming and commitment to working with others of diverse cultural and interdisciplinary backgrounds by applying engineering abilities, communication skills, and knowledge of contemporary and global issues.

As a complement to the instructional activity, the ECPE Department provides opportunities for each student to have experience with broadening activities. Through the cooperative education and internship program, students have the opportunity to gain practical industry experience. See College of Engineering, Cooperative Programs.

Students have the opportunity to participate in advanced research activities; and through international exchange programs, students learn about engineering practices in other parts of the world. Well-qualified juniors and seniors in electrical engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both the bachelor of science and master of science degrees or the bachelor of science and master of science degrees. See Graduate Study for more information.

Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses.

Courses for students who are not in the electrical engineering program: 442, 448. Credit in these courses may not be counted toward a degree in either electrical engineering or computer engineering.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with major in electrical engineering and minor work to students with other majors. Minor work for electrical engineering majors is usually selected from a wide range of courses outside electrical engineering.

The degree master of science with thesis is recommended for students who intend to continue toward the doctor of philosophy degree or to undertake a career in research and development. The nonthesis master of science degree requires a creative component.

The normal prerequisite to major graduate work in electrical engineering is the completion of undergraduate work substantially equivalent to that required of electrical engineering students at this university. Because of the diversification in the electrical engineering graduate program, however, it is possible for a student to qualify for graduate study in certain areas of electrical engineering even though the student's undergraduate or prior graduate training has been in a discipline other than electrical engineering. Supporting work, if required, will depend on the student's background and area of research interest. Prospective students from a discipline other than electrical engineering are required to submit, with the application for admission, a statement of the proposed area of graduate study.

The department requires submission of GRE General test scores by applicants. All students whose first language is not English and who have no U.S. degree must submit TOEFL examination scores. Students pursuing the doctor of philosophy must complete the department qualifying process.

The Department of Electrical and Computer Engineering is a participating department in the interdepartmental graduate minor in complex adaptive systems. Students interested in this program should see the Complex Adaptive Systems section of the catalog for requirements.

The Department of Electrical and Computer Engineering is a participating department in the interdepartmental master of science and doctor of philosophy degree programs in bioinformatics and computational biology. Students interested in these programs may earn their degrees while working under an adviser in electrical and computer engineering.

The Department of Electrical and Computer Engineering is also a participating department in the interdepartmental master of science in information assurance program. Students interested in studying information assurance topics may earn a degree in computer engineering or in information assurance. *(See catalog section on Information Assurance.)*

The Department of Electrical and Computer Engineering offers a graduate certificate in electric power systems engineering. Completion of the certificate requires at least twelve credits selected from 553, 554, 555, 556, and 653. E E 653 is a repeatable course and may be used more than once to satisfy the certificate requirement.

Well qualified juniors or seniors in electrical engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both the bachelor of science and master of science degrees or the bachelor of science and master of business administration degrees. Under concurrent enrollment, students are eligible for assistantships and simultaneously take undergraduate and graduate courses. Details are available in the Student Services Office and on the department's web site.

Courses primarily for undergraduate students

E E 166. Professional Programs Orientation. (Cross-listed with Cpr E). Cr. R. F.S. (1-0) Overview of the nature and scope of electrical engineering and computer engineering professions. Overview of portfolios. Departmental rules, advising center operations, degree requirements, program of study planning, career options, and student organizations.

E E 185. Introduction to Electrical Engineering and Problem-Solving I. (2-2) Cr. 3. F.S. *Prereq: Credit or enrollment in Math 142.* Project based examples from electrical engineering. Systematic thinking process for engineering problem solving. Group problem solving. Mathematical, conceptual and computer based projects. Solving engineering problems and presenting solutions through technical reports and oral presentations. Solutions of engineering problems using computation tools and basic programming in C.

E E 186. Introduction to Electrical Engineering and Problem Solving II. (0-2) Cr. 1. S. *Prereq: 185.* Project based and hands on continuation of 185. Group skills needed to work effectively in teams. Individual interactive skills for small and large groups. Learning to use tools and methods for solving electrical engineering problems.

E E 201. Electric Circuits. (3-2) Cr. 4. F.S. *Prereq: Credit or registration in Math 267 and Phys 222.* Emphasis on Mathematical tools. Circuit elements (resistors, inductors, capacitors) and analysis methods including power and energy relationships. Network theorems. DC, sinusoidal steady-state, and transient analysis. AC power. Frequency response. Two port models. Diodes, PSPICE. Laboratory instrumentation and experimentation. Credit for only E E 201 or 442 may be used towards graduation.

E E 224. Signals and Systems I. (3-3) Cr. 4. F.S. *Prereq: 201, Math 267, Phys 222.* Mathematical preliminaries. Introduction to signals and systems. Signal manipulations. System properties. LTI systems, impulse response and convolution. Fourier Series representation and properties. Continuous and discrete-time Fourier Transforms and properties. Sampling and reconstruction. Modulation and demodulation. Applications and demonstrations using Matlab.

E E 230. Electronic Circuits and Systems. (3-3) Cr. 4. F.S. *Prereq: 201, Math 267, Phys 222.* Frequency domain characterization of electronic circuits and systems, transfer functions, sinusoidal steady state response. Time domain models of linear and nonlinear electronic circuits, linearization, small signal analysis. Stability and feedback circuits. Operational amplifiers, device models, linear and nonlinear applications, transfer function realizations. A/D and D/A converters, sources of distortions, converter linearity and spectral characterization, applications. Design and laboratory instrumentation and measurements.

E E 294. Program Discovery. (Cross-listed with Cpr E). Cr. R. *Prereq: 166 or Cpr E 166.* The roles of professionals in computer and electrical engineering. Relationship of coursework to industry and academic careers. Issues relevant to today's world. Satisfactory-fail only.

E E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

E E 303. Energy Systems and Power Electronics. (3-0) Cr. 3. F.S. *Prereq: Math 267, Phys 222. Credit or registration in 224 and 230.* Structure of competitive electric energy systems. System operation and economic optimization. Mutual inductance, transformers. Synchronous generators. Balanced three-phase circuit analysis and power calculations. Network calculations and associated numerical algorithms. Two-port circuits. Voltage regulation. Resonance and power factor correction. DC and induction motors. Power electronic circuit applications to power supplies and motor drives. Electronic loads and power quality. Nonmajor graduate credit.

E E 311. Electromagnetic Fields and Waves. (4-0) Cr. 4. F.S. *Prereq: 201, Math 265, Phys 222, credit or registration in Math 267.* Fundamentals and applications of electric and magnetic fields and materials. Electrostatics and magentostatics, potentials, capacitance and inductance, energy, force, torque. Uniform plane electromagnetic waves, Poynting vector. Transmission lines: transient and sinusoidal steady-state conditions, reflection coefficient. Nonmajor graduate credit.

E E 314. Electromagnetics for non Electrical Engineers. (3-0) Cr. 3. *Prereq: Physics 222, 112, or equivalent.* Conceptual study of electomagnetism and its application in engineering and related fields. Em fundamentals, Em spectrum, radiation, radiating systems, wireless, Moderns concepts of physics, transmission lines, high speed effects, waveguides, GPS and other related phenomena will be discussed and explained with the application in mind. Nonmajor graduate credit.

E E 322. Probabilistic Methods for Electrical Engineers. (Cross-listed with Stat). (3-0) Cr. 3. F.S. *Prereq: E E 224.* Introduction to probability with applications to electrical engineers. Sets and events, probability space, conditional probability, total probability and Bayes' rule. Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, moments, moment generating function, multiple random variables, functions of random variables. Elements of Statistics, hypothesis testing, confidence intervals, least squares. Introduction to random processes.

E E 324. Signals and Systems II. (3-3) Cr. 4. F.S. *Prereq: 224.* Laplace and z-Transforms, properties and inverses. Applications to LTI systems and analog/digital filters. Feedback systems and stability. State-space representation and analysis. Nonmajor graduate credit.

E E 330. Integrated Electronics. (Cross-listed with Cpr E). (3-3) Cr. 4. *Prereq: 201, credit or enrollment in 230, Cpr E 281.* Semiconductor technology for integrated circuits. Modeling of integrated devices including diodes, BJTs, and MOSFETs. Physical layout. Circuit simulation. Digital building blocks and digital circuit synthesis. Analysis and design of analog building blocks. Laboratory exercises and design projects with CAD tools and standard cells. Credit for only one of E E 330 or 331 may be counted toward graduation. Nonmajor graduate credit.

E E 331. Electronics II. (3-3) Cr. 4. *Prereq: 230, Cpr E 288, E E 224 recommended.* I-V characteristics of diodes, BJTs, and MOSFETs. Diode and transistor circuits. Small-signal analysis and biasing techniques for amplifier circuits. CMOS digital circuit building blocks. Noise and distortion in electronic systems. Various types of sensors and their use in electronic systems. Active filters. Power Amplifiers. DC motor control circuits. Interfacing electronic circuits with programmable microcontrollers. Laboratory exercises and design projects, including a board-level system layout. Credit for only one of E E 330 or 331 may be counted toward graduation.

E E 332. Semiconductor Materials and Devices. (Cross-listed with Mat E). (3-0) Cr. 3. S. *Prereq: Phys 222 and, only for Mat E majors, Mat E 334.* Introduction to semiconductor material and device physics. Quantum mechanics and band theory of semiconductors. Charge carrier distributions, generation/recombination, transport properties. Physical and electrical properties and fabrication of semiconductor devices such as MOSFETs, bipolar transistors, laser diodes and LED's. Nonmajor graduate credit.

E E 351. Introduction to Energy Systems: An Engineering Perspective. (Cross-listed with E St). (3-0) Cr. 3. Dalal. Energy-scientific, engineering and economic foundations. Energy utilization-global and national. Sectoral analysis of energy consumption. Relationship of energy consumption and production to economic growth and environment. Technology for energy production. Economic evaluation of energy utilization and production. Scientific basis for global warming. Environmental impact of energy production and utilization. Renewable energy.

E E 388. Sustainable Engineering and International Development. (Cross-listed with A E, C E, M E, Mat E). (2-2) Cr. 3. F. *Prereq: Junior classification in engineering.* Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as nongovernment organizations (NGOs). Course readings, final project/design report.

E E 394. Program Exploration. (Cross-listed with Cpr E). Cr. R. *Prereq: 294 or Cpr E 294.* Exploration of academic and career fields for electrical and computer engineers. Examination of professionalism in the context of engineering and technology with competencies based skills. Introduction to professional portfolio development and construction. Satisfactory-fail only.

E E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period. Students must register for this course before commencing work.

E E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* One semester maximum per academic year professional work period. Students must register for this course before commencing work.

E E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

E E 408. Interdisciplinary Problem Solving. (Cross-listed with I E, TSM). (3-0) Cr. 3. F.S. *Prereq: Junior or senior classification.* Use of the Theory of Constraints as a way of approaching problem solving, win-win negotiation, project planning and effective delegation in the context of engineering/business systems. Team projects aimed at improving design outcomes. Nonmajor graduate credit.

E E 409. Interdisciplinary Systems Effectiveness. (Cross-listed with I E, TSM). (3-0) Cr. 3. F.SS. *Prereq: Junior or senior classification.* Focus on functions that determine the effectiveness of an entire organization. Generic Theory of Constraints solutions to production, distribution, and project management are compared to traditional solutions. Strategy for improvements discovered using simulations. Nonmajor graduate credit.

E E 414. Microwave Engineering. (Dual-listed with 514). (3-3) Cr. 4. F. *Prereq: 230, 311.* Principles, analyses, and instrumentation used in the microwave portion of the electromagnetic spectrum. Wave theory in relation to circuit parameters. S parameters, couplers, discontinuities, and microwave device equivalent circuits. RF amplifier design, microwave sources, optimum noise figure and maximum power designs. Microwave filters and oscillators. Nonmajor graduate credit.

E E 417. Electromagnetic Radiation, Antennas, and Propagation. (Dual-listed with 517). (3-3) Cr. 4. S. *Prereq: 311.* Fundamental antenna concepts. Radiation from wire-and aperture-type sources. Radio transmission formulas. Wave and antenna polarization. Antenna arrays. Modern antenna topics. Practical antenna design. Antenna noise. Radiowave propagation in the presence of the earth and its atmosphere. Antenna measurements and computer aided analysis. Nonmajor graduate credit.

E E 418. High Speed System Engineering Measurement and Testing. (Cross-listed with Cpr E). (3-2) Cr. 4. F. *Prereq: 230 and 311.* Measurement of high speed systems and mixed signal systems. Measurement accuracy and error. Network analysis and spectrum analysis used in high speed measurement and testing. Test specification process and parametric measurement. Sampling and digital signal processing concepts. Design for testability. Testing equipment. Applications. Nonmajor graduate credit.

E E 421. Communication Systems I. (3-0) Cr. 3. F. *Prereq: 224, credit or registration in 322.* Frequency domain analysis, spectral filtering, bandwidth. Linear modulation systems. Angle modulation systems. Phase locked loop, super-heterodyne receiver. Sampling and pulse code modulation. Digital data transmission, line coding, pulse shaping, multiplexing. Nonmajor graduate credit.

E E 422. Communication Systems II. (3-0) Cr. 3. *Prereq: 421 and enrollment in 423.* Introduction to probability and random processes; Performance of analog systems with noise; Performance of digital communication with noise; optimum receivers, transmission impairments, and error rates; Introduction to information theory and coding: source coding, channel coding, channel capacity. Nonmajor graduate credit.

E E 423. Communication Systems Laboratory. (0-3) Cr. 1. *Prereq: 421, enrollment in 422.* Construction and evaluation of modulators, demodulators, modems, and other components for analog and digital communications. Design and evaluate wireless communication systems and their key components. Noise measurement. Design and construction of a communication system. Nonmajor graduate credit.

E E 424. Introduction to Digital Signal Processing. (3-3) Cr. 4. *Prereq: 324.* Sampling and reconstruction. Concepts and mathematical tools in discrete-time signal processing with examples from digital signal processing and communications. Discrete-time correlation and matched-filter receivers. Discrete Fourier transform (DFT). Fast Fourier algorithms. Z transforms. Design of finite impulse response (FIR) and infinite impulse response (IIR) filters. Realizations of discrete-time systems and quantization effects. Multi-rate signal processing. Laboratory experiments illustrating DSP implementations and applications. Nonmajor graduate credit.

E E 432. Microelectronics Fabrication Techniques. (Dual-listed with 532). (Cross-listed with Mat E). (2-4) Cr. 4. *Prereq: Phys 222, Math 267. E E 332 or Mat E 334 recommended.* Techniques used in modern integrated circuit fabrication, including diffusion, oxidation, ion implantation, lithography, evaporation, sputtering, chemical-vapor deposition, and etching. Process integration. Process evaluation and final device testing. Extensive laboratory exercises utilizing fabrication methods to build electronic devices. Use of computer simulation tools for predicting processing outcomes. Recent advances in processing CMOS ICs and micro-electro-mechanical systems (MEMS). Nonmajor graduate credit.

E E 435. Analog VLSI Circuit Design. (Cross-listed with Cpr E). (3-3) Cr. 4. S. *Prereq: 324, 330, 332, and either E E 322 or Stat 330.* Basic analog integrated circuit and system design including design space exploration, performance enhancement strategies,

operational amplifiers, references, integrated filters, and data converters. Nonmajor graduate credit.

E E 438. Optoelectronic Devices and Applications. (Dual-listed with 538). (3-0) Cr. 3. *Prereq: 311, 332.* Transmission and reflection of electromagnetic plane waves. Propagation in dielectric and fiber optic waveguides. LED and laser operating principles and applications. Photodetectors and solar cells. Optical modulation and switching. Nonmajor graduate credit.

E E 439. Nanoelectronics. (3-0) Cr. 3. S. *Prereq: E E 332/Mat E 332 or Mat E 331.* Concepts of quantum mechanics relevant to nanoelectronic devices, including quantization, tunneling, and transport; overview of some of the leading technologies for nanoelectronics, including carbon nanotubes, quantum dots, and molecular transistors; fabrication methods for building nanoelectronic devices. Nonmajor graduate credit.

E E 442. Introduction to Circuits and Instruments. (3-2) Cr. 2. F.S. *Prereq: Phys 222, Math 267.* Half-semester course. Basic circuit analysis using network theorems with time domain and Laplace transform techniques for resistive, resistive-inductive, resistive-capacitive, and resistive- inductive-capacitive circuits. Transient circuit behavior. Basic operational amplifiers and applications. Familiarization with common E E instrumentation and demonstration of basic principles. Credit for only 201 or 442 may be counted toward graduation; credit for 442 will not count toward graduation for E E or Cpr E majors. Nonmajor graduate credit.

E E 448. Introduction to AC Circuits and Motors. (3-2) Cr. 2. F.S. *Prereq: 303 or 441 or 442.* Half-semester course. Magnetic circuits. Power transformers. AC steady state and three-phase circuit analysis. Basic principles of operation and control of induction and single-phase motors. Nonmajor graduate credit.

E E 452. Electrical Machines and Power Electronic Drives. (2-3) Cr. 3. S. *Prereq: 303; 330 or 332; credit or registration in E E 324.* Basic concepts of electromagnetic energy conversion. DC motors and three-phase induction motors. Basic introduction to power electronics. Adjustable speed drives used for control of DC, induction, and AC motors. Experiments with converter topologies, DC motors, AC motors and adjustable speed drives. Nonmajor graduate credit.

E E 455. Introduction to Energy Distribution Systems. (3-0) Cr. 3. F. *Prereq: 303, credit or registration in 324.* Overhead and underground distribution system descriptions and characteristics, load descriptions and characteristics, overhead line and underground cable models, distribution transformers, power flow and fault analysis, overcurrent protection, power factor correction, system planning and automation, and economics in a deregulated environment. Nonmajor graduate credit.

E E 456. Power System Analysis I. (3-0) Cr. 3. F. *Prereq: 303, credit or registration in 324.* Power transmission lines and transformers, synchronous machine modeling, network analysis, power system representation, load flow. Nonmajor graduate credit.

E E 457. Power System Analysis II. (3-0) Cr. 3. S. *Prereq: 303, credit or registration in 324.* Power system protection, symmetrical components, faults, stability. Power system operations including the new utility environment. Nonmajor graduate credit.

E E 458. Economic Systems for Electric Power Planning. (Cross-listed with Econ). (3-0) Cr. 3. *Prereq: 303 or Econ 301.* Evolution of electric power industry. Power system operation and planning and related information systems. Linear and integer optimization methods. Short-term electricity markets and locational marginal prices. Risk management and financial derivatives. Basics of public good economics. Cost recovery models including tax treatment for transmission investments. Nonmajor graduate credit.

E E 463. Design of Electrical Systems. (1-10) Cr. 5. SS. *Prereq: 322 and completion of 24 credits in the E E core professional program, Engl 314.* Distance-education students only. Team project design experience. Emphasis on defining, planning, and implementing to achieve project objectives to meet a client's need with due consideration to professional and technical considerations of engineering design and implementation. Oral and written presentations of project achievements.

E E 465. Digital VLSI Design. (Cross-listed with Cpr E). (3-3) Cr. 4. S. *Prereq: E E 330.* Digital design of integrated circuits employing very large scale integration (VLSI) methodologies. Technology considerations in design. High level hardware design languages, CMOS logic design styles, area-energy-delay design space characterization, datapath blocks: arithmetic and memory, architectures and systems on a chip (Soc) considerations. VLSI chip hardware design project. Nonmajor graduate credit.

E E 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Aer E, Cpr E, Engr, I E, M E, Mat E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing, and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

E E 475. Automatic Control Systems. (3-0) Cr. 3. F. *Prereq: 324.* Stability and performance analysis of automatic control systems. The state space, root locus, and frequency response methods for control systems design. PID control and lead-lag compensation. Computer tools for control system analysis and design. Nonmajor graduate credit.

E E 476. Control System Simulation. (2-3) Cr. 3. S. *Prereq: 475.* Computer aided techniques for feedback control system design, simulation, and implementation. Nonmajor graduate credit.

E E 488. Eddy Current Nondestructive Evaluation. (Dual-listed with 588). (Cross-listed with Mat E). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Math 265 and (Mat E 216 or 272 or E E 311 or Phys 364).* Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

E E 490. Independent Study. Cr. arr. *Prereq: Senior classification in electrical engineering.* Investigation of an approved topic commensurate with the student's prerequisites.
H. Honors

E E 491. Senior Design Project I and Professionalism. (Cross-listed with Cpr E). (2-3) Cr. 3. F.S. *Prereq: 322 or Cpr E 308, completion of 24 credits in the E E core professional program or 29 credits in the Cpr E core professional program, Engl 314.* Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; design review presentation. First of two-semester team-oriented, project design and implementation experience.

E E 492. Senior Design Project II. (Cross-listed with Cpr E). (1-3) Cr. 2. F.S. *Prereq: 491 or Cpr E 491.* Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in E E 491 or Cpr E 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements; project poster.

E E 494. Portfolio Assessment. (Cross-listed with Cpr E). Cr. R. *Prereq: Credit or enrollment in 491.* Portfolio update and evaluation. Portfolios as a tool to enhance career opportunities.

E E 496. Modern Optics. (Cross-listed with Phys). (3-0) Cr. 3. *Prereq: Credit or enrollment in Phys 322 and 365.* Review of wave and electromagnetic theory; topics selected from: reflection/refraction, interference, geometrical optics, Fourier analysis, dispersion, coherence, Fraunhofer and Fresnel diffraction, holography, quantum optics, nonlinear optics. Nonmajor graduate credit.

E E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education programs. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduate students

E E 501. Analog and Mixed-Signal VLSI Circuit Design Techniques. (Cross-listed with Cpr E). (3-3) Cr. 4. F. *Prereq: 435.* Design techniques for analog and mixed-signal VLSI circuits. Amplifiers; operational amplifiers, transconductance amplifiers, finite gain amplifiers and current amplifiers. Linear building blocks; differential amplifiers, current mirrors, references, cascading and buffering. Performance characterization of linear integrated circuits; offset, noise, sensitivity and stability. Layout considerations, simulation, yield and modeling for high-performance linear integrated circuits.

E E 505. CMOS and BiCMOS Data Conversion Circuits. (Cross-listed with Cpr E). (3-3) Cr. 4. Alt. S., offered 2010. *Prereq: 501.* Theory, design and applications of data conversion circuits (A/D and D/A converters) including: architectures, characterization, quantization effects, conversion algorithms, spectral performance, element matching, design for yield, and practical comparators, implementation issues.

E E 507. VLSI Communication Circuits. (Cross-listed with Cpr E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 330 or 501.* Phase-locked loops, frequency synthesizers, clock and data recovery circuits, theory and implementation of adaptive filters, low-noise amplifiers, mixers, power amplifiers, transmitter and receiver architectures.

E E 508. Filter Design and Applications. (3-3) Cr. 4. *Prereq: 501.* Filter design concepts. Approximation and synthesis. Transformations. Continuous-time and discrete time filters. Discrete, active and integrated synthesis techniques.

E E 510. Topics in Electromagnetics. Cr. arr. Repeatable.

E E 511. Modern Optical Communications. (3-0) Cr. 3. S. *Prereq: 311.* Propagation in optical media. Optical fibers. Optical sources and detectors. Fiber optic communications systems. DWDM considerations.

E E 512. Advanced Electromagnetic Field Theory I. (3-0) Cr. 3. F. *Prereq: 413.* Review of Static electric and magnetic fields. Maxwell's equations. Circuit concepts and impedance elements. Propagation and reflection of plane waves in isotropic media. Guided electromagnetic wave. Characteristics of common waveguides and transmission lines. Propagation in anisotropic media. Special theorems and concepts. Radiation and scattering.

E E 513. Advanced Electromagnetic Field Theory II. (3-0) Cr. 3. S. *Prereq: 512.* Green's functions, perturbational and variational techniques. Analysis of microstrip lines and interconnects. Spectral domain approach, waves in layered media. Integral equations. Inverse scattering. Electromagnetic applications.

E E 514. Microwave Engineering. (Dual-listed with 414). (3-3) Cr. 4. F. *Prereq: 230, 311.* Principles, analyses, and instrumentation used in the microwave portion of the electromagnetic spectrum. Wave theory in relation to circuit parameters. S parameters, couplers, discontinuities, and microwave device equivalent circuits. RF amplifier design, microwave sources, optimum noise figure and maximum power designs. Microwave filters and oscillators.

E E 516. Computational Methods in Electromagnetics. (3-0) Cr. 3. S. *Prereq: 311.* Maxwell's equations. Analytical methods. Differential equation based methods. Finite Difference and Finite Difference Time Domain Methods, Boundary Conditions. Finite Element Method, Applications to the Analysis of Practical Devices. Integral Equation Based Methods. Electric and Magnetic Field Integral Equations. Fast Solution Methods.

E E 517. Electromagnetic Radiation, Antennas, and Propagation. (Dual-listed with 417). (3-3) Cr. 4. S. *Prereq: 311.* Fundamental antenna concepts. Radiation from wire-and aperture-type sources. Radio transmission formulas. Wave and antenna polarization. Antenna arrays. Modern antenna topics. Practical antenna design. Antenna noise. Radiowave propagation in the presence of the earth and its atmosphere. Antenna measurements and computer-aided analysis.

E E 518. Microwave Remote Sensing. (Cross-listed with Agron, Mteor). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 265 or equivalent or permission of instructor.* Microwave remote sensing of Earth's surface and atmosphere. Overview of relevant electromagnetic theory and antenna theory. Planck emission and the radiative transfer equation. The electrical properties of natural materials at microwave frequencies. Specific examples include remote sensing of atmospheric temperature and water vapor, precipitation, and soil and vegetation water content.

E E 520. Selected Topics in Communications and Signal Processing. (3-0) Cr. 3. Repeatable. Space-time processing. Multiuser communications, Wireless Communications, statistical signal processing. Pattern recognition. Coding theory. Multirate communications and signal processing. Signal processing and communications applications.

E E 521. Advanced Communications. (3-0) Cr. 3. F. *Prereq: 422, Coreq: 523.* Digital communication systems overview. Characterization of communication channels. Digital modulation and demodulation design and performance analysis. Channel capacity and error-control coding concepts. Waveform design for band-limited channels. Equalization. Wireless fading channels and performance.

E E 523. Random Processes for Communications and Signal Processing. (3-0) Cr. 3. *Prereq: 322, Math 317.* Axioms of probability; Repeated trials; Functions of a random variable and multiple random variables: covariance matrix, conditional distribution, joint distribution, moments, and joint moment generating function; Mean Square estimation; stochastic convergence; Some important stochastic processes: Random walk, Poisson, Wiener, and shot noise; Markov chaines; Power spectral analysis; Selected applications.

E E 524. Digital Signal Processing. (3-0) Cr. 3. F. *Prereq: 322, 424, Math 317.* Review: sampling and reconstruction of signals; discrete-time signals, systems, and transforms. Multi-rate digital signal processing and introduction to filter banks. Optimal linear filtering and prediction. Introductions to adaptive filtering and spectral estimation. Applications.

E E 527. Detection and Estimation Theory. (3-0) Cr. 3. S. *Prereq: 422.* Statistical estimation theory and performance measures: maximum likelihood estimation, Cramer-Rao bound, Bayesian estimation, optimal demodulation, signal design. Introduction to graphical models. Hidden Markov models and Kalman filter. Classical Statistical decision theory, decision criteria, binary and composite hypothesis tests. Error probability and Chernoff bound. Applications.

E E 528. Digital Image Processing. (3-0) Cr. 3. S. *Prereq: 322, 424.* Review of sampling, linear algebra and probability. Classical image processing topics such as image sampling and quantization, image transforms (2D Fourier, KLT, DCT, etc), image enhancement, restoration and filtering. Image analysis topics including edge detection, segmentation, registration and tracking (uses least squares estimation, EM, Kalman filter). Medical image reconstruction from tomographic projections (Radon transform, Fourier slice theorem and reconstruction algorithms using them) and Magnetic Resonance Imaging (MRI). Basic introduction to image and video compression methods.

E E 530. Selected Topics in Electronics, Microelectronics and Photonics. (3-0) Cr. 3. Repeatable. *Prereq: 332.*

E E 532. Microelectronics Fabrication Techniques. (Dual-listed with 432). (2-4) Cr. 4. *Prereq: Phys 222, Math 267. E E 332 or Mat E 331 recommended.* Techniques used in modern integrated circuit fabrication, including diffusion, oxidation, ion implantation, lithography, evaporation, sputtering, chemical-vapor deposition, and etching. Process integration. Process evaluation and final device testing. Extensive laboratory exercises utilizing fabrication methods to build electronic devices. Use of computer simulation tools for predicting processing outcomes. Recent advances in processing CMOS ICs and micro-electro-mechanical systems (MEMS).

E E 535. Physics of Semiconductors. (Cross-listed with Phys). (3-3) Cr. 4. *Prereq: 311 and 332.* Basic elements of quantum theory, Fermi Statistics, motion of electrons in periodic structures, crystal structure, energy bands, equilibrium carrier concentration and doping, excess carriers and recombination, carrier transport at low and high fields, phonons, optical properties, amorphous semiconductors, heterostructures, and surface effects. Laboratory experiments on optical properties, carrier lifetimes, mobility, defect density, doping density.

E E 536. Physics of Semiconductor Devices. (Cross-listed with Phys). (3-0) Cr. 3. *Prereq: 535.* P-n junctions, band-bending theory, tunneling phenomena, Schottky barriers, heterojunctions, bipolar transistors, field-effect transistors, negative-resistance devices and optoelectronic devices.

E E 538. Optoelectronic Devices and Applications. (Dual-listed with 438). (3-0) Cr. 3. *Prereq: 311 or 332.* Transmission and reflection of electromagnetic plane waves. Propagation in dielectric and fiber optic waveguides. Led and laser operating principles and applications. Photodetectors and solar cells. Optical modulation and switching.

E E 545. Artificial Neural Networks. (3-0) Cr. 3. F. *Prereq: 324.* Introduction to the fundamentals of artificial neural networks (ANNs). Theory and practical implementation of networks. ANNs for pattern recognition, function approximation, prediction. Activation functions, neural net architectures, supervised and unsupervised learning. Various neural network methods and architectures.

E E 547. Pattern Recognition. (3-0) Cr. 3. F. *Prereq: 324.* Mathematical formulation of pattern recognition problems and decision functions. Statistical approaches: Bayes classifier, probability density function estimation and expectation minimization. Clustering (supervised and unsupervised), learning, and neural network algorithms. Fuzzy recognition systems. Feature selection systems. Classifier comparison. Current applications.

E E 553. Steady State Analysis. (3-0) Cr. 3. F. *Prereq: 456, 457.* Power flow, economic dispatch, unit commitment, electricity markets, automatic generation control, sparse matrix techniques, interconnected operation, voltage control.

E E 554. Power System Dynamics. (3-0) Cr. 3. S. *Prereq: 456, 457, 475.* Dynamic performance of power systems with emphasis on stability. Modeling of system components and control equipment. Analysis of the dynamic behavior of the system in response to small and large disturbances.

E E 555. Advanced Energy Distribution Systems. (3-0) Cr. 3. *Prereq: 455.* Transient models of distribution components, automated system planning and distribution automation, surge protection, reliability, power quality, power electronics and intelligent systems applications.

E E 556. Power Electronic Systems. (3-0) Cr. 3. *Prereq: 452.* Converter topologies, AC/DC, DC/DC, DC/AC, AC/AC. Converter applications to do motor drives, power supplies, AC motor drives, power system utility applications (var compensators) and power quality.

E E 565. Systems Engineering and Analysis. (Cross-listed with Aer E, I E). (3-0) Cr. 3. *Prereq: Coursework in basic Statistics.* Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated systems. Life-cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test, evaluation and systems engineering planning and organization. Not available for degrees in industrial engineering.

E E 566. Avionics Systems Engineering. (Cross-listed with Aer E). (3-0) Cr. 3. S. *Prereq: E E 565.* Avionics functions. Applications of systems engineering principles to avionics. Top down design of avionics systems. Automated design tools.

E E 570. Systems Engineering Analysis and Design. (3-0) Cr. 3. *Prereq: 475, 577.* Selected topics in abstract algebra, linear algebra, real analysis, functional analysis, and optimization methods in electrical engineering.

E E 573. Random Signal Analysis and Kalman Filtering. (Cross-listed with Aer E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 370 or 411 or Math 341 or 395.* Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

E E 574. Optimal Control. (Cross-listed with Aer E, Math, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* The optimal control problem. Variational approach. Pontryagin's principle, Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

E E 575. Introduction to Robust Control. (Cross-listed with Math, Aer E, M E). (3-0) Cr. 3. *Prereq: E E 577.* Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H2, Hoo, and l1 control problems. Tools for robustness analysis and synthesis.

E E 576. Digital Feedback Control Systems. (Cross-listed with Aer E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 475 or Aer E 432 or M E 411 or 414 or Math 415; and Math 267.* Sampled data, discrete data, and the z-transform. Design of digital control systems using transform methods: root locus, frequency response and direct design methods. Design using State-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

E E 577. Linear Systems. (Cross-listed with Aer E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 414 or Math 415; and Math 307.* State variable and input-output descriptions of linear continuous-time and discrete-time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by State feedback. Design of feedback systems. Stability of linear dynamical systems.

E E 578. Nonlinear Systems. (Cross-listed with Aer E, Math, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* Classification of nonlinear control systems. Existence and uniqueness of solutions. Approximate analysis methods. Periodic orbits. Concept of stability and Lyapunov stability theory. Absolute stability of feedback systems. Input-output stability. Passivity.

E E 588. Eddy Current Nondestructive Evaluation. (Dual-listed with 488). (Cross-listed with M S E). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Math 265 and Mat E 216 or 272 or E E311 or Phys 364).* Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

E E 590. Special Topics. Cr. arr. Repeatable. Formulation and solution of theoretical or practical problems in electrical engineering.
A. Electromagnetic Theory
B. Control Systems
C. Communication Systems
E. Computer Engineering
F. Electric Power
G. Electrical Materials
H. Electronic Devices and Circuits
I. Signal Processing

E E 591. Seminar in Electronics, Microelectronics, and Photonics. Cr. arr. Repeatable.

E E 592. Seminar in Electromagnetics, Microwave, and Nondestructive Evaluation. Cr. 1. Repeatable. *Prereq: Graduate student Status.* Satisfactory-fail only.

E E 594. Seminar in Electric Power. Cr. arr. Repeatable.

E E 596. Seminar in Control Systems. Cr. arr. Repeatable.

E E 597. Seminar in Communications and Signal Processing. Cr. 1. Repeatable. Satisfactory-fail only.

E E 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

E E 621. Coding Theory. (3-0) Cr. 3. *Prereq: 521.* Fundamentals of error-control coding techniques: coding gain, linear block codes. Galois fields. Cyclic codes: BCH, Reed-Solomon. Convolutional codes and the Viterbi algorithm. Trellis-coded modulation. Iterative decoding. Recent developments in coding theory.

E E 622. Information Theory. (3-0) Cr. 3. *Prereq: 521, 523. Information* system overview. Entropy and mutual information. Data Compression and source encoding. Discrete memoryless channel capacity. Noisy channel coding theorem. Rate distortion theory. Waveform channels. Advanced topics in information theory.

E E 653. Advanced Topics in Electric Power System Engineering. (3-0) Cr. 3. *Prereq: Permission of instructor.* Advanced topics of current interest in electric power system engineering.

E E 674. Advanced Topics in Systems Engineering. (3-0) Cr. 3. *Prereq: Permission of instructor.* Advanced topics of current interest in the areas of control theory, stochastic processes, digital signal processing, and image processing.

E E 697. Engineering Internship. (Cross-listed with Cpr E). Cr. R. Repeatable. *Prereq: Permission of department chair and Engineering Career Services, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

E E 699. Research. Cr. arr. Repeatable.

Engineering

Most of the courses with the designator of Engr are broad-based engineering courses applicable to all engineering disciplines. Several of these courses are part of the basic program which is required for engineering students. All courses are administered by the college and with the exception of Engr 160 and Engr 170 are coordinated through Engineering Student Services in Engineering Academic and Student Affairs. Course-related questions should be directed to the department or unit with responsibility for that course. The following is a list of those responsibilities:

Engr 160 Materials Science and Engineering

Engr 170 Agricultural and Biosystems Engineering

Courses primarily for undergraduate students

Engr 101. Engineering Orientation. Cr. R. F.S. Introduction to the College of Engineering and the engineering profession. Information concerning university and college policies, procedures, and resources. Undeclared sections: Considerations in choosing an engineering curriculum. Opportunities to interact with departments. Declared sections: Introduction to major-specific topics. Satisfactory-fail only.

Engr 104. LEAD Program Orientation. (1-0) Cr. 1. F. Orientation for LEAD Living/Learning Community participants. Applications of problem solving, engineering design, teamwork, study, and time management techniques and skills. Engineering professional development. Satisfactory-fail only.

Engr 105. LEAD Program Seminar. (1-0) Cr. 1. S. Seminar for LEAD Program participants in the residential learning community. Industrial tours and orientation to engineering profession. Satisfactory-fail only.

Engr 131. Learning Community Seminar. (1-0) Cr. R. F.S. Peer-mentored review of course topics in engineering undeclared learning communities. Available to students interested in engineering if in Liberal Arts and Science Open (option) major. Satisfactory-fail only.

Engr 150. Foundations of Leadership Development and Learning. (1-0) Cr. 1. F.S. *Prereq: ELP students only.* Leadership development with focus on global context and awareness of events shaping the context. Exposure to theory of leadership with examples. Necessary characteristics of a leader, and strategies for leadership skills development. Exposure to non-traditional career paths for engineers. Outline of personalized leadership development. Satisfactory-fail only.

Engr 160. Engineering Problems with Computer Applications Laboratory. (2-2) Cr. 3. F.S.SS. *Prereq: Satisfactory scores on Mathematics placement examinations; credit or enrollment in Math 142, 165.* Solving engineering problems and presenting solutions through technical reports. Significant figures. Use of SI units. Graphing and curve-fitting. Flowcharting. Introduction to mechanics, statistics and engineering economics. Use of spreadsheet programs to solve and present engineering problems. Solution of engineering problems using computer programming languages. (The honors section includes application of programming to mobile robotics).
H. Honors. F.

Engr 170. Engineering Graphics and Introductory Design. (2-2) Cr. 3. F.S. *Prereq: Satisfactory scores on mathematics placement assessments; credit or enrollment in Math 142.* Integration of fundamental graphics, computer modeling, and engineering design. Applications of multiview drawings and dimensioning. Techniques for visualizing, analyzing, and communicating 3-D geometries. Application of the design process including written and oral reports. Freehand and computer methods.

Engr 193. Academic Excellence Workshop. (0-3) Cr. 1. F.S. *Prereq: Engineering classification and concurrent enrollment in appropriate course.* Collaborative learning community workshops for LEAD participants. Satisfactory-fail only.
A. Chemistry 155 (Fall only)
B. Chemistry 165 (Spring only)
C. Chemistry 167
D. Mathematics 165
E. Mathematics 166
F. Physics 221
G. Physics 222
I. Engineering Problems-Computer Applications

Engr 320. International Experience Report. Cr. 3. F.S. *Prereq: Satisfactory completion of international work experience of at least ten weeks or nine credits of approved course work taken abroad. Permission of student's department prior to departure.* Critique of work/study abroad experience as it relates to professional development. Taken the semester after completion of work abroad or study abroad. Written report and presentation. Satisfactory-fail only.

Engr 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of Engineering Student Services advisor and Engineering Career Services.* Summer professional work period.

Engr 397. Professional Internship. Cr. R. F.S.SS. *Prereq: Permission of adviser and engineering college classification officer.* Professional or interdisciplinary work period in engineering or career-related field. Enrollment limited to one summer and/or one semester per academic year. Satisfactory-fail only.

Engr 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Aer E, Cpr E, E E, I E, M E, Mat E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing, and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

Engr 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or senior classification in engineering, college approval.*
E. Entrepreneurship

Engineering Mechanics

(Administered by the Department of Aerospace Engineering)

Thomas Shih, Chair of Department

Distinguished Professors: Soukoulis, R. B. Thompson

Distinguished Professors (Emeritus): D. Thompson, Young

Professors: Chandra, Chimenti, Durbin, Holger, Kelkar, Levitas, Lu, Oliver, Rajagopalan, Rothmayer, Rudolphi, Sarkar, Schmerr, Shih, Takle, Wang, Wie, Zachary

Professors (Emeritus): Akers, Greer, Inger, Iversen, Jenison, McConnell, McDaniel, Munson, Pierson, Rizzo, Rogge, Rohach, Tannehill, Tsai, Weiss, Wilson

Professors (Adjunct): Hsu, Nakagawa

Associate Professors: Bastawros, Bryden, Dayal, Hilliard, Hindman, Mitra, Sherman, Sturges

Associate Professors (Emeritus): Hermann, Seversike, Trulin, Vogel

Associate Professors (Adjunct): Biner, Cox, Roberts

Associate Professor (Collaborator): Flatau

Assistant Professors: Chung, Holland, Hong, Hu, Jacobson

Assistant Professors (Adjunct): Byrd, Gray

Assistant Professor (Collaborator): Chavez

Senior Lecturers: Deam, Haugli, Schaefer

Lecturer: Boylan

Undergraduate Study

The undergraduate courses in mechanics are intermediate between those in physics and mathematics and the professional and design courses of the several engineering curricula. In these courses the student is expected to acquire an understanding of the basic principles and analysis techniques pertaining to the static and dynamic behavior of rigid media, deformable solids, fluids, and gasses. Physical properties of engineering materials are studied in the classroom and are tested in the laboratory. General physical laws are given mathematical expression and are made suitable for use in the solution of specific problems in machine and structural design, and in the flow and measurement of fluids.

Graduate Study

The department offers work for the degrees master of science, master of engineering, and doctor of philosophy with major in engineering mechanics, and minor work to students taking major work in other departments.

The master of science degree requires a thesis and a minimum of 8 research credits. It has strong research emphasis and is recommended for students who anticipate entering a doctoral program later. At least 30 credits of acceptable graduate work are required for the degree.

The master of engineering degree does not require either research credits or a thesis. However, at least two credits of acceptable creative component and at least 26 credits of acceptable graduate coursework are required. A minimum of 30 credits of acceptable graduate work is required for the degree. The program is intended to give students additional instruction at the graduate level to better qualify them for advanced professional engineering work. By careful selection of electives and perhaps additional courses during the senior undergraduate year, students should be able to qualify for the master of engineering degree with an additional year of full-time study after receiving their baccalaureate degree in one of the several engineering curricula.

Credits for creative component will be obtained by registering for E M 599. A written report and an oral presentation will be given to the student's graduate committee.

The normal prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this university. However, because of the diversity of interests in graduate work in engineering mechanics, it is possible for a student to qualify for graduate study even though undergraduate or prior graduate training has been in a discipline other than engineering—e.g., physics or mathematics.

Courses primarily for undergraduate students

E M 274. Statics of Engineering. (3-0) Cr. 3. F.S.SS. *Prereq: Credit or enrollment in Math 166; credit or enrollment in Phys 111 or 221.* Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, second moments of areas, principal second moments of area, radius of gyration, internal forces, shear and bending moment diagrams.
H. Honors. F.S.

E M 324. Mechanics of Materials. (3-0) Cr. 3. F.S.SS. *Prereq: 274.* Plane stress, plane strain, stress-strain relationships, and elements of material behavior. Application of stress and deformation analysis to members subject to centric, torsional, flexural, and combined loadings. Elementary considerations of theories of failure, buckling. Nonmajor graduate credit.

E M 327. Mechanics of Materials Laboratory. (0-2) Cr. 1. F.S.SS. *Prereq: Credit or enrollment in 324.* Experimental determination of mechanical properties of selected engineering materials. Experimental verification of assumptions made in 324. Use of strain measuring devices. Preparation of reports. Students who are not present for the first laboratory meeting of their own sections may qualify for continuation in the course only by attending the first laboratory meeting of some other section of the course. Nonmajor graduate credit.

E M 345. Dynamics. (3-0) Cr. 3. F.S.SS. *Prereq: 274, credit or enrollment in Math 266 or 267.* Particle and rigid body kinematics, Newton's laws of motion, kinetics of plane motion, rigid body problems using work-energy, linear, and angular impulse-momentum principles, vibrations. Nonmajor graduate credit.

E M 350. Introduction to Nondestructive Evaluation Engineering. (3-0) Cr. 3. S. *Prereq: 324, Math 266 or 267, Phys 222.* The Physics of ultrasonic, eddy current, and x-ray testing. Introduction to linear system concepts, wave propagation, electromagnestics and radiation. Models of the generation, scattering and reception of waves in ultrasonics, the electrical impedance changes of eddy current testing, and image formation process for x-rays. Pattern recognition methods for the interpretation of measured responses. Nonmajor graduate credit.

E M 362. Principles of Nondestructive Testing. (Cross-listed with Mat E). (3-0) Cr. 3. S. *Prereq: Phys 112 or 222.* Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection, and other techniques. Physical bases of tests; materials to which applicable; types of defects detectable; calibration standards, and reliability safety precautions. Nonmajor graduate credit.

E M 362L. Nondestructive Testing Laboratory. (Cross-listed with Mat E). (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 362.* Application of nondestructive testing techniques to the detection and sizing of flaws in materials and to the characterization of material's microstructure. Included are experiments in hardness, dye penetrant, magnetic particle, x-ray, ultrasonic and eddy current testing. Field trips to industrial laboratories. Nonmajor graduate credit.

E M 378. Mechanics of Fluids. (2-2) Cr. 3. F.S.SS. *Prereq: 274.* Properties of fluids. Fluid Statics. Kinematics and kinetics of fluid flow. Mass, momentum, and energy conservation laws; dimensional analysis; flow in pipes and channels. Selected laboratory experiments. Nonmajor graduate credit.

E M 417. Experimental Mechanics. (Cross-listed with Aer E). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: 324.* Introduction of different aspects of measuring deformation, strains, and stress for practical engineering problems. Strain gage theory and application. Selected laboratory experiments. Nonmajor graduate credit.

E M 424. Intermediate Mechanics of Materials. (3-0) Cr. 3. F.S. *Prereq: 324.* Analysis of stresses, strains, and deflections. Torsion and bending of unsymmetrical members. Analysis of thick wall pressure vessels and shrink fit problems. Dynamic load effects, fatigue and fracture mechanics introduction. Work-strain energy methods. Nonmajor graduate credit.

E M 425. Introduction to the Finite Element Method. (3-0) Cr. 3. S. *Prereq: 324, Math 266 or 267.* Introduction of finite element analysis through applications to one-dimensional, steady-state problems such as elastic deformation, heat and fluid flow, consolidation, beam bending, and mass transport. Transient heat conduction and wave propagation. Two-dimensional triangular and quadrilateral elements. Plane problems of torsion, thermal and potential flow, stress analysis. Simple computer programs for one- and two-dimensional problems. Nonmajor graduate credit.

E M 450. Engineering Vibrations. (Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: 324, 345.* Elementary vibration analysis, single and multiple degrees of freedom, energy methods, free and forced vibrations, viscous and other forms of damping transform methods and response to periodic and random force inputs, numerical methods of solution, eigenvalues and modal analysis, energy methods, vibration isolation and suppression, string or cable dynamics, beam bending dynamics, application problems in aerospace and mechanical engineering (as relevant). Nonmajor graduate credit.

E M 451. Engineering Acoustics. (Cross-listed with M E). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: Phys 221 and Math 266 or 267.* Sound sources and propagation. Noise standards and effects of noise on people. Principles of noise and vibration control used in architectural and engineering design. Characteristics of basic noise measurement equipment. Experience in use of noise measuring equipment, sound power measurements, techniques for performing noise surveys, evaluation of various noise abatement techniques applied to common noise sources. Selected laboratory experiments. Nonmajor graduate credit.

E M 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
H. Honors

Courses primarily for graduate students, open to qualified undergraduate students

E M 510. Continuum Mechanics. (3-0) Cr. 3. F. *Prereq: Math 385.* Introduction to Cartesian tensors as linear vector transformations. Kinematics of continuous deformations, Lagrangian and Eulerian descriptions of motion. Fundamental equations or balance laws of continuous media, linear and angular momentum balance. Conservation laws of momentum and energy. Introduction to constitutive equations of classical elastic solids and simple fluids. Formulations and solutions of some canonical problems.

E M 514. Advanced Mechanics of Materials. (Cross-listed with Aer E). (3-0) Cr. 3. F. *Prereq: 324.* Theory of stress and strain, stress-strain relationships. Unsymmetrical bending, curved beams, shear center. Torsion of thin-walled noncircular sections. Equilibrium, compatibility equations. Airy stress functions. Membrane stresses in shells, thick-walled cylinders.

E M 516. Mechanics of Deformable Solids. (3-0) Cr. 3. S. *Prereq: E M 510.* Fundamental mechanics of linear elasticity, formulation and solution of simple elastostatic boundary value problems. Kinematics of small deformations, constitutive equations for isotropic and anisotropic media. Field equations for elastic solids, plane strain/plane stress and some classic canonical solutions. Constitutive models of inelastic/plastic solids and selected problems of elastoplasticiy, contact mechanics, fracture mechanics and defects in crystalline solids.

E M 517. Experimental Mechanics. (Cross-listed with Aer E). (3-2) Cr. 4. Alt. S., offered 2010. *Prereq: E M 510 or 514 or 516.* Fundamental concepts for force, displacement, stress, and strain measurements. Strain gages. Full field deformation measurements with laser interferometry and digital image processing. Advanced experimental concepts at the micro and nano scale regimes.

E M 518. Waves in Elastic Solids with Applications to Ultrasonic Nondestructive Evaluation. (3-0) Cr. 3. F. *Prereq: Math 385.* Propagation of bulk waves, surface waves, and guided waves in isotropic and anisotropic elastic media. Transmission and reflection of waves at plane and curved interfaces. Radiation of sources with application to ultrasonic transducer beam modeling. Elastic wave scattering from cracks and inclusions. Reciprocity principles and their use in the development of an ultrasonic measurement model. Characterization and measurement of material attenuation.

E M 525. Finite Element Analysis. (Cross-listed with Aer E). (3-0) Cr. 3. S. *Prereq: 425, Math 385.* Variational and weighted residual approach to finite element equations. Emphasis on two- and three-dimensional problems in solid mechanics. Isoparametric element formulation, higher order elements, numerical integration, imposition of constraints and penalty, convergence, and other more advanced topics. Use

of two- and three-dimensional computer programs. Dynamic and vibrational problems, eigenvalues, and time integration. Introduction to geometric and material nonlinearities.

E M 526. Boundary Element Methods in Engineering. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 514 or 516.* Introductory boundary element methods through plane problems. Singular integrals, Cauchy principal values, integral representations and boundary integrals in one dimension. Direct and indirect formulations. Plane potential and elastostatic problems. Higher order elements, numerical integration. Regularizations. Body forces and infinite regions. Specialized fundamental solutions, half-plane and axisymmetric problems. Diffusion and wave problems. Coupling with finite elements.

E M 543. Introduction to Random Vibrations and Nonlinear Dynamics. (Cross-listed with M E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 444.* Vibrations of continuous systems. Nonlinear vibration phenomena, perturbation expansions; methods of multiple time scales and slowly-varying amplitude and phase. Characteristics of random vibrations; random processes, probability distributions, spectral density and its significance, the normal or Gaussian random process. Transmission of random vibration, response of simple single and two-degree-of-freedom systems to Stationary random excitation. Fatigue failure due to random excitation.

E M 548. Advanced Engineering Dynamics. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 345, Math 266 or 267.* 3-D kinematics and dynamics of particles and rigid bodies. Coordinate systems, calculus of variations. Lagrange's equations with constraints, modified Euler's equations, torque-free motion of rigid bodies in 3-D, moment equations with constraints.

E M 550. Fundamentals of Nondestructive Evaluation. (Cross-listed with M S E). (3-2) Cr. 4. S. *Prereq: 324, Math 385.* Principles of five basic NDE methods and their application in engineering inspections. Materials behavior and simple failure analysis. NDE reliability, and damage-tolerant design. Advanced methods such as acoustic microscopy, laser ultrasonics, thermal waves, computed tomography, and thermoelectrics are analyzed. Laboratory experiments on all basic methods: ultrasonics, eddy currents, x-ray, liquid penetrants, magnetic testing, and visual inspection are performed.

E M 552. Advanced Acoustics. (Cross-listed with M E). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 451.* Theoretical acoustics: wave propagation in fluids; acoustic radiation, diffraction and scattering; and architectural acoustics. Applications of basic acoustic theory in noise control and acoustic radiation. Introduction to selected numerical methods in acoustics.

E M 564. Fracture and Fatigue. (Cross-listed with M S E, M E). (3-0) Cr. 3. F. *Prereq: 324 and either Mat E 216 or 272 or 392. Undergraduates: Permission of instructor.* Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

E M 569. Mechanics of Composite and Combined Materials. (Cross-listed with M S E, Aer E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 324.* Mechanics of fiber-reinforced materials. Micromechanics of lamina. Macromechanical behavior of lamina and laminates. Strength and interlaminar stresses of laminates. Failure criteria. Stress analysis of laminates. Thermal moisture and residual stresses. Joints in composites.

E M 570. Wind Engineering. (Cross-listed with Aer E). (3-0) Cr. 3. F. *Prereq: 378, 345.* Atmospheric circulations, atmospheric boundary layer wind, bluff-body aerodynamics, aeroelastic phenomena, wind-tunnel and full-scale testing, wind-load code and standards, effect of tornado and thunderstorm winds, design applications.

E M 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
F. Introduction to Dislocation and Plasticity
H. Mechanics of Thin Films and Adhesives
I. Mechanics of Cellular and Porous Media
J. Other

E M 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

E M 690. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
N. Advanced Experimental Methods
O. Advanced Wave Propagation
P. Advanced Materials
Q. Advanced Computational Methods
R. Reliability and Failure
S. Other

E M 697. Engineering Internship. Cr. R. Repeatable. *Prereq: Permission of DOGE (Director of Graduate Education), graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

E M 699. Research. Cr. arr. Repeatable.

Engineering Studies

www.eng.iastate.edu/esm/

(Interdepartmental minor)

The College of Engineering offers an undergraduate minor in engineering studies for non-engineering students designed to improve their understanding of engineering. This minor is not intended to train non-engineering students to do the work of practicing, degree-holding engineers. Rather, students who complete the minor in engineering studies will be able to work more effectively in their primary field by better appreciating the nature, capabilities, and limitations of engineering.

The minor in engineering studies is structured so that no student will be excluded due to insufficient preparation in mathematics or the sciences. The required courses in the minor and many of the elective courses are specifically designed to offer a range of prerequisites, so that students from all curricula will find coursework that supports an accessible and intellectually stimulating program of study.

With the exception of E St 260, 265, and 270, courses offered for the minor in engineering studies are also open to students whose major curriculum is in the College of Engineering. However, the minor in engineering studies will be awarded only to students whose degree program is not in engineering.

To receive a minor in engineering studies, students must complete a total of 21 course credits that satisfy the following:

- E St 260, 265, and 270 (3 credits each) are required for all students in the minor in engineering studies.
- Twelve additional credits from an approved list of eligible courses. Some of these approved courses are taught by the College of Engineering; additional courses are taught by other colleges. A minimum of six of those 12 credits must be courses that bear the designation "E St" or are courses offered by engineering departments. Eligible courses will include those 200-level and above courses offered by the departments in the College of Engineering that are expressly designated by that department's curriculum committee for use in the minor in engineering studies.
- A minimum of 6 credits in the minor must be 300-level or above (university requirement)

Courses primarily for undergraduate students

E St 260. Engineering: Getting from Thought to Thing. (2-2) Cr. 3. *Prereq: Students enrolled in minor in Engineering Studies only.* What is engineering, technology and their roles in Society? Investigation of engineering methods through case studies of everyday objects. Explore questions about the impact of technology in Society. Apply engineering methods to design and failure analysis.

E St 265. Survey of the Impacts of Engineering Activity. (3-0) Cr. 3. *Prereq: Students enrolled in minor in Engineering Studies only.* Survey of the economic, environmental, societal, and political benefits and problems resulting from engineering activity. Effects of engineering projects on human health, social structures, and the environment. Examination of improvements in economic opportunities and quality of life resulting from engineering activity. Case studies of the effects of engineering activity.

E St 270. Survey of How Things Work. (2-2) Cr. 3. *Prereq: Students enrolled in minor in Engineering Studies only.* An overview of the similarities and differences of the major engineering disciplines; methods used to manufacture products, build structures, and design systems. Laboratory exercises in measuring properties of basic engineering materials, welding, casting, and machining; case studies in product development; student design exercises.

E St 351. Introduction to Energy Systems: An Engineering Perspective. (Cross-listed with E E). (3-0) Cr. 3. Dalal. Energy-scientific, engineering and economic foundations. Energy utilization-global and national. Sectoral analysis of energy consumption. Relationship of energy consumption and production to economic growth and environment. Technology for energy production. Economic evaluation of energy utilization and production. Scientific basis for global warming. Environmental impact of energy production and utilization. Renewable energy.

E St 490. Independent Study. Cr. arr. F. *Prereq: Permission of instructor.*

English

www.Engl.iastate.edu/

Charles Kostelnick, Chair of Department

Distinguished Professor: Swander

Distinguished Professor (Emeritus): Bowers

University Professors: Mendelson, Nakadate

University Professors (Emeritus): Burnett, Daly

Professors: Carlson, Chapelle, Ewald, Freed, Graham, Herndl, Hickok, Kienzler, Kostelnick, Marquart, Owen, Poague, Price-Herndl, Russell, Tremmel, Z. Zimmerman

Professors (Emeritus): Abraham, Anderson-Hsieh, Bataille, Blyler, David, Dearin, Douglas, Geha, Haggard, Herrnstadt, McCarthy, Nostwich, Potter, Silet, Underhill, Vann, Winsor, Zbaracki

Associate Professors: Blakely, Consigny, Goodwin, Haas, Hagge, Hegelheimer, Honeycutt, Kupfer, Larson, LaWare, Levis, Niday, Payne, Pett, Post, Redmond, Roberts, Schwarte, Slagell, Yager

Associate Professor (Adjunct): Betcher

Associate Professors (Emeritus): Galyon, Gwiasda, Matthies, Ross, Whitaker

Assistant Professors: Pendar, Percy, Sauer, Shenk, Sivils, Wiegand, Wilson, D. Zimmerman

Assistant Professors (Emeritus): Kaufmann, McCully, J. Vallier

Assistant Professor (Adjunct): Vrchota

Instructors (Adjunct): Barratt, Mahoney, Myers, Noland, Schmidt

Senior Lecturers: Aune, Benner, Clarke, Demaray, Dewall, Gilchrist, Levis, Liebich, Lowery, McGough, Messenger, Ringlee, Schabel, Tremmel, Vandervalk

Lecturers: Behrens, Boehm, Brottman, Chamberlin, Collins, Coppoc, Corey, Cross, DeBoest, DiSalvo, Fromm, Greenwald, Hagge, House, Hughes, Judge, Kelley, Langenberg, Malven, Meyer, Nelson, Newgaard, Paulson, Reedy, Regenold, Rozendaal, Satterwhite, Smith, Thune, F. Vallier, Walrod, Weiner

Undergraduate Study

The department offers a wide variety of courses for students seeking a degree in English or Technical Communication, as well as for students wishing to broaden their general education. Offerings include classes in introductory college writing, literature, film, creative writing, rhetoric and professional communication, technical communication, English education, linguistics, and teaching English as a second language/applied linguistics.

The discipline of English helps to develop students' understanding of how language functions in literature, mass media, and both personal and professional writing. Students not pursuing an English or Technical Communication major may select English courses to fill electives, to pursue a minor, or to complement their training in other majors.

Graduates majoring in English will possess a broad-based knowledge and understanding of the discipline. They will also understand their particular disciplinary specialization whether it be literary studies, rhetorical studies, teacher education, creative writing, or teaching English as a second language/applied linguistics. Graduates in Technical Communication will learn how to communicate scientific and technical information through coursework both in English and in scientific and technical fields. Graduates in either major will be able to write well-organized, well-reasoned essays that demonstrate their ability to read and think critically.

Introductory writing courses in the department are designed to improve the skills in communication and reading comprehension necessary for successful university work.

Through the Intensive English and Orientation Program, the department offers special courses in English for both undergraduate and graduate students who are native speakers of other languages. (See catalog entries under *English Courses for Native Speakers of Other Languages and English Requirement for International Students*.)

Careers for English Majors

Students who graduate with a major in English often enter fields that require special communication skills, such as publishing, public service, research, business and technical writing, or human resources. An undergraduate major in English can be a solid basis for the professional study of law, medicine, theology, or business management. Students in English Education can qualify to teach English in middle or high school. (See *Index, Teacher Education*.) English majors may also pursue graduate studies in a number of communication-related fields.

Careers for Technical Communication Majors

Students who graduate with a major in Technical Communication will be prepared for careers in scientific and technical writing and editing. They will typically seek positions in companies or nonprofit organizations; in communication-based units of local, state, and federal government; in the documentation units of software developers or publishers; or in such areas as web design and communication consulting. Technical Communication majors may also pursue graduate study in rhetoric and professional communication or other communication-related fields.

English Major Requirements

English majors choose one of three programs of study: Literary Studies, Rhetorical Studies, or English Education. Students interested in creative writing typically choose Literary Studies as a program of study. English majors are required to have, in addition to ISUComm foundation courses, at least 39 credits in English; those in English Education must have 48 credits in English in addition to required teaching-related courses taken in other departments. English majors transferring from other institutions must take at least 18 of their credits in English while in residence at Iowa State.

To graduate with a major in the English Department, a student must earn at least a C (not a C-) in English 150 and 250 as well as in each of the courses taken to fulfill the program of study. Earning at least a C in ISUComm foundation courses and in one advanced communication course also meets the departmental Communication Proficiency requirement.

Finally, all English majors must take at least one pre-1800 literature course and one pre-1900 literature course.

Distributed Requirements

All English majors, no matter what their program of study, must take nine courses for a total of 27 credits from a list of distributed requirements:

Engl 199: Introduction to the Study of English	R
Engl 497: Capstone Assessment	R
Engl 220: Descriptive English Grammar	3
Engl 225-228:Literature Survey	9
Engl 260: Introduction to Literary Study	3
Engl 310: Rhetorical Analysis	3
Engl 207, 302-309, 313-316 Advanced Comm	3
Engl 340-349, 352, 389: Women's or Multicultural Literature	3
	27

These distributed requirements may not overlap with any advanced study requirements.

Advanced Study Requirements

Each program of study has its own requirements for advanced work:

Literary Studies

Engl 200- or 300-Level—Literary History	3
Engl 300 or above—English Elective	3
Engl 440-460 Literature Seminars	6
	12

Rhetorical Studies

Rhetorical Studies Elective	3
Engl 350 Rhetorical Theories and Issues in Context	3
Engl/Sp Cm 300+Rhetorical Studies Elective	3
Engl 418 Seminar in Argumentation	3
Engl/Sp Cm 400+Rhetorical Studies Elective	3
	12

English Education

Engl 219 Intro to Linguistics	3
Engl 225-228 Literature Surveys, whichever course not taken for Distributed Requirement	3
Engl 353 World Literature: Ancient to Renaissance	3
Engl 354 World Literature: Seventeenth Century to the Present	3
Engl 396 Teaching the Reading of Young Adult Literature	3
Engl 397 Practice & Theory of Teaching Writing in the Secondary Schools	3
Engl 420 History of the English Language	3
Engl 494Prac & Theory of Teaching Literature in the Secondary School	3
	24

There are a number of other course requirements outside of English for English Education majors. These requirements may overlap with General Education requirements for the college:

C I 202 Introduction to Instructional Technology for Grades 7-12	3
C I 204 Social Foundations of American Education	3
C I 280A Pre-Student-Teaching Experience	4
C I 395 Teaching Reading in Middle and Secondary Schools	3
C I 406 Multicultural Gender Fair Education	3
C I 426 Principles of Secondary Education	3
Engl 417E Student Teaching	16
Cl St 353 World Literature	3
Psych 230 Developmental Psychology	3
Psych 333 Educational Psychology	3
Hist or Pol S American History or Government	3
Sp Cm 212 or Thtre 358	3

Technical Communication Major Requirements

Technical Communication majors must take 39 credits within the major as well as 12 credits in a Designated Area of Concentration (DAC) in a technical, scientific, or design field. Majors develop advanced skills in multiple aspects of technical communication and apply their knowledge of technical communication to a specific discipline.

Core Requirements

Engl 310 Rhetorical Analysis	3
Engl 350 Rhetoric Theories and Issues in Context	3
Engl 411 Technology, Rhetoric and Professional Communication	3
Engl 314 Technical Communication	3
Engl 415 Business and Technical Editing	3
Engl 416 Visual Aspects of Business and Technical Communication	3
Engl 477 Seminar in Technical Communication	6

TComm Elective credits, from Engl 309, 313, 332, 418, 477 6

Complementary courses

Engl 220 Descriptive English Grammar	3
200-or 300-level literature course	3
Communication Elective	3
Engl 487 Internship	1-3

Designated Area of Concentration in a Technical, Scientific, or Design Field 12

The DAC is a student-designed grouping of related courses in a technical, scientific, or design field that will meet the student's professional or academic interests. All courses for the 12-credit DAC must be taken outside the English Department and approved by the Technical Communication Program Coordinator. A second major or a minor in areas such as computer science, social science, natural science, entrepreneurial studies, design studies, engineering studies, or another technical, scientific, or design field may substitute for the DAC.

Learning Goals

Graduates of the bachelor's degree programs in the English Department will demonstrate knowledge of the nature, history, current practice and critical issues in their curricular fields. They will employ the terminology, skills, and techniques specific to the field. Specifically, they will demonstrate advanced skills in reading and writing, speaking and argumentation, and research and application of appropriate technology. They will demonstrate the ability to perform professionally as educators, communicators, writers and editors. They will also be able to analyze aspects of culture and society and will become critical thinkers, having an awareness of ethical and humane issues essential to professional careers and to the practice of lifelong learning. (See department's URL for learning goals for specific programs.)

Graduates of advanced degree programs in the department will have, in addition to these

skills, knowledge of theory, methodology, and practice within their disciplines; advanced skills in research, innovation, and creative and critical thinking; and well-developed skills in problem-solving and critical analysis.

Minors and Second Majors
English majors are encouraged to seek a minor or a second major to complement their English studies. To find out the requirements for particular majors or minors, consult the section in this catalog relating to the department offering the major or minor. Students in English Education are particularly encouraged to acquire secondary certification in another teaching area. Consult ISU's certification officer in the College of Education for a list of Iowa Secondary Certification requirements in various subject areas.

Degree Choices
English majors may earn a bachelor of arts or a bachelor of science degree; Technical Communication majors may earn a bachelor of science degree only. For English majors, the B.S. degree requires an extra 12 credits beyond the general education requirements; these credits must be taken in linguistics, natural science, mathematics, social science, or selected courses in exercise and sport science.

English Minor Requirements
The department offers a minor in English, which students may earn by completing at least 18 credits in English courses beyond the 100 level, excluding Engl 250. A student earning an English minor must take 9 of the 18 credits at the 300-level or above and must earn a grade of C (not C-) or higher in each course taken in the minor. No specific courses need be taken; students may design their minor programs around their own interests.

Technical Communication Minor Requirements
The department offers a minor in Technical Communication, which students may earn by completing 18 credits in Technical Communication courses, 6 from Theory and History and 12 additional credits. Half of the 18 credits must be 300-level or above and students must earn a grade of C (not C-) or higher in each course taken in the minor. Although students may design their minor programs around their own interests, they are encouraged to work with a departmental adviser in Technical Communication.

Departmental Awards and Scholarships
Each spring the English Department offers many scholarships and awards for both undergraduate and graduate students. Some undergraduate awards are for returning English and Technical Communication majors only; others are for returning students of any major demonstrating excellence in some aspect of English or Technical Communication. A list of current awards and application forms are available on the English Department website and in 206 Ross Hall early in the Spring Semester. Award winners are announced each year in April.

Other Programs Associated with English
The English Department participates in interdepartmental programs in African American Studies, American Indian Studies, Classical Studies, Latina/o Studies, Linguistics, Speech Communication, Theatre and Women's Studies. (See the *Index for requirements for these interdepartmental programs.*)

Graduate Study

The master of arts degree programs offer various possibilities for the advanced study of writing, language, and literature. Prospective students must first secure admission to the graduate studies program through the English Department. Students can be admitted to the M.A. in English with a specialization in literature which is designed to prepare students for teaching at the secondary, two-year college, or beginning college and university levels; or for further graduate study in language and literature. Students can be admitted to the M.A. in Rhetoric, Composition, and Professional Communication designed to prepare students for technical writing, business communication, editing, and associated professional writing. Students can be admitted to one of the optional specializations for the M.A. in TESL/Applied Linguistics: Computer-Assisted Language Learning (CALL); Language Assessment; English for Specific Purposes (ESP); Literacy; and Literature in ESL. The master of arts degree requires 30 hours of graduate credits, including a thesis or project (3 credits). The M.A. in English (literature specialization) and the M.A. in TESL/Applied Linguistics have language requirements that may be met through a number of options, including previous foreign language study, graduate linguistics courses, or satisfactory performance on a test-out exam. A student whose native language is other than English is considered to have met the language requirement after satisfying the Graduate College English requirement.

The master of fine arts program in Creative Writing and Environment is unique in its effort to cultivate in its students an interdisciplinary approach to research and writing, as well as develop a heightened environmental imagination that finds expression in quality, publishable works of fiction, nonfiction, and poetry. The program is designed to prepare students for careers as writers, teachers at the college and university level, and editors. Prospective students must first secure admission to the graduate studies program through the English Department. The master of fine arts degree requires 54 hours of graduate credit: a core of creative writing courses, a book-length thesis (6 credits), a fieldwork experiential component (3 credits), and 18 credits in disciplines other than English (such as Landscape Architecture, Anthropology, Environmental Science, among many others) relevant to an individual student's research interests and thesis project.

The doctor of philosophy in Applied Linguistics and Technology focuses on English language teaching and assessment with particular emphasis on issues and practices related to technology use in these areas. It prepares students to hold a variety of academic appointments in departments of applied linguistics and English, and professional opportunities in research and development foundations, international publishing enterprises, and government agencies in the U.S. and around the world where English as a second language is taught and used for specific educational, vocational, and professional purposes. Prospective students must first secure admission to the graduate studies program through the English Department. Candidates are required to complete 72 hours of graduate credit and a dissertation, and to pass a portfolio assessment, a preliminary examination consisting of a dissertation proposal and pilot study and a written response to questions about the proposal or pilot study, and an oral defense of the dissertation.

The doctor of philosophy in Rhetoric and Professional Communication focuses on the theory of rhetoric and the practice of written communication in professional communities such as business, industry, and government. The degree qualifies graduates for academic positions in rhetoric and in business and technical communication, as well as for work in the private sector as professional writing specialists, editors, and communications production managers. Prospective students must first secure admission to the graduate studies program through the English Department. Candidates are required to complete 72 hours of graduate credit and a dissertation, and to pass a portfolio assessment, a preliminary examination consisting of a comprehensive examination and a special field examination, and an oral defense of the dissertation.

The department offers graduate students an opportunity to gain professional experience through professional writing internships, selected departmental research activities, the Intensive English and Orientation Program (IEOP), the ISUComm foundation courses program, the advanced communication program, and the interpersonal and rhetorical communication program. Teaching and research assistantships are available for qualified students. Teaching assistants are responsible for teaching with faculty supervision, classes in ISUComm foundation courses, courses in public speaking, courses in English as a second language, and courses in business and technical communication. Research assistants are assigned to individual faculty members engaged in projects in writing, language, or literature. One or more Pearl Hogrefe Fellowships in Creative Writing covering stipend and tuition are awarded each year to outstanding graduate students. Grannis Scholarships are awarded to new students in the Applied Linguistics and Technology doctoral program. Several Freda Huncke Endowment Graduate Teaching Fellowships are available to first-year Rhetoric and Professional Communication doctoral students. Miller Fellowships are also available to highly qualified students.

With prior written approval from the College of Human Sciences, students may take English courses to meet part of the requirements for certification to teach English in two-year and community colleges. Selected courses may also be used to meet requirements for ESL endorsement (K-12) for teachers.

A graduate minor in the English Department at the M.A. level requires 9 credits of English at the 500 or 600 level in the respective major (English, RCPC, TESL/AL). A graduate minor in the English Department at the M.F.A. or Ph.D. level requires 12 credits at the 500 or 600 level in the respective major (CWE, ALT, RPC).

A graduate certificate in Teaching English as a Second Language is a 12 credit program that includes two prerequisites, one core requirement (Engl 518), and three graduate courses chosen from a list of accepted graduate courses.

Courses primarily for undergraduate students

Engl 010. Intensive English and Orientation Program. (21-0) F.S.SS. *Prereq: Recommendation of the English Department.* Full-time study of English for speakers of other languages. Brochure available from the IEOP Office, 102 Landscape Architecture, or at www.ieop.iastate.edu. Satisfactory-fail only.

Engl 099. Strategies for Non-native Speakers of English. F.S. *Prereq: Recommendation of English Department; placement in sections is determined by examination.*
L. Strategies for Listening. Available P/NP to graduate students at their department's option.
R. Strategies for Reading. Available for P/NP to graduate students at their department's option.

Engl 101. English for Native Speakers of Other Languages. (3-0) Cr. 3. F.S. *Prereq: Recommendation of English Department; placement in various sections is determined by examination. (See English Requirement for International Students in Index.).* For undergraduates: Completion of English 101 requirement prepares students for English 150. For graduates: Completion of English 101 satisfies the English requirement of the Graduate College. Engl 101 courses are limited to students who are nonnative speakers of English. Credit from Engl 101 does not count toward graduation.
B. Academic English I. Available P/NP to graduate students at their department's option.
C. Academic English II–Undergraduates.
D. Academic English II–Graduates. Available P/NP to graduate students at their department's option.

Engl 120. Computers and Language. (Cross-listed with Ling). (3-0) Cr. 3. Introduction to the use of linguistic knowledge in computer applications today and the basic computational techniques used in such applications. The development of these techniques throughout the history of computational linguistics. How the study of language has contributed to the advancement of technology and how certain computational problems have influenced the way linguists study language.

Engl 150. Critical Thinking and Communication. (3-0) Cr. 3. F.S.SS. *Prereq: Concurrent enrollment in Lib 160.* Application of critical reading and thinking abilities to topics of civic and cultural importance. Introduction of basic oral, visual, and electronic communication principles to support writing development. Initiation of communication portfolio.

Engl 180. Communication Skills for International Teaching Assistants. Cr. arr. Repeatable. F.S. Placement based upon SPEAK/TEACH test results. Persons whose native language is English cannot take 180 for credit. No more than one section of 180 may be taken per semester; up to two sections total. Credit for Engl 180 does not apply toward graduation. Satisfactory-fail only.
A. Speaking Skills. Cr. 3. Emphasis on pronunciation improvement and greater fluency in spoken English for teaching purposes.
B. Intermediate Spoken English. Cr. 3.
C. Advanced Spoken English. Cr. 3. For students who have completed 180A or 180B but have not reached the passing level on the SPEAK/TEACH test.
D. Presentation Skills. Cr. 3. Developing explanations, leading discussions and handling questions in a teaching environment.
E. Supervised Independent Study. Cr. 1. Seminar with individual observation and consultation.

Engl 199. Introduction to the Study of English. (1-0) Cr. R. F.S. 8 weeks. General introduction to the discipline; discussion of the various fields in English; consideration of career opportunities. Satisfactory-fail only.

Engl 201. Introduction to Literature. (3-0) Cr. 3. F.S. *Prereq: Credit in or exemption from 150.* Study of selected examples of drama, poetry, short fiction, and the novel drawn from both British and American literature. Recommended for nonmajors.

Engl 205. Popular Culture Analysis. (Cross-listed with Sp Cm). (3-0) Cr. 3. F.S. *Prereq: Credit in or exemption from 150.* Analysis of how information and entertainment forms persuade and manipulate audiences. Study of several forms that may include newspapers, speeches, television, film, advertising, fiction, and magazines. Special attention to verbal and visual devices.

Engl 207. Introduction to Creative Writing. (3-0) Cr. 3. F.S. *Prereq: Credit in or exemption from 150.* Course introduces students to the fundamentals of writing fiction, poetry, and creative nonfiction. Extensive readings in all three genres. Students learn creative processes through writing exercises, workshops, and conferences.

Engl 219. Introduction to Linguistics. (Cross-listed with Ling). (3-0) Cr. 3. F.S. *Prereq: Sophomore classification.* Introduction to linguistic concepts and principles of linguistic analysis with English as the primary source of data. Sound and writing systems, sentence structure, vocabulary, and meaning. Issues in the study of usage, regional and social dialects, language acquisition, and language change.

Engl 220. Descriptive English Grammar. (Cross-listed with Ling). (3-0) Cr. 3. F.S. *Prereq: 250.* Overview of grammatical structures and functions. Parts of speech; phrase, clause, and sentence structure; sentence types and sentence analysis; rhetorical grammar and sentence style; terminology. Not a remedial, English composition, or ESL course.

Engl 225. Survey of British Literature to 1800. (3-0) Cr. 3. *Prereq: 250.* Representative works of British literature from the origins to 1800 in historical, cultural, and literary contexts. Will include multiple genres.

Engl 226. Survey of British Literature since 1800. (3-0) Cr. 3. *Prereq: 250.* Representative works from 1800 to the present in historical, cultural, and literary contexts. Will include multiple genres and may include texts that reflect and/or critique the impact and legacy of the British empire on its former colonies, i.e., postcolonial literature.

Engl 227. Survey of American Literature to 1865. (3-0) Cr. 3. *Prereq: 250.* Representative works of American literature from its origins (including indigenous and conquest literatures) through the end of the Civil War in historical, cultural, and literary contexts. Will include multiple genres.

Engl 228. Survey of American Literature since 1865. (3-0) Cr. 3. *Prereq: 250.* Representative works written in the United States since the Civil War in historical, cultural, and literary contexts, with attention to the cultural and ethnic diversity of Americans. Will include multiple genres.

Engl 237. Survey of Film History. (3-0) Cr. 3. F. *Prereq: Credit in or exemption from 150.* A survey of the history of film, both U.S. and international, from the beginnings in the late nineteenth century to the present.

Engl 240. Introduction to American Indian Literature. (Cross-listed with Am In). (3-0) Cr. 3. F. *Prereq: Credit in or exemption from Engl 150.* Appreciation of oral and written forms of American Indian literatures. Tropes and techniques in oral, visual and written texts. Focus on the role of American Indians in interdisciplinary approaches to modern social and environmental issues as expressed in literary works.

Engl 250. Written, Oral, Visual, and Electronic Composition. (3-0) Cr. 3. F.S.SS. *Prereq: 150 or exemption from 150; sophomore classification or exemption from 150; credit for or concurrent enrollment in Lib 160.* Analyzing, composing, and reflecting on written, oral, visual, and electronic (WOVE) discourse within academic, civic, and cultural contexts. Emphasis on supporting a claim and using primary and secondary sources. Continued development of student portfolio.

Engl 250H. Written, Oral, Visual, and Electronic Composition, Honors. (3-0) Cr. 3. F. *Prereq: Exemption from 150 and admission to Freshman Honors Program; credit for or concurrent enrollment in Lib 160.* In-depth analysis, composition, and reflection on written, oral, visual, and electronic (WOVE) discourse within academic, civic, and cultural contexts. Emphasis on argumentation: developing claims, generating reasons, providing evidence. Individual sections organized by special topics. Development of student portfolio.

Engl 260. Introduction to Literary Study. (3-0) Cr. 3. F.S. *Prereq: Credit in or exemption from 150.* Basic principles of literary study. Emphasis on writing of interpretive and critical essays. Particular attention to poetry. Designed for English majors.

Engl 302. Business Communication. (3-0) Cr. 3. F.S.SS. *Prereq: 250, junior classification.* Theory, principles and processes of effective written communication typically encountered in business and the professions. Extensive practice in many areas of workplace communication, including letter, memo, and email correspondence; short proposals and reports; policies and procedures; job packet including letters of application and resumes; website analysis; brochures; and individual and team presentations.
H. Honors.

Engl 303. Free-Lance Writing for Popular Magazines. (3-0) Cr. 3. S. *Prereq: 250, not open to freshmen.* Practical workshop in writing nonfiction articles for popular magazines. Emphasis on writing, market research, preparation of manuscripts, methods of submission. Major goal of the course is production of marketable material.

Engl 304. Creative Writing—Fiction. (Cross-listed with W S). (3-0) Cr. 3. F.S. *Prereq: 250, not open to freshmen.* Progresses from practice in basic techniques of fiction writing to fully developed short stories. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

Engl 305. Creative Writing—Nonfiction. (3-0) Cr. 3. F.S. *Prereq: 250, not open to freshmen.* Workshop in writing imaginative essays, both critical and personal. Analytical reading, development of literary techniques. Individual and small group conferences.

Engl 306. Creative Writing—Poetry. (3-0) Cr. 3. F.S. *Prereq: 250, not open to freshmen.* Progresses from traditional to contemporary forms. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

Engl 309. Report and Proposal Writing. (3-0) Cr. 3. F.S. *Prereq: 250, junior classification.* Introduction to the theory and practice of preparing and analyzing reports and proposals intended for businesses, governmental agencies, and/or private and corporate foundations. Individual assignments and group projects include text documents and oral presentations.

Engl 310. Rhetorical Analysis. (3-0) Cr. 3. F.S. *Prereq: 250.* Fundamental principles of rhetorical criticism. Focus on selected theories for analyzing cultural texts, including essays, speeches, film, technical and scientific documents, and websites. Emphasis on identifying artifacts, formulating research questions, applying methodologies, and understanding and practicing critical analysis through discussion and in writing.

Engl 312. Biological Communication. (3-0) Cr. 3. F.S. *Prereq: Engl 250.* Emphasis on effective writing and communication methods in the biological sciences, presentation of research data, methods of bibliographic citation, ethical communication, use of oral and visual presentation methods for biological information, manuscript and report preparation. For students in the biological and related life sciences.

Engl 313. Writing for the World Wide Web. (3-0) Cr. 3. F.S. *Prereq: 250.* Rhetorical principles of hypertextual writing and publishing. Group and individual projects using XHTML to construct interactive sites for the World Wide Web. Special emphasis on business and technical applications. Nonmajor graduate credit.

Engl 314. Technical Communication. (3-0) Cr. 3. F.S.SS. *Prereq: 250, junior classification.* Theories, principles, and processes of effective written communication of technical information. Attention to major strategies for analyzing and adapting to audiences in various communication situations and composing technical discourse including organizing visual and verbal information. Extensive practice in many areas of technical communication, including instructions and procedures, proposals and reports, website analysis and design, and individual and team presentations.
H. Honors.

Engl 315. Creative Writing—Screenplays. (3-0) Cr. 3. F. *Prereq: 250, not open to freshmen.* Stresses master scene technique of writing fully developed screenplays. Emphasis on movie techniques, writing, workshop criticism, analytical reading and viewing, and individual conferences. Nonmajor graduate credit.

Engl 316. Creative Writing—Playwriting. (Cross-listed with Thtre). (3-0) Cr. 3. S. *Prereq: Engl 250, not open to freshmen.* Progresses from production of scenes to fully developed one-act plays. Emphasis on action, staging, writing, analytical reading, workshop criticism, and individual conferences. Nonmajor graduate credit.

Engl 330. Science Fiction. (3-0) Cr. 3. *Prereq: 250.* Study of science fiction from its origins in nineteenth-century to the present. May include study of specific types of science fiction, such as classic, cyberpunk, feminist, or apocalyptic narratives; and may include consideration of science fiction film and/or theory.

Engl 332. Visual Communication of Quantitative Information. (Cross-listed with Stat). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Stat 101, 104 or 226; Engl 250.* Communicating quantitative information using visual displays; visualizing data; interactive and dynamic data displays; evaluating current examples in the media; color, perception, and representation in graphs; interpreting data displays. Nonmajor graduate credit.

Engl 335. Studies in Film. (3-0) Cr. 3. Repeatable. *Prereq: 250.* Principles of film art and the traditional vocabulary of literature as applied to film. Influence of film on modes of thought and behavior. Nonmajor graduate credit.

Engl 339. Literary Theory and Criticism. (3-0) Cr. 3. F.S. *Prereq: 260 and 3 additional credits in literature.* Study of selected texts of literary criticism, with attention to the purposes and practices of criticism.

Engl 340. Women's Literature. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: 250.* Historical and thematic survey of literature by and about women. May include autobiographies, journals, letters, poetry, fiction, and drama. Nonmajor graduate credit.

Engl 344. U.S. Latino/a Literature. (3-0) Cr. 3. S. *Prereq: 250.* An introduction to the literature of Mexican Americans, Puerto Ricans, Cuban Americans and other Latino/a sub-groups. Special emphasis on themes such as ethnic relations and comparisons with EuroAmerican literary traditions.

Engl 345. Women and Literature: Selected Topics. (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: Engl 250.* Literature by women and/or dealing with the images of women, e.g., study of individual authors or related schools of authors; exploration of specific themes or genres in women's literature; analysis of recurrent images of women in literature. Nonmajor graduate credit.

Engl 346. American Indian Literature. (Cross-listed with Am In). (3-0) Cr. 3. S. *Prereq: 250.* Survey of literature by Native Americans from pre-Columbian tales and songs to contemporary novels and poetry. Nonmajor graduate credit.

Engl 347. African American Literature to 1960. (Cross-listed with Af Am). (3-0) Cr. 3. *Prereq: 250.* Intensive study of African American writing, possibly including slave narratives, Harlem Renaissance works, literature of social protest, and forerunners of contemporary works that reveal key thematic, stylistic, and historical range of the literature. Nonmajor graduate credit.

Engl 348. Contemporary African American Literature. (Cross-listed with Af Am). (3-0) Cr. 3. S. *Prereq: 250.* Intensive reading in literature by African Americans from 1960 to the present. Nonmajor graduate credit.

Engl 349. Topics in Multicultural Literatures of the United States. (3-0) Cr. 3. Repeatable. *Prereq: 250.* Literature by writers from U.S. multicultural groups. May include literature of several groups or focus upon one of the following: Asian Americans, African Americans, Latino/a Americans, American Indians. Nonmajor graduate credit.

Engl 350. Rhetorical Theories and Issues in Context. (Cross-listed with Cl St, Sp Cm). (3-0) Cr. 3. S. *Prereq: 250.* Ideas about the relationship between rhetoric and society in contemporary and historical contexts. An exploration of classical and contemporary rhetorical theories in relation to selected topics that may include politics, gender, race, ethics, education, science, or technology.

Engl 351. Literature and Science. (3-0) Cr. 3. *Prereq: 250.* Study of texts that may include the following topics: the representation of science in literature; the use of literature by science and scientists; reading "scientific" texts as literature; the interactions between literary and scientific ideas. Nonmajor graduate credit.

Engl 352. Gay and Lesbian Literature. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Engl 250.* Literary portrayals of gay and lesbian lives and relationships from many different genres. Attention to changing definitions and representations of sexual orientation and gender identity over time. Nonmajor graduate credit

Engl 353. World Literature: Western Foundations through Renaissance. (Cross-listed with Cl St). (3-0) Cr. 3. F.S. *Prereq: 250.* Representative works from the drama, epics, poetry, and prose of the Ancient World through the late sixteenth century. May include Homer, Aeschylus, Sappho, Catullus, Dante, Marie de France, Boccaccio, Christine de Pizan, Cervantes, and others.

Engl 354. World Literature: Seventeenth Century to the Present. (3-0) Cr. 3. F. *Prereq: 250.* Global literatures in their various cultural and aesthetic contexts. Representative works, oral and written literature, including poetry, fiction, nonfiction, and drama.

Engl 355. Literature and the Environment. (Cross-listed with Env S). (3-0) Cr. 3. *Prereq: 250.* Study of literary texts that address the following topics, among others: the relationship between people and natural/urban environments, ecocriticism, and the importance of place in the literary imagination. Nonmajor graduate credit.

Engl 358. Myth and Fairytale. (3-0) Cr. 3. *Prereq: 250.* Study of traditional fairytales, myths, and legends from diverse cultures. Nonmajor graduate credit.

Engl 359. Literature and the Arts. (3-0) Cr. 3. *Prereq: 250.* Study of texts that may include the following topics: the relationship between literature and other art forms (including painting, sculpture, dance, music, photography, and film); the representation of the arts in literature; the influences of other art forms on literature; the interrelation of art theory and literary theory. Nonmajor graduate credit.

Engl 360. Studies in American Literature to 1800. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in American literature from its beginnings through the colonial period; may reflect themes, genres, or social and cultural contexts.

Engl 362. Studies in 19th Century American Literature. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in American literature of the 19th century; may reflect themes, genres, or social and cultural contexts.

Engl 364. Studies in American Literature: 1900 to the Present. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in American literature since 1900; may reflect themes, genres, or social and cultural contexts.

Engl 370. Shakespeare. (3-0) Cr. 3. F.S. *Prereq: 250.* Reading and analysis of selected plays. Development of Shakespeare's dramatic art in its social and intellectual context.

Engl 373. Studies in British Literature: The Middle Ages. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in medieval literature from its beginnings through the fifteenth century; may reflect themes, genres, or social and cultural contexts.

Engl 374. Studies in British Literature: The Renaissance. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in British literature from 1500 to 1660; may reflect themes, genres, or social and cultural contexts.

Engl 375. Studies in British Literature: The Restoration and 18th Century. (3-0) Cr. 3. S. *Prereq: 250; sophomore classification.* Selected readings in British literature from 1660 to 1800; may reflect themes, genres, or social and cultural contexts.

Engl 376. Studies in British Literature: Romantic and Victorian. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings from British literature from the late eighteenth century to about 1900; may reflect themes, genres, or social and cultural contexts.

Engl 378. Studies in British Literature: 1900 to the Present. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in British literature since 1900; may reflect themes, genres, or social and cultural contexts.

Engl 389. Postcolonial Literature. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Historical, thematic and theoretical study of postcolonial literatures from one or more of the following areas: Africa, South Asia, the Caribbean, and the Middle East. Irish and immigrant British writers may also be included.

Engl 393. The History of Children's Literature. (3-0) Cr. 3. F. *Prereq: 250.* Origin and development of English and American children's literature through the early twentieth century. Special emphasis on nature, structure, and enduring themes of fantasy literature.

Engl 395. Study and Travel. Cr. arr. SS. *Prereq: Permission of instructor.* Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.
A. Literature.
B. Creative Writing.
C. Linguistics.
D. Rhetoric and Professional Communication.
E. Teacher Education.

Engl 396. Teaching the Reading of Young Adult Literature. (3-0) Cr. 3. F.S. *Prereq: 250.* Critical study and evaluation of the genre; examination of modes and themes found in the literature; strategies of effective reading; study of the relationship of the genre to children's literature and adult literature; discussion techniques for teachers and parents. Evaluation of literature for use in school programs. Restricted to students seeking teacher licensure. Nonmajor graduate credit.

Engl 397. Practice and Theory of Teaching Writing in the Secondary Schools. (3-0) Cr. 3. F.S. *Prereq: 219 or 220 (Taken concurrently with C I 280. Cr. 2). Students must begin the application process for admission to the University Teacher Education Program and initiate a State of Iowa Department of Criminal Investigation background check prior to the semester in which they plan to take English 397.* Introduction to teaching secondary language arts. Current theories and practices in the teaching of writing to secondary school students. Theories of rhetoric, approaches to teaching, lesson design and planning. Evaluating writing. Professional portfolio preparation.

Engl 404. Creative Writing Workshop—Fiction. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 304.* Individual projects in short fiction on a workshop and conference basis. Readings in short fiction. Discussion of elements of narrative such as plot, point of view, characterization, theme, setting.

Engl 405. Creative Writing Workshop—Nonfiction. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 305.* Individual projects in memoir, immersion journalism, character studies, and/or the personal essay on a workshop and conference basis. Readings in creative nonfiction.

Engl 406. Creative Writing Workshop—Poetry. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 306.* Individual projects in poetry on a workshop and conference basis. Readings in poetry. Discussion of poetic elements such as image, sound, internal structure, rhythm, tone, figurative language.

Engl 411. Technology, Rhetoric, and Professional Communication. (3-0) Cr. 3. S. *Prereq: 310; 302, 309, 313, or 314; junior classification.* Study of the implication of technologies, especially computer technology, for the writing and reading of business, technical, and academic texts. Focus on selected technology-related topics.

Engl 415. Business and Technical Editing. (3-0) Cr. 3. S. *Prereq: 302, 309, or 314; junior classification.* Editing journal articles, research reports, technical manuals, newsletters, and proposals. Attention to editorial levels and styles, project management, editor-author relationships, and electronic editing. Nonmajor graduate credit.

Engl 416. Visual Aspects of Business and Technical Communication. (3-0) Cr. 3. F. *Prereq: 302, 309, or 314; junior classification.* Rhetoric of visual elements in business and technical communication. Issues in the design of text, charts, graphs, diagrams, schematics, illustrations, and other visual displays.

Engl 417. Student Teaching. (Cross-listed with C I). Cr. arr. F.S. *Prereq: 494, admission to teacher education, approval of coordinator the semester prior to student teaching.* Full-time teaching in secondary English: long term and unit planning, lesson planning, classroom teaching practice in English language arts. E. English and Literature (Same as C I 417E.)

Engl 418. Seminar in Argumentation. (3-0) Cr. 3. S. *Prereq: 310, junior classification.* Advanced seminar in theory and analysis with extensive practice in various modes of argument. Nonmajor graduate credit.

Engl 420. History of the English Language. (Cross-listed with Ling). (3-0) Cr. 3. F.S. *Prereq: 219, 220.* Comparison of English to other languages by family background and by type. Analysis of representative Old, Middle, Early Modern and present-day English texts, including both literary works and non-literary documents. Nonmajor graduate credit.

Engl 422. Women, Men, and the English Language. (Cross-listed with Ling, W S). (3-0) Cr. 3. S. *Prereq: 219.* The ways men and women differ in using language in varied settings and the ways in which language both creates and reflects gender divisions. Nonmajor graduate credit.

Engl 425. Second Language Learning and Teaching. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: 219; junior classification.* The process of second language learning and principles and techniques of teaching second languages. Learning and teaching in specific situations and for particular purposes. Current applications of technology in teaching and assessment. Nonmajor graduate credit.

Engl 437. Grammatical Analysis. (Dual-listed with 537). (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 220; junior classification.* Theories and methods for analysis of English syntax with emphasis on recent syntactic theory.

Engl 440. Seminar in British Literature. (3-0) Cr. 3. Repeatable. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected authors, movements, eras, or genres in British literature. Readings in criticism; required research paper. Nonmajor graduate credit.

Engl 441. Seminar in American Literature. (3-0) Cr. 3. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected authors, movements, eras, or genres in American literature. Readings in criticism; required research paper. Nonmajor graduate credit.

Engl 445. Seminar: Literature Crossing Boundaries. (3-0) Cr. 3. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Intensive study of selected literature that bridges traditional genre, period, national, or disciplinary boundaries. Readings in criticism; required research paper. Nonmajor graduate credit

Engl 450. Seminar in Drama and Film. (3-0) Cr. 3. Repeatable. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected playwrights, screenwriters, film directors, dramatic or cinematic movements, genres, or national traditions. Readings in criticism; required research paper. Nonmajor graduate credit.
A. Drama
B. Film
C. Other

Engl 451. Seminar in Poetry. (3-0) Cr. 3. Repeatable. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected authors, movements, eras, or national literatures. Readings in criticism; required research paper. Nonmajor graduate credit.

Engl 452. Seminar in Prose. (3-0) Cr. 3. Repeatable. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected authors, movements, eras, or national literatures. May include the novel, the short story, the essay, or autobiography. Readings in criticism; required research paper. Nonmajor graduate credit.

Engl 460. Seminar in Gender and Ethnicity. (Cross-listed with W S). (3-0) Cr. 3. Repeatable. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected readings of various authors, movements, eras, or genres. Readings in criticism; required research paper. Nonmajor graduate credit.

Engl 477. Seminar in Technical Communication. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 302, 309, or 314 and 6 additional credits in technical communication.* Intensive study of a selected topic that bridges theory and practice in technical communication. Required project that contributes to the understanding of an emerging issue in the profession. Nonmajor graduate credit.

Engl 487. Internship in Business, Technical, and Professional Communication. Cr. R. F, S. *Prereq: 9 credits in 302, 309, 313, 314, 415 (preferred), 416, or 477, senior classification; and permission of coordinator.* An opportunity to write, edit, and design business and technical documents in a professional setting. Projects include reports, proposals, manuals, brochures, newsletters.

Engl 489. Undergraduate Seminar. (Cross-listed with Ling). (3-0) Cr. 3. Repeatable. F. *Prereq: 9 credits in English beyond 250.* Intensive study of a selected topic in literature, criticism, rhetoric, writing, or language. Cross-listing with linguistics acceptable only when offered as a course in linguistics. Nonmajor graduate credit.

Engl 490. Independent Study. Cr. arr. Repeatable. F.S. *Prereq: 9 credits in English beyond 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee.* Designed to meet the needs of students who wish study in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Engl 490 may be used toward graduation.
A. Literature
B. Linguistics, Semantics (Ling 490B)
C. Rhetoric, Teaching of Composition
D. Criticism and Theory of Literature
E. Reading: Instructional Methods and Research
F. Creative Writing
G. Business/Technical Communication
H. Honors

Engl 494. Practice and Theory of Teaching Literature in the Secondary Schools. (Cross-listed with C I). (3-0) Cr. 3. F.S. *Prereq: Engl 310, 397, 9 other credits in English beyond 250, Psych 333, admission to teacher education program.* Portfolio review. Current theories and practices in the teaching of literature to secondary school students. Integrating literary study and writing. Preparation and selection of materials. Classroom presentation. Unit planning. (Taken concurrently with C I 280, Cr. 2, and Sp Ed 450)

Engl 497. Capstone Assessment. Cr. R. F.S. *Prereq: 199.* Must be taken by all seniors in their last semester of classes.

Courses primarily for graduate students, open to qualified undergraduate students

Open on a priority basis to graduate students admitted to one of the degree programs in English; instructor permission required for other students.

Engl 500. Proseminar: Teaching English Composition. (3-0) Cr. 3. F. Required of all new English teaching assistants. Introduction to the teaching of ISUComm Foundation Courses. Foundational and relevant newer composition theory and pedagogical methods related to ISUComm Foundation Courses objectives and their classroom enactment, including development of assignments and supporting activities, and evaluation of student projects.

Engl 503. Theory and Research in Composition. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits in English.* In-depth consideration of the theory and practice of critical composition pedagogy. Opportunities for actual classroom application.

Engl 504. Teaching Business and Technical Communication. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 302, 309 or 314.* Theory and practice of teaching college courses in business and technical communication. Some consideration of in-service writing courses for business and government. Emphasis on applicable communication and composition theory, curriculum planning, assignment design, and materials development.

Engl 505. Technology in Business, Technical, and Professional Communication. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate classification.* Examination of the role of technology, especially computer technology, in communication practices within academic and workplace settings.

Engl 506. Theory and Research in Professional Communication. (3-0) Cr. 3. S. *Prereq: 6 credits in English.* Introduction to professional communication as a discipline, with emphasis on theories of communication and discourse that inform professional communication research and on trends and developments in that research and the field.

Engl 507. Writing and Analyzing Professional Documents. (3-0) Cr. 3. F. *Prereq: 6 credits in English.* Introduction to the theory and practice of planning, preparing, and presenting information in written, oral, and visual forms prepared for business, science, industry, and government. Guided readings. Team projects. Individual projects.

Engl 508. Advanced Workshop in Academic Writing. (3-0) Cr. 3. Repeatable. Alt. SS., offered 2011. *Prereq: 6 graduate credits.* Hands-on practice in writing academic discourse for publication; rhetorical analyses of student-selected academic journals; discussion of current trends in academic writing; professional perspectives on the referee process and on journal editorial decision making. Focus on the writing of selected short pieces (opinion essays, standard reviews, conference-length papers) and of article-length manuscripts.

Engl 509. Writing Proposals and Grant Applications. (3-0) Cr. 3. F. *Prereq: 6 credits in English composition.* Introduction to the theory and practice of preparing and analyzing proposals and grant applications intended for businesses, governmental agencies, and/or private and corporate foundations. Individual assignments and group projects include text documents and oral presentations.

Engl 510. Introduction to Computers in Applied Linguistics. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Use of applications software for language teaching, linguistic analysis, and statistical analysis. Issues and problems in applied linguistics related to computer methods.

Engl 511. Introduction to Linguistic Analysis. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Principles and methods of linguistic analysis with emphasis on phonology, morphology,

and syntax. Description of linguistic variation and current theoretical approaches to linguistics.

Engl 513. Language Assessment Practicum. (3-0) Cr. 3. F.S.SS. *Prereq: 519.* Advanced practicum in language assessment.

Engl 514. Sociolinguistics. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Theories and methods of examining language in its social setting. Analysis of individual characteristics (e.g., age, gender, ethnicity, social class, region), interactional factors (e.g., situation, topic, purpose) and national policies affecting language use.

Engl 515. Statistical Natural Language Processing. (Cross-listed with Ling, HCI). (3-0) Cr. 3. F. *Prereq: Stat 330 or equivalent, recommended Ling 219 or Ling 511.* Introduction to computational techniques involving human language and speech in applications such as information retrieval and extraction, automatic text categorization, word prediction, intelligent Web searching, spelling and grammar checking, speech recognition and synthesis, statistical machine translation, n-grams, POS-tagging, word-sense disambiguation, on-line lexicons and thesauri, markup languages, corpus analysis, and Python programming language.

Engl 517. Second Language Acquisition. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Theory, methods, and results of second language acquisition research with emphasis on approaches relevant to second language teaching.

Engl 518. Teaching English as a Second Language Methods and Materials. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Introduction to approaches, methods, techniques, materials, curricular design, and assessment for various levels of ESL instruction. Attention to issues related to the teaching of listening, speaking, reading, writing, vocabulary, pronunciation, and culture.

Engl 519. Second Language Assessment. (3-0) Cr. 3. S. *Prereq: 517.* Principles of second language assessment including reliability, validity, authenticity and practicality. Constructing, scoring, interpreting, and evaluating second language tests for a variety of situations.

Engl 520. Computational Analysis of English. (Cross-listed with Ling, HCI). (3-0) Cr. 3. F. *Prereq: Engl 510 or 511.* Concepts and practices for analysis of English by computer with emphasis on the applications of computational analysis to problems in applied linguistics such as corpus analysis and recognition of learner language in computer-assisted learning and language assessment.

Engl 521. Teaching of Literature and the Literature Curriculum. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in literature.* Examination of the roles of the literary work, reader, and teacher in literary study. Responses to literature. Place of literature in language arts. Study and development of curriculum materials for middle school, high school, and college levels of instruction.

Engl 522. Literary Theory and Criticism. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 credits in literature.* Examination of the history, logic, and rhetoric of contemporary literary criticism and analysis.

Engl 523. Introduction to Old English Language and Literature. (3-0) Cr. 3. *Prereq: Course in medieval literature or history or history of the English language recommended.* Introductory study of Old English language and literature in prose and poetry, including extracts from Beowulf. Some attention to Anglo-Saxon culture.

Engl 524. Literacy: Issues and Methods for Non-native Speakers of English. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Theoretical and practical issues and techniques in the teaching of literacy in a variety of contexts, involving children and adults at basic skill levels and teens and adults in academic and vocational programs.

Engl 525. Methods in Teaching Listening and Speaking Skills to Nonnative Speakers of English. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Theoretical and practical issues and techniques in the teaching of second language pronunciation, listening, and speaking skills. Topics will be relevant to those intending to teach in various contexts involving both K-12 and adult learners.

Engl 526. Computer-Assisted Language Learning. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: 511 or equivalent.* Theory, research, and practice in computer use for teaching nonnative speakers of English. Methods for planning and evaluating computer-based learning activities.

Engl 527. Discourse Analysis. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Methods and theoretical foundations for linguistic approaches to discourse analysis. Applications of discourse analysis to the study of texts in a variety of settings, including academic and research contexts.

Engl 528. English for Specific Purposes. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 511 or an introductory course in linguistics.* Issues and techniques in analyzing, teaching, and assessing English for specific purposes. Topics include theories of specific purpose language use, analysis of learner needs in target language contexts, and syllabus and materials development for teaching and assessment.

Engl 529. Multimedia Content Management. (3-0) Cr. 3. Alt. S. *Prereq: 313, 505, or permission of instructor.* Strategies for developing and delivering multimodal content via digital media. Focus on the principles of database design, interface development, usability testing, and collaborative content management within professional communication settings.

Engl 531. Topics in the Study of Literature. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: 6 credits in literature.* Intensive study of literary genres, periods, movements, or themes; e.g., Literature and Historicism, Narrating the Feminine, Allegory.

Engl 532. American Literature to 1865. (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 6 credits in literature.* Selected texts in American literature from Beginnings to the Civil War. Study may include Native American literature, the literature of European conquest, Colonial and Revolutionary periods, Early Republic, and Jacksonian Era, in critical and cultural contexts.

Engl 533. British Literature to 1830. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: 6 credits in literature.* Selected texts from the Medieval, Renaissance, Restoration, Eighteenth-Century, and/or Romantic periods, in critical and cultural contexts.

Engl 534. American Literature 1865 to the Present. (3-0) Cr. 3. Repeatable. Alt. F., offered 2009. *Prereq: 6 credits in literature.* Selected texts in American literature from the Civil War to the present. Study may include Realism, Naturalism, Modernism, and Postmodernism, with significant attention to race/ethnicity, gender, and identity, and to contemporary critical views. Range of authors and genres.

Engl 535. British Literature 1830 to the Present. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: 6 credits in literature.* Selected texts from the Victorian, Edwardian, Modernist, and/or Contemporary periods, in critical and cultural contexts.

Engl 536. Postcolonial Literatures. (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 6 credits in literature.* Colonial and postcolonial Anglophone literatures from various locations, such as Africa, Asia, the Caribbean, and the British Isles, in critical and cultural contexts.

Engl 537. Grammatical Analysis. (Dual-listed with 437). (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 219, 220, or 511; junior classification.* Theories and methods for analysis of English syntax with emphasis on recent syntactic theory.

Engl 538. Fiction. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: 6 credits in literature.* Selected fiction writers in English; range of authors and genres. Emphasis on both male and female writers; attention to the relationships between fiction and cultural change.

Engl 539. Poetry. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: 6 credits in literature.* Selected poets writing in English, considered in representative groups. Some emphasis on twentieth-century poets and poetics.

Engl 540. Drama. (3-0) Cr. 3. Repeatable. F. *Prereq: 6 credits in literature.* Primary texts in dramatic genres from various literary periods, in critical and cultural contexts. Frequently concentrates on the English Renaissance and the Shakespearean stage.

Engl 541. Autobiography, Biography, Memoir. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: 6 credits in literature.* Study of lifewriting, e.g., autobiography, biography, memoir, cross-genre writing, autobiographical criticism. Readings may be arranged by period, nationality, or subgenre (e.g., autobiography of childhood experience, celebrity auto/biography).

Engl 542. Production Processes for Technical Documents. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 302, 309, 313, or 314; junior classification.* Review of the principles of desktop publishing as practiced in the field of technical communication. Focus on theories of print document design and project management, as well as digital prepress techniques needed to produce documents using outside print bureaus. Practice with current desktop publishing software.

Engl 543. Environmental Literature. (3-0) Cr. 3. S. *Prereq: Graduate classification.* An exploration of the major genres that derive from literary encounters with the environment. Readings may come from various cultures and time periods, but about half of the texts will represent canonical American environmental literature from the 19th and 20th centuries.

Engl 544. Multicultural U.S. Literatures. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: 6 credits in literature.* Primary texts by U.S. multicultural writers. Development of U.S. literary traditions, discourses of race and gender, counter-storytelling, myths of origin, phases and movements within the national literary canon. Readings in several genres.

Engl 545. Women's Literature. (Cross-listed with W S). (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 6 credits in literature.* Primary texts by women writers; historical, thematic, formal, or theoretical approaches; secondary readings; e.g., Nineteenth-Century Women Writers; American Women's Personal Narratives; Southern Women Writers of the U.S.

Engl 546. Issues in the Study of Literature. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: 6 credits in literature.* Intensive study of current and emerging topics and problems concerning literature and its relationship to theory and to language study; e.g., Theory of Metaphor; Renegotiating the Canon; Feminist Theory.

Engl 547. The History of Rhetorical Theory I: From Plato to Bacon. (3-0) Cr. 3. F. *Prereq: 6 credits in English.* Rhetorical theory from the classical period of ancient Greece and Rome through the Middle Ages to the early Renaissance; attention to its relation to the nature of knowledge, communication, practice, and pedagogy.

Engl 548. The History of Rhetorical Theory II: From Bacon to the Present. (3-0) Cr. 3. S. *Prereq: 6 credits in English.* Rhetorical theory from the early modern period (Bacon, Descartes, and Locke) to the present; attention to its relation to the nature of knowledge, communication practice, and pedagogy.

Engl 549. Multimedia Design in Professional Communication. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 505.* Rhetorical principles of information-based multimedia design. Practical understanding of computer applications used in multimedia development. Focus on theoretical and practical elements of producing

multimedia training programs in both education and industry. Work with interactive hypertext, digital audio, and non-linear video editing.

Engl 550. Creative Writing: Craft and Professional. (3-0) Cr. 3. F. *Prereq: Admission into MFA Program in Creative Writing and Environment.* A multigenre craft course required of all incoming students in the *MFA Program in Creative Writing and Environment.* Students develop an understanding of craft and environmental writing across genres (poetry, fiction, nonfiction) as well as learn about editing and publication practice through the lens of a working literacy journal, Flyway: A Journal of Writing and Environment. Other course activities include presentations on the production practices of leading literary journals; individual editing projects; pragmatic tips for finding publication outlets for polished creative work; and a field trip to publishing houses.

Engl 551. Advanced Multi-Genre Creative Writing Workshop. (3-0) Cr. 3. *Prereq: Fourth-semester or equivalent standing in the Creative Writing and Environment M.F.A. program.* Students develop book-length manuscripts of fiction, creative nonfiction, or poetry.

Engl 553. Graduate Workshop: Writing The Long Project. (3-0) Cr. 3. Repeatable. *Prereq: 550 and graduate classification. Open to graduate students outside Creative Writing only with permission of instructor.* Individual long creative writing project ideas developed in course. Portions of long creative writing project workshopped, revised, discussed in conferences.

Engl 554. Graduate Fiction Workshop. (3-0) Cr. 3. Repeatable. *Prereq: 550 and graduate classification. Open to graduate students outside Creative Writing only with permission of instructor.* Individual projects in fiction on a workshop and conference basis. Readings in short fiction. Discussion of elements of narrative such as plot, point of view, characterization, theme, setting.

Engl 555. Graduate Nonfiction Workshop. (3-0) Cr. 3. Repeatable. *Prereq: 550 and graduate classification. Open to graduate students outside Creative Writing only with permission of instructor.* Individual projects in memoir, immersion journalism, character studies, and/or the personal essay on a workshop and conference basis. Readings in creative nonfiction.

Engl 556. Graduate Poetry Workshop. (3-0) Cr. 3. Repeatable. *Prereq: 550 and graduate classification. Open to graduate students outside Creative Writing only with permission of instructor.* Individual projects in poetry on a workshop and conference basis. Readings in poetry. Discussion of poetic elements such as image, sound, internal structure, rhythm, tone, figurative language.

Engl 557. Studies in Creative Writing. (3-0) Cr. 3. Repeatable. *Prereq: Graduate classification.* Special topics course on ideas, issues, and techniques in creative writing. Subject matter may include specific genres, aspects of the creative writing process, or themes of particular interest. Significant readings and written work required; previous workshop experience helpful.

Engl 558. Teaching Creative Writing. (3-0) Cr. 3. *Prereq: Graduate classification.* Pedagogical approaches that are effective for grade-school through adult-education creative writing teaching. Writing exercises, workshops, text evaluation, and visits from creative writers.

Engl 559. Creative Writing Teaching Internship. Cr. arr. *Prereq: Permission of participating instructors.* Students assist in an introductory creative writing class. Some supervised teaching but mainly evaluation of submissions and individual conferences. Requirements and grades determined by participating instructors.

Engl 560. Environmental Field Experience. (3-0) Cr. 3. Repeatable. *Prereq: Graduate classification.* Students spend a term on a project that requires fieldwork. Projects might include working for a federal, state or private non-profit environmental organization or farm, or living and working in a specified natural area.

Engl 586. Visual Communication in Professional Writing. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: A course in business or technical communication.* Rhetorical theory and research in graphics, document design, and related principles of visual communication. Methods of designing texts, data displays, illustrations, and other visual elements in business and technical communication.

Engl 587. Internship in Business, Technical, and Professional Communication. (3-0) Cr. arr. Repeatable. F. S. *Prereq: 507 plus 3 additional graduate credits in business and technical writing or composition and rhetoric, permission of instructor. Limited to master's and doctoral degree candidates in the English Department.* An opportunity to write, edit, and design business and technical documents in a professional setting. Projects include reports, proposals, manuals, brochures, newsletters.

Engl 588. Supervised Practicum in Teaching English as a Second Language. (Cross-listed with Ling). (1-5) Cr. 3. F.S.SS. *Prereq: 15 credits toward the TESL/Applied Linguistics master's degree.* Intensive observation of ESL instruction and supervised practice in teaching learners of English in a context appropriate to the practicum student's goals. Seminar discussion of observed practices in relation to language teaching theories and methods.

Engl 589. Supervised Practicum in Literary Editing. (3-0) Cr. 3. S. *Prereq: 552, at least one graduate creative writing workshop, permission of instructor.* Students assume editorial duties for Flyway, a nationally distributed literary journal: overseeing a staff; screening submissions; corresponding with authors; editing and proofing; assisting with layout; communicating with the printer; overseeing a contest; and promoting the magazine.

Engl 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of the Graduate Studies Committee according to guidelines available in the department office.*
A. Literature
B. Teaching English as a Second Language (TESL)/Applied Linguistics. (Cross-listed with Ling 590B)
C. Composition and Rhetoric
E. Rhetoric and Professional Communication
F. Creative Writing
G. Applied Linguistics and Technology

Engl 592. Studies in Rhetoric and Professional Communication. (3-0) Cr. 3. Repeatable. *Prereq: 12 hours in rhetoric, linguistics, or literature, excluding 150/250.* Seminar on selected topics in rhetoric and professional communication or composition.

Engl 595. Graduate Study and Travel. Cr. R. *Prereq: Permission of instructor.* Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.
A. Literature
B. Creative Writing
C. Linguistics
D. Rhetoric and Professional Communication
E. Teacher Education

Engl 599. Creative Component. Cr. 3. F.S.SS. *Prereq: Graduate classification, permission of major professor.*

Courses for graduate students

Engl 601. Research Methods in Rhetoric and Professional Communication. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 graduate credits in English.* Survey of the major qualitative and quantitative methods used in research on communication and language in academic and nonacademic settings.

Engl 602. Research Design in Rhetoric and Professional Communication. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 601.* A workshop for advanced graduate students in rhetoric and professional communication. Focus on qualitative and/or quantitative methods.

Engl 603. Seminar in Advanced Pedagogy in Rhetoric and Composition: Theory and Research. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 503 or 504.* Exploration of relationships between theory and practice in current pedagogy. Intensive examination of contemporary theories of poststructuralism, new media, feminism, postcolonialism, or cultural studies and their impact on current pedagogical practice. Participation in pedagogical research and theory building.

Engl 611. Topics in the History of Rhetorical Theory. (3-0) Cr. 3. Repeatable. Alt. F., offered 2009. *Prereq: 547 or 548.* Rhetorical theory, criticism, and/or practice in relation to a historical period; the historical development of a rhetorical concept.

Engl 621. Topics in Current Rhetorical Theory. (3-0) Cr. 3. Repeatable. S. *Prereq: 503 or 506.* Advanced study of a specialized topic or problem in rhetorical theory, criticism, or practice.

Engl 623. Research Methods in Applied Linguistics. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 511, 517, 518, 519.* Survey of research traditions in applied linguistics. Focus on theoretical and practical aspects of quantitative and qualitative approaches to applied linguistic study, including experimental and quasi-experimental methods, classroom observation and research, introspective methods, elicitation techniques, case studies, interactional analysis, ethnography, and program evaluation. Computational tools and resources for linguistic research will be highlighted.

Engl 626. Computer-Assisted Language Testing. (3-0) Cr. 3. F. *Prereq: 510, 511, 519.* Principles and practice for the use and study of computers and the Internet in second language assessment.

Engl 630. Seminar in Technology and Applied Linguistics. (Cross-listed with Ling). (3-0) Cr. 3. F.S. *Prereq: Engl 510, 511, 517, 518, others depending on the topic.* Topic changes each semester. Topics include advanced methods in natural language processing, technology and literacy in a global context, feed back in CALL programs, and advances in language assessment.

Engl 688. Practicum in Technology and Applied Linguistics. (Cross-listed with Ling). (1-5) Cr. 3. F.S.SS. *Prereq: Engl 510, 626, or equivalent; 2nd year PhD student.* Focus on integrating theoretical knowledge with practical expertise. Assess client needs; develop, integrate, and evaluate solutions. Practical understanding of computer applications used in multimedia development. Create web-based or CD-ROM-based multimedia materials. Work with advanced authoring applications.

Engl 699. Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification, permission of major professor.* Research.

Entomology

www.ent.iastate.edu

Leslie Lewis, Chair of Department

University Professr (Emeritus): Pedigo

Professors: Bonning, Coats, Courtney, Dewitt, Jurenka, D. Lewis, L. Lewis, Rice, Tollefson, Wintersteen

Professors (Emeritus): Guthrie, Hart, Krafsur, R. Lewis, Mutchmor, Rowley, Showers

Associate Professors: Beetham, Holscher

Assistant Professors: Bartholomay, Gassmann, Oneal

Assistant Professor (Adjunct): Vandyk

Assistant Professors (Collaborators): Hellmich, Sappington, Sumerford

Undergraduate Study

For undergraduate curriculum in Insect Science, see *College of Agriculture, Curricula*.

A degree in Insect Science will provide students with a strong foundation in the biological sciences with an emphasis on insects. This degree prepares students for positions in industry, government, education, and public health. Chemical and seed companies, pest-management or consulting firms, and Horticultural nurseries employ insect scientists. State and federal agencies employ insect science graduates as consultants, extension directors, mosquito abatement agents, and research aides. A significant number of graduates pursue advanced graduate degrees in academia or professional degrees in the medical or veterinary fields.

Graduates understand the evolutionary and ecological relationships of insects with other life forms, and the impact of insects relative to human and animal health, as well as the relationships between insects and humanity's food, fiber, structural, and aesthetic needs and expectations. They are skilled in identifying insects and related groups and understand the biology, ecology, behavior, diversity, and evolutionary relationships of the major groups of insects. Graduates understand the principles and methods available to manage beneficial and pest insect populations. They understand the application of the scientific method in problem solving and the principles of experimental design and analysis. Graduates are able to communicate research and educational materials properly and competently - orally, visually, and in writing - and are able to work effectively with others.

Graduates of the agricultural and Horticultural insect management option are skilled in identifying pests and measuring their impact on plant and animal hosts for the management of these pests. They understand the environmental, legal, and ethical issues involved in insect population management. Graduates of the insect biology option have achieved an understanding of the biochemical and physiological processes governing insect metabolism, growth, and form. They understand the evolutionary and ecological significance of insects. Graduates of this option often enter graduate or professional schools.

The department offers a minor in Insect Science that may be earned by completing Ent 370 and 12 credits in courses selected from an approved list supplied by the department. Entomology administers the Emerging Global Diseases minor (see www.ent.iastate.edu/dept/undergrad/egd). Core courses address the biology of emerging disease agents (e.g., protozoa, fungi, microbes, and viruses), the clinical manifestations and epidemiology of emerging diseases, and the impact of those diseases on human interactions and Socioeconomics. One course must be taken from each of three core areas: (Pathogens and Disease) Micro 310 or Biol/Micro 353; (Sociology and Economics) Soc 411, Soc 345, FS HN 342, or Anthr 439; (Arthropod-borne Diseases) Ent 374 or Ent 574. The remainder of the credits (for a total of 15) may be selected from any of the above-listed courses not selected, and from other appropriate courses as approved by Emerging Global Diseases program advisers.

Graduate Study

The department offers work for the master of science and doctor of philosophy degrees with a major in entomology. Studies at the Ecosystem, Organismal, and Subcellar levels occur in the following areas: aquatic entomology, biological control, chemical ecology, ecology, host plant resistance, insecticide toxicology, medical/veterinary entomology, pathology, pest management, physiology, population genetics, or systematics.

Graduates have a broad understanding of entomology and related disciplines, and an in-depth command of their area of concentration. They are able to communicate effectively with scientific colleagues and the general public in both formal and informal settings. Graduates are able to address complex problems facing entomology or toxicology professionals, taking into account related ethical, social, legal, economic, and environmental issues. They are skilled in research methods, data analyses, and interpretation of results. They also are skilled in working effectively with their colleagues, and writing concise and persuasive grant proposals. They have an understanding of and can critically evaluate current entomological literature.

Prerequisite to the entomology major and to minor graduate work in the department is completion of at least two years of zoological courses, for part of which credit in other closely allied biological sciences may be substituted. Specific course requirements for advanced degrees depend partly upon previous training and experience in the major field of specialization.

Any student receiving the M.S. in entomology shall have at least one course in insect physiology, one course in insect systematics, two courses of Ent 590 (selected from topics A through D, F through I, M and N, inclusive), and at least 1 credit of Ent 600. Any student receiving the Ph.D. in entomology shall have at least one course in insect physiology, one course in insect systematics, four additional courses of Ent 590 (selected from topics A through D and F through I, M through N inclusive), and at least 1 credit of Ent 600. At least one 590 must be taken from each of these subgroups: Population (C, D, N); Organismal (A, B, F, M); and Suborganismal (G, H, I). In addition, Ph.D. students majoring either in Entomology or Toxicology shall have two semesters of teaching experience, taken as Ent 590K both semesters or Ent 590K one semester and Ent 590L the other semester.

A student can receive a Ph.D. minor in Entomology by taking 3 Entomology courses (500 level and above) for a total of 9 credits to be determined by the student's POS committee and approved by the Entomology Director of Graduate Education.

An option for an emphasis in molecular Entomology is available. Any student receiving the M.S. in entomology with an emphasis in molecular entomology is required to take Ent 555, Ent 590G, plus one other course of Ent 590 (selected from topics A through D, F, H, I, M, N), one additional course in molecular entomology, Ent 600 Seminar, BBMB 404, BBMB 542A, and one course from the following: Ent 576, Ent 525, or Ent 568.

Any student receiving the Ph.D. in entomology with an emphasis in molecular entomology is required to take Ent 555, Ent 590G, plus three other courses of Ent 590 (selected from topics A through D, F, H, I, M, N), one additional course in molecular entomology, Ent 600 Seminar, BBMB 542A, plus two other workshops selected from BBMB 542 B through E, an additional course with a molecular component, and one from each of the following two categories: Systematics (Ent 576, Ent 525, Ent 568), Biochemistry (BBMB 404, BBMB 405, BBMB 501).

Entomology participates in the interdepartmental majors in ecology and evolutionary biology; genetics; Microbiology; and molecular, cellular and developmental biology; and in the interdepartmental major and minor in toxicology (see *Index*).

The Federal Corn Insects and Crop Genetics Research Unit and the North Central Plant Introduction Station are available for advanced study in certain phases of entomological research.

More information about the department, such as current research, faculty resumes, physical facilities, and graduate students can be viewed on the department's website at www.ent.iastate.edu. Curriculum assessment for the department can be viewed here: http://www.ent.iastate.edu/assessment.

Courses primarily for undergraduate students

Ent 110. Technical Lecture. Cr. R. F. Orientation to areas of and opportunities in entomology.

Ent 201. Introduction to Insects. (1-0) Cr. 1. F.S.SS. 5 weeks. S. Classroom section spring only. World Wide Web section of course offered summer and fall semesters. Biological and ecological aspects of insects.

Ent 211. Insects and Society. (2-0) Cr. 2. F.S. *Prereq: Ent 201.* 11 weeks. Classroom section spring only. World Wide Web section offered fall semester. Holscher. The importance of insects in human well-being. Insect-human interactions. Primarily for nonscience and nonagriculture majors.

Ent 283. Pesticide Application Certification. (Cross-listed with Agron, For, Hort). (2-0) Cr. 2. S. Holscher. Core background and specialty topics in agricultural, and Horticultural pesticide applicator certification. Students can Select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

Ent 370. Insect Biology. (2-3) Cr. 3. F. *Prereq: Biol 101 or 211.* Jurenka. Structure, physiology, evolution, behavior, life histories, and recognition of insects. Collection required. Nonmajor graduate credit.

Ent 371I. Introduction to Insect Ecology. (Cross-listed with Ia LL). (3-3) Cr. 4. Alt. SS., offered 2011. Field and laboratory study of insects, their diversity, life history; emphasis on ecology and behavior.

Ent 372. Livestock Entomology. (2-0) Cr. 2. Alt. S., offered 2011. Classroom and off-campus videotape sections. 12 weeks. Holscher. Recognition, biology, behavior, economic importance, and management of insects and other arthropods affecting livestock and poultry production. Nonmajor graduate credit.

Ent 374. Insects and Our Health. (Cross-listed with Micro). (3-0) Cr. 3. S. *Prereq: 3 credits in biological sciences.* Bartholomay. Identification, biology, and significance of insects and arthropods that affect the health of humans and animals, particularly those that are vectors of disease. Nonmajor graduate credit.

Ent 374L. Insects and Our Health Laboratory. (Cross-listed with Micro). (0-3) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in Ent 374.* Bartholomay. Laboratory and field techniques for studying medical or public health entomology, including: collection, identification and maintenance of medically significant arthropods and experimental design and execution related to the biology of arthropods or arthropod-pathogen interactions.

Ent 375. Plant Protection Using Natural Enemies. (Dual-listed with 575). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 370 or 376.* Bonning, Harris. Overview of the biology, ecology, and classification of insect pathogens, predators, and parasitoids. Discussion of the use of these organisms in plant protection, including an emphasis on genetic alteration of natural enemies. Nonmajor graduate credit.

Ent 376. Fundamentals of Entomology and Pest Management. (2-3) Cr. 3. S. *Prereq: Biol 101 or 211.* O'Neal. Introduction to entomology and insect-pest management, including life processes, ecology, economics, tactics of population suppression, and ecological backlash. Credit for either Ent 376 or 386, but not both, may be applied toward graduation. Nonmajor graduate credit.

Ent 386. Management of Insect Pests. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Biol 101 or 211.* Tollefson. Introduction to insects and their lifestyles. Theory and application of pest-management practices. Examples drawn primarily from field crops. Credit for either Ent 376 or 386, but not both, may be applied for graduation. Nonmajor graduate credit.

Ent 410. Insect-Virus Interactions: a Molecular Perspective. (Dual-listed with 510). (Cross-listed with Micro). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Permission of an instructor.* Bonning, Bartholomay. Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

Ent 425. Aquatic Insects. (Dual-listed with 525). (Cross-listed with A Ecl). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312 or equivalent.* Courtney. Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

Ent 452. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 552). (Cross-listed with Pl P, Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Ent 471. Insect Ecology. (Dual-listed with 571). (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 9 credits biological sciences.* O'Neal. The contribution of insects to ecosystem function is staggering. This course will focus on insect population ecology, predator-prey interaction and chemical ecology. The role of insects in nutrient cycling, pollination and pest management will be discussed with case studies used to highlight the applied nature of insect ecology and its relationship to agriculture.

Ent 478. Global Protozoology - Molecular Biology of Protozoa. (Dual-listed with 578). (Cross-listed with V Pth). (2-1) Cr. 3. F. *Prereq: Permission of instructor.* Analysis of cellular systems, molecules, and organelles of pathogenic protozoan parasites. Emphasis is placed on processes and systems that are unique to protozoa, are important to understanding vector-parasite-host biology/ecology, or are targets of disease prevention/treatment programs for international disease control. Nonmajor graduate credit.

Ent 490. Independent Study. Cr. arr. Repeatable. *Prereq: 15 credits in biological sciences, junior or senior classification.* A maximum of 6 credits of Ent 490 may be used toward the total of 128 credits required for graduation.
E. Research or work experience.
U. Laboratory teaching experience. For students registering to be undergraduate laboratory assistants.

Ent 493. Workshop on Insect Management. Cr. 1. SS. *Prereq: 370, 372, 376, or 386.* Holscher. Insect recognition and sampling will be practiced in agricultural systems. The applications of current pest management practices will be demonstrated in both crop and livestock systems. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Ent 510. Insect-Virus Interactions: a Molecular Perspective. (Dual-listed with 410). (Cross-listed with Micro). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Permission of an instructor.* Bonning, Bartholomay. Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

Ent 511. Integrated Management of Tropical Crops. (Cross-listed with Pl P, Hort). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Pl P 408 or 416 or Ent 370 or 376 or Hort 221.* Gleason, Lewis, Nonnecke. Applications of Integrated Crop Management principles (including plant pathology, entomology, and Horticulture) to tropical cropping systems. Familiarization with a variety of tropical agroecosystems and Costa Rican culture is followed by 10-day tour of Costa Rican agriculture during spring break, then writeup of individual projects. Tour expenses paid by students.

Ent 525. Aquatic Insects. (Dual-listed with 425). (Cross-listed with A Ecl). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312 or equivalent.* Courtney. Morphology, ecology, diversity and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

Ent 530. Ecologically Based Pest Management Strategies. (Cross-listed with Agron, Pl P, SusAg). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: SusAg 509.* Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

Ent 550. Pesticides in the Environment. (Cross-listed with Tox). (2-0) Cr. 2. S. *Prereq: 9 credits of biological sciences.* Coats. Fate and significance of pesticides in soil, water, plants, animals, and the atmosphere.

Ent 552. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 452). (Cross-listed with Pl P, Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Ent 555. Insect Physiology. (3-3) Cr. 4. S. *Prereq: 370.* Jurenka. Life processes of the insects, including reviews of current problems in insect physiology.

Ent 568. Advanced Systematics. (Cross-listed with EEOB). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Permission of instructor.* Principles and practice of systematic biology; taxonomy, nomenclature and classification of plants and animals; sources and interpretation of systematic data; speciation; fundamentals of phylogenetic systematics.

Ent 570. Plant-Insect Interactions. (2-0) Cr. 2. Alt. F., offered 2009. *Prereq: 370 or 376.* Gassman. Principles of insect and host interactions and mechanisms of insect control by host plant resistance.

Ent 571. Insect Ecology. (Dual-listed with 471). (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 9 credits biological sciences.* O'Neal. The contribution of insects to ecosystem function is staggering. This course will focus on insect population ecology, predator-prey interaction and chemical ecology. The role of insects in nutrient cycling, pollination and pest management will be discussed with case studies used to highlight the applied nature of insect ecology and its relationship to agriculture.

Ent 574. Medical Entomology. (3-3) Cr. 4. Alt. S., offered 2010. *Prereq: 9 credits in biological sciences.* Bartholomay. Identification, biology, and significance of insects and other arthropods that attack people and animals, particularly those that are vectors of disease.

Ent 575. Plant Protection Using Natural Enemies. (Dual-listed with 375). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 370 or 376.* Bonning, Harris. Overview of the biology, ecology, and classification of insect pathogens, predators, and parasitoids. Discussion of the use of these organisms in plant protection, including an emphasis on genetic alteration of natural enemies.

Ent 576. Systematic Entomology. (3-6) Cr. 5. Alt. F., offered 2009. *Prereq: 370.* Courtney. Classification, distribution, and natural history of insects, including fundamentals of phylogenetic systematics, biogeography, taxonomic procedures, and insect collection and curation.

Ent 578. Global Protozoology - Molecular Biology of Protozoa. (Dual-listed with 478). (Cross-listed with V Pth). (2-1) Cr. 3. F. *Prereq: Permission of instructor.* Analysis of cellular systems, molecules, and organelles of pathogenic protozoan parasites. Emphasis is placed on processes and systems that are unique to protozoa, are important to understanding vector-parasite-host biology/ecology, or are targets of disease prevention/treatment programs for international disease control.

Ent 590. Special Topics. Cr. arr. Repeatable. *Prereq: 15 credits in biological sciences..*
A. Biological Control and Pathology.
B. Chemical Ecology and Behavior.
C. Ecology and Pest Management.
D. Evolution and Systematics.
E. Special Research Topics.
F. Medical and Veterinary Entomology.
G. Molecular Entomology.
H. Physiology and Biochemistry.
I. Toxicology.
K. Teaching Experience.
L. Extension Internship.
M. Immature Insects.
N. Population Genetics.

Courses for graduate students

Ent 600. Seminar. Cr. 1. F.S.SS. Presentation of research results.

Ent 675. Insecticide Toxicology. (Cross-listed with Tox). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 555 or Tox 501.* Coats. Principles of insecticide toxicology; classification, mode of action, metabolism, and environmental effects of insecticides.

Ent 699. Research. Cr. arr. Repeatable.

Entrepreneurial Studies

www.isupjcenter.org/education/minor

(Interdepartmental Undergraduate Minor)

Supervisory Committee: Kay Palan (Business), Chair; Lisa Nolan (Vet Med); David Acker (Ag); Diane Rover (Engineering); Corly Brooke (Human Sciences); Kate Schwennsen (Design); Zora Zimmerman (LAS).

Entrepreneurial Studies is an interdisciplinary program that provides opportunities to students to learn about entrepreneurship—the process of creating value through recognizing and developing opportunities. It serves to complement the student's major area of study, in any college, by offering a means of putting theory and science into practice. The goal of the Entrepreneurial Studies program is to provide the knowledge and skills needed to create value through recognizing and developing opportunities. In addition to feasibility analysis and business planning, the program deals with the topics of innovation, opportunity recognition, technology transfer, industry analysis, and competitive strategy. Although the program introduces some fundamental concepts from accounting, finance, marketing, and management, it does not attempt to substitute for any business courses in these areas.

A minor in entrepreneurial studies is available to all undergraduate students at ISU. Students must follow college specific rules in selecting courses. The college representatives to the supervisory committee will be responsible for advising students in their college, and will inform students about the details of the college rules.

Minor

A student seeking a minor in entrepreneurial studies must successfully complete a minimum of 15 credits in courses approved for use in the entrepreneurial studies program, including the two required courses, Management 310 and 313. Management 310, *Entrepreneurship and Innovation*, is the introductory course and provides an overview of the entire field. Management 313, *Feasibility Analysis and Business Planning*, emphasizes developing an idea for a new venture, conducting a feasibility study, researching the potential market, analyzing the competition, and preparing a formal business plan. Students take two entrepreneurship-oriented electives (6 cr.), from an approved course list and must also take 3 cr. of experiential learning. Up to six of the 15 credits required for the minor may also be used in the student's required program of study. More information about the minor and the list of approved electives are available online.

Environmental Science

www.ensci.iastate.edu

(Interdepartmental Program)

William G. Crumpton: Coordinator

Environmental Science provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems. The magnitude and complexity of environmental problems are creating a growing need for scientists with rigorous, interdisciplinary training in environmental science. The Environmental Science program is designed to prepare students for positions of leadership in this rapidly changing discipline. Environmental Science graduates have a solid foundation in biological and physical natural sciences and the specialized training necessary for integrated analysis of environmental systems.

Undergraduate Study

The Environmental Science undergraduate major is offered through both the College of Agriculture and Life Sciences and the College of Liberal Arts and Sciences. Environmental Science majors complete foundation courses in biology, chemistry, earth science, geology, physics and mathematics, plus a major consisting of an integrated core of Environmental Science courses and additional advanced course work in Environmental Science. Scientific rigor is stressed throughout the program, beginning with the foundation courses in the first two years of the curriculum. The upper level core courses emphasize a dynamic systems approach that provides a framework for integrating physical, chemical, and biological aspects of environmental systems.

Students seeking an Environmental Science major complete the following: (1) A foundation of approved supporting courses in science and mathematics including biology, chemistry, earth science, physics, calculus, and Statistics, (2) 29 credits of course work in the major, including the Environmental Science core (EnSci 110, 201, 250, 381, and 382) and 15 additional credits of approved course work in Environmental Science. A combined average grade of C or higher is required in courses applied in the major.

Graduate Study

Environmental Science offers an interdisciplinary graduate program leading to the M.S. and Ph.D. degrees with a major in Environmental Science. Faculty from the colleges of Agriculture and Life Sciences, Engineering, and Liberal Arts and Sciences cooperate to offer courses and research opportunities covering a broad array of environmental topics.

Applicants should have completed an undergraduate or masters degree in one of the biological, chemical, physical, or engineering sciences or should have equivalent preparation.

The Environmental Science graduate program emphasizes fundamental concepts and research, which at the same time address major environmental issues. The curriculum is designed to provide the interdisciplinary approach needed in Environmental Science education and research. In addition to work in their chosen area of specialization, students are afforded a broad exposure to the biological, chemical and physical aspects of environmental systems and the specialized training necessary for integrated analysis of these systems.

Courses primarily for undergraduate students

EnSci 110. Orientation to Environmental Science. (1-0) Cr. 1. F. *Prereq: Freshman classification in EnSci.* Overview of Environmental Science curriculum and discussion of professional opportunities. Satisfactory-fail only.

EnSci 201. Introduction to Environmental Issues. (Cross-listed with Env S). (2-0) Cr. 2. F.S. Discussion of current and emerging environmental issues such as human population growth, energy use, loss of biodiversity, water resources, and climate change.

EnSci 250. Environmental Geography. (Cross-listed with Env S). (3-0) Cr. 3. F. The distribution, origins and functions of the earth's physical systems and the spatial relationship between human activity and the natural world.

EnSci 290. Apprenticeship. Cr. arr. Repeatable. F.S.SS. *Prereq: Approval of the Environmental Science Coordinator.* Practical experience in an approved setting such as a research laboratory, government office, or private office. Satisfactory-fail only.

EnSci 301. Natural Resource Ecology and Soils. (Cross-listed with NREM). (3-3) Cr. 4. F. *Prereq: Biol 211, 211L; for 201 or a second course in Biology.* Effects of environmental factors on ecosystem structure and function using forest, prairie and agricultural ecosystems as models. Special emphasis is given to soil-forming factors and the role of soil in nutrient and water cycling and ecosystem dynamics. Additional emphasis is given to human influences on natural ecosystems and the role of perennial plant communities in agricultural landscapes. Nonmajor graduate credit.

EnSci 312. Ecology. (Cross-listed with A Ecl, Biol). (3-3) Cr. 4. F.SS. *Prereq: Biol 211L and 212L.* Fundamental concepts and principles of ecology dealing with organisms, populations, communities and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats.

EnSci 312I. Ecology. (Cross-listed with A Ecl, Ia LL). Cr. 4. SS. An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

EnSci 345. Natural Resource Photogrammetry and Geographic Information Systems. (Cross-listed with NREM). (2-3) Cr. 3. F. *Prereq: Junior classification.* Measurement and interpretation of aerial photos in resource management. Introduction to Geographic Information Systems (GIS) using ArcGIS including digitizing, development and query of attribute tables, georeferencing, and use of multiple GIS layers in simple spatial analyses. Nonmajor graduate credit.

EnSci 360. Environmental Soil Science. (Cross-listed with Agron). (2-3) Cr. 3. S. *Prereq: Agron 260 or Geol 100 or 201.* Burras and Killorn. Application of soil science to contemporary environmental problems; comparison of the impacts that different management strategies have on short- and long-term environmental quality and land development. Emphasis on participatory learning activities.

EnSci 381. Environmental Systems I: Introduction to Environmental Systems. (Dual-listed with 581). (Cross-listed with Biol, Env S, Micro). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including Biology and chemistry.* Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

EnSci 382. Environmental Systems II: Analysis of Environmental Systems. (Dual-listed with 582). (Cross-listed with Biol). (2-4) Cr. 4. S. *Prereq: EnSci 381.* Continuation of EnSci 381. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

EnSci 390. Internship in Environmental Science. Cr. arr. Repeatable. F.S.SS. *Prereq: Approval of the Environmental Science coordinator.* Supervised off-campus work experience in the field of environmental science. Satisfactory-fail only.

EnSci 402. Watershed Hydrology. (Dual-listed with 502). (Cross-listed with Agron, Geol, Mteor, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or Biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

EnSci 402I. Watershed Hydrology and Surficial Processes. (Cross-listed with Agron, Ia LL). Cr. 4. SS. *Prereq: Four courses in physical or Biological sciences or engineering.* Effects of geomorphology, soils, and land use on transport of water and materials (nutrients, contaminates) in watersheds. Fieldwork will emphasize investigations of the Iowa Great Lakes watershed. Nonmajor graduate credit.

EnSci 404. Global Change. (Dual-listed with 504). (Cross-listed with Agron, Env S, Mteor). (3-0) Cr. 3. S. *Prereq: Four courses in physical or Biological sciences or engineering; junior standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Nonmajor graduate credit.

EnSci 405. Environmental Biophysics. (Dual-listed with 505). (Cross-listed with Agron, Mteor). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities. Nonmajor graduate credit.

EnSci 406. World Climates. (Cross-listed with Agron, Mteor). (3-0) Cr. 3. F. *Prereq: Agron/Mteor 206.* Arritt. Distribution and causes of different climates around the world. Effects of climate and climate variations on human activities including Society, economy and agriculture. Current issues such as climate change and international efforts to assess and mitigate the consequences of a changing climate. Semester project and in-class presentation required. Nonmajor graduate credit.

EnSci 407. Watershed Management. (Dual-listed with 507). (Cross-listed with Env S, NREM). (3-3) Cr. 4. S. *Prereq: A course in general Biology.* Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

EnSci 408. GIS and Natural Resources Management. (Dual-listed with 508). (Cross-listed with A E). (2-2) Cr. 3. F. *Prereq: Working knowledge of computers and Windows environment.* Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS.

EnSci 409. Field Methods in Hydrogeology. (Dual-listed with 509). (Cross-listed with Geol). (0-4) Cr. 2. Alt. SS., offered 2010. *Prereq: 402 or 411 or C E 473.* Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, electronic instrumentation for data collection, and geophysics. Field trips to investigate water resource, water quality, and remediation projects.

EnSci 411. Hydrogeology. (Dual-listed with 511). (Cross-listed with Geol). (3-2) Cr. 4. F. *Prereq: Geol 100 or 201; Math 165 or 181; Phys 111 or 221.* Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations. Nonmajor graduate credit.

EnSci 414. Applied Groundwater Flow Modeling. (Dual-listed with 514). (Cross-listed with Geol). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 411 or C E 473; Math 165 or 181.* Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course. Nonmajor graduate credit.

EnSci 415. Paleoclimatology. (Dual-listed with 515). (Cross-listed with Geol). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Four courses in Biological or physical science.* Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods, utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~1 million years). Nonmajor graduate credit.

EnSci 418. Stream Ecology. (Dual-listed with 518). (Cross-listed with A Ecl). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 486.* Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

EnSci 419. Environmental Geochemistry. (Dual-listed with 519). (Cross-listed with Geol). (2-2) Cr. 3. F. *Prereq: 402 or 411 or equivalent.* Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling. Nonmajor graduate credit.

EnSci 422l. Prairie Ecology. (Cross-listed with Ia LL). Cr. 4. SS. *Prereq: Familiarity with basic principles in Biological sciences and ecology.* Basic patterns and underlying physical and biotic causes of both regional and local distributions of plants and animals of North American prairies; field and laboratory analyses and projects. Nonmajor graduate credit.

EnSci 424. Air Pollution. (Dual-listed with 524). (Cross-listed with A E, C E). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology.
E. Agricultural sources of pollution

EnSci 426. Stable Isotopes in the Environment. (Dual-listed with 526). (Cross-listed with Geol). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Four courses in Biological or physical science.* Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, Biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance. Nonmajor graduate credit.

EnSci 434. Contaminant Hydrogeology. (Dual-listed with 534). (Cross-listed with Geol). (3-0) Cr. 3. S. *Prereq: Geol 411 or equivalent.* Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface Microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies. Nonmajor graduate credit.

EnSci 446. Integrating GPS and GIS for Natural Resource Management. (Dual-listed with 546). (Cross-listed with NREM). (2-3) Cr. 3. S. *Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS.* Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

EnSci 451. Applied and Environmental Geophysics. (Dual-listed with 551). (Cross-listed with Geol). (2-2) Cr. 3. S. *Prereq: Geol 100 or 201, Math 181 or equivalent experience.* Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic- and resistivity-imaging systems and radar. Nonmajor graduate credit.

EnSci 452. GIS for Geoscientists. (Dual-listed with 552). (Cross-listed with Agron, Geol). (2-2) Cr. 3. F. *Prereq: Geol 100, Geol 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses. Nonmajor graduate credit.

EnSci 459. Environmental Soil and Water Chemistry. (Dual-listed with 559). (Cross-listed with Agron). (3-3) Cr. 4. F. *Prereq: Agron 354 or EnSci 360; Chem 164, 165, or 178; Math 140. Chem 211 or 231 recommended.* Thompson. An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, and applications to contemporary environmental issues. Nonmajor graduate credit.

EnSci 461l. Introduction to GIS. (Cross-listed with Env S, Ia LL, L A). Cr. 4. SS. Descriptive and predictive GIS modeling techniques, spatial Statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management. Nonmajor graduate credit.

EnSci 463. Soil formation and Landscape Relationships. (Dual-listed with 563). (Cross-listed with Agron). (2-4) Cr. 4. S. *Prereq: 154 or 260.* Sandor. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for one of EnSci 463 or 463l may be applied for graduation. Nonmajor graduate credit.

EnSci 463l. Soil formation and Landscape Relationships. (Dual-listed with 563l).(Cross-listed with Agron, Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: Agron 154 or 260.* Burras. Relationships between soil formation, geomorphology, and environment. Soil description classification, geography, mapping, and interpretation for land use. Credit for one of EnSci 463 or 463l may be applied for graduation. Nonmajor graduate credit.

EnSci 479. Surficial Processes. (Dual-listed with 579). (Cross-listed with Geol). (2-2) Cr. 3. F. *Prereq: Geol 100 or 201 or equivalent experience.* Study of surficial processes in modern and ancient geological environments. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory emphasizes aerial photo and topographic map interpretation. Nonmajor graduate credit.

EnSci 480. Engineering Analysis of Biological Systems. (Dual-listed with 580). (Cross-listed with BSE). (2-2) Cr. 3. F. *Prereq: A E 216; Math 266; Biol 211 or 212; M E 330.* Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues.

EnSci 484. Ecosystem Ecology. (Cross-listed with Biol). (3-0) Cr. 3. S. *Prereq: Combined 12 credits in biology and chemistry.* Introduction of the study of ecosystems and the factors that influence their properties and dynamics. Conceptual foundations for ecosystem studies. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems.

EnSci 485. Soil and Environmental Microbiology. (Dual-listed with 585). (Cross-listed with Agron, Micro). (2-3) Cr. 3. F. *Prereq: 402 or Agron 154, Micro 201 (Micro 203 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues. Nonmajor graduate credit.

EnSci 486. Aquatic Ecology. (Dual-listed with 586). (Cross-listed with A Ecl, Biol). (3-0) Cr. 3. F. *Prereq: Biol 312 or EnSci 381 or EnSci 402 or NREM 301.* Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine and wetland ecology. Nonmajor graduate credit.

EnSci 486L. Aquatic Ecology Laboratory. (Dual-listed with 586L).(Cross-listed with A Ecl, Biol). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in 486.* Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts. Nonmajor graduate credit.

EnSci 487. Microbial Ecology. (Cross-listed with Biol, Micro). (3-0) Cr. 3. F. *Prereq: Six credits in biology and 6 credits in chemistry.* Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems. Nonmajor graduate credit.

EnSci 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval of the Environmental Science coordinator.*

EnSci 495. Current Topics and Case Studies in Environmental Science. Cr. arr. *Prereq: Junior classification in Environmental Science, permission of instructor.* Current topics and case studies related to the analysis and management of environmental systems. Individual and/or group projects.

EnSci 496. Travel Course. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Extended field trips to study environmental topics in varied locations. Location and duration of trips will vary. Trip expenses paid by students. Check with department for current offerings.
A. International Tour
B. Domestic Tour

EnSci 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of Environmental Science Coordinator.* Required of all cooperative education students. Students must register prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

EnSci 502. Watershed Hydrology. (Dual-listed with 402). (Cross-listed with Geol, Mteor). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

EnSci 504. Global Change. (Dual-listed with 404). (Cross-listed with Agron, Mteor). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior, senior, or graduate standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change.

EnSci 505. Environmental Biophysics. (Dual-listed with 405). (Cross-listed with Agron, Mteor). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities. Semester project required.

EnSci 507. Watershed Management. (Dual-listed with 407). (Cross-listed with NREM). (3-3) Cr. 4. S. *Prereq: A course in general biology.* Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

EnSci 508. GIS and Natural Resource Management. (Dual-listed with 408). (Cross-listed with A E). (2-2) Cr. 3. F. *Prereq: Working knowledge of computers and Windows environment.* Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS. In addition to other assignments, graduate students will prepare research literature reviews on topics covered in class and develop enterprise applications.

EnSci 508I. Aquatic Ecology. (Cross-listed with Ia LL, NREM). Cr. 4. SS. *Prereq: Courses in ecology, chemistry, and physics.* Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

EnSci 509. Field Methods in Hydrogeology. (Dual-listed with 409). (Cross-listed with Geol). (0-4) Cr. 2. Alt. SS., offered 2010. *Prereq: 402 or 411 or C E 473.* Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, electronic instrumentation for data collection, and geophysics. Field trips to investigate water resource, water quality, and remediation projects.

EnSci 511. Hydrogeology. (Dual-listed with 411). (Cross-listed with Geol). (3-2) Cr. 4. F. *Prereq: Geol 100 or 201; Math 165 or 181; Phys 111 or 221.* Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations.

EnSci 514. Applied Groundwater Flow Modeling. (Dual-listed with 414). (Cross-listed with Geol). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 411 or C E 473; Math 165 or 181.* Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course.

EnSci 515. Paleoclimatology. (Dual-listed with 415). (Cross-listed with Geol). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Four courses in biological or physical science.* Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods; utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~ 1 million years).

EnSci 518. Stream Ecology. (Dual-listed with 418). (Cross-listed with A Ecl). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 486.* Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

EnSci 519. Environmental Geochemistry. (Dual-listed with 419). (Cross-listed with Geol). (2-2) Cr. 3. F. *Prereq: 511 or equivalent.* Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling.

EnSci 520. Environmental Engineering Chemistry. (Cross-listed with C E). (2-3) Cr. 3. *Prereq: Chem 177 and 178, Math 166.* Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilibria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions and mass transfer principles. Individual laboratory practicals and group projects required. Term paper and oral presentation for graduate level only.

EnSci 521. Environmental Biotechnology. (Cross-listed with C E). (2-2) Cr. 3. *Prereq: C E 326.* Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, bioenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens and parasites, and disinfection. Term paper and oral presentation.

EnSci 522. Water Pollution Control Processes. (Cross-listed with C E). (2-2) Cr. 3. *Prereq: 521.* Fundamentals of biochemical processes, aerobic growth in a single CSTR, multiple events in complex systems, and techniques for evaluating kinetic parameters; unit processes of activated sludge system, attached growth systems, stabilization and aerated lagoon systems, biosolids digestion and disposal, nutrient removal, and anaerobic treatment systems.

EnSci 523. Physical-Chemical Treatment Process. (Cross-listed with C E). (2-2) Cr. 3. *Prereq: C E 520.* Material and energy balances. Principles and design of physical-chemical unit processes; including screening, coagulation, flocculation, chemical precipitation, sedimentation, filtration, lime softening and stabilization, oxidation, adsorption, membrane processes, ion exchange and disinfection; recovery of resources from residuals and sludges; laboratory exercises and demonstrations; case studies in mineral processing and secondary industries. Individual and group projects required.

EnSci 524. Air Pollution. (Dual-listed with 424). (Cross-listed with A E, C E). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology
E. Agricultural sources of pollution

EnSci 526. Stable Isotopes in the Environment. (Dual-listed with 426). (Cross-listed with Geol). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Four courses in biological or physical science.* Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance.

EnSci 527. Solid Waste Management. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: C E 326.* Planning and design of solid waste management systems; includes characterization and collection of domestic, commercial, and industrial solid wastes, waste minimization and recycling, energy and materials recovery, composting, incineration, and landfill design.

EnSci 529. Hazardous Waste Management. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: C E 326.* Regulatory requirements for the classification, transport, storage and treatment of hazardous wastes. Analysis and design of alternatives for treatment and disposal technologies, including physical, chemical, and biological treatment, solidification, incineration, and secure landfill design. Regulatory requirements and procedures for hazardous waste contaminated site investigations and risk analysis. Analysis and design of remedial action alternatives for site restoration.

EnSci 531. Design and Evaluation of Soil and Water Conservation Systems. (Cross-listed with A E). (2-3) Cr. 3. F. *Prereq: E M 378 or Ch E 356.* Hydrology and hydraulics in agricultural and urbanizing watersheds. Design and evaluation of systems for the conservation and quality preservation of soil and water resources. Use and analysis of hydrologic data in

engineering design; relationship of topography, soils, crops, climate, and cultural practices in conservation and quality preservation of soil and water for agriculture. Small watershed hydrology, water movement and utilization in the soil-plant-atmosphere system, agricultural water management, best management practices, and agricultural water quality. Graduate students will prepare several research literature reviews on topics covered in the class in addition to the other assignments.

EnSci 533. Erosion and Sediment Transport. (Cross-listed with A E). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: A E 422 or C E 372, Math 266.* Soil erosion processes, modified universal soil loss equation and its application to conservation planning, sediment properties, initiation of sediment motion and over land flow, flow in alluvial channels and theory of sediment transport, channel stability, reserves sedimentation, wind erosion, BMPs for controlling erosion.

EnSci 534. Contaminant Hydrogeology. (Dual-listed with 434). (Cross-listed with Geol). (3-0) Cr. 3. S. *Prereq: Geol 511 or equivalent.* Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface Microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies.

EnSci 535. Restoration Ecology. (Cross-listed with EEOB, NREM). (2-3) Cr. 3. F. *Prereq: Biol 366 or 474 or graduate standing.* Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies.

EnSci 535l. Restoration Ecology. (Cross-listed with A Ecl, EEOB, Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: A course in ecology.* Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

EnSci 546. Integrating GPS and GIS for Natural Resource Management. (Dual-listed with 446). (Cross-listed with NREM). (2-3) Cr. 3. S. *Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS.* Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

EnSci 551. Applied and Environmental Geophysics. (Dual-listed with 451). (Cross-listed with Geol). (2-2) Cr. 3. S. *Prereq: Geol 100 or 201, Math 181 or equivalent experience.* Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic- and resistivity-imaging systems and radar.

EnSci 552. GIS for Geoscientists. (Dual-listed with 452). (Cross-listed with Agron, Geol). (2-2) Cr. 3. F. *Prereq: Geol 100, Geol 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

EnSci 553. Soil-Plant Relationships. (Cross-listed with Agron). (3-0) Cr. 3. F. *Prereq: Agron 354.* Killorn. Composition and properties of soils in relation to the nutrition and growth of plants.

EnSci 558. Laboratory Methods in Soil Chemistry. (Cross-listed with Agron). (2-3) Cr. 3. F. *Prereq: Agron 354 and Chem 178 or 211.* Tabatabai. Experimental and descriptive inorganic and organic analyses. Operational theory and principles of applicable instruments, including spectrophotometry, atomic and molecular absorption and emission spectroscopy, mass spectrometry, X-ray diffraction and fluorescence, gas and ion chromatography, and ion-selective electrodes.

EnSci 559. Environmental Soil and Water Chemistry. (Dual-listed with 459). (Cross-listed with Agron). (3-3) Cr. 4. F. *Prereq: Agron 354 or EnSci 360; Chem 164, 165, or 178; Math 140. Chem 211 or 231 recommended.* Thompson. An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, chemical-equilibrium speciation programs, and applications to contemporary environmental issues.

EnSci 563. Soil formation and Landscape Relationships. (Dual-listed with 463). (Cross-listed with Agron). (2-4) Cr. 4. S. *Prereq: Agron 154 or 260.* Sandor. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for only EnSci 563 or 563l may be applied for graduation.

EnSci 563l. Soil formation and Landscape Relationships. (Dual-listed with 463l).(Cross-listed with Agron, Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: Agron 154 or 260.* Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for one of EnSci 563 or 563l may be applied for graduation.

EnSci 564. Wetland Ecology. (Cross-listed with EEOB). (3-0) Cr. 3. S. *Prereq: 15 credits in biological sciences.* Ecology, classification, creation and restoration, and management of wetlands. Emphasis on North American temperate wetlands.

EnSci 564l. Wetland Ecology. (Cross-listed with EEOB, Ia LL). Cr. 4. SS. *Prereq: Ia LL 312l.* Ecology, classification, creation, restoration, and management of wetlands. Field studies will examine the composition, structure and functions of local natural wetlands and restored prairie pothole wetlands. Individual or group projects.

EnSci 571. Surface Water Hydrology. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: C E 372.* Analysis of hydrologic data including precipitation, infiltration, evapotranspiration, direct runoff and streamflow; theory and use of frequency analysis; theory of streamflow and reservoir routing; use of deterministic and Statistical hydrologic models. Fundamentals of surface water quality modeling, point and non-point sources of contamination. Design project.

EnSci 572. Analysis and Modeling Aquatic Environments. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: C E 372.* Principles of surface water flows and mixing. Introduction to hydrologic transport and water quality simulation in natural water systems. Advection, diffusion and dispersion, chemical and biological kinetics, and water quality dynamics. Applications to temperature, dissolved oxygen, primary productivity, and other water quality problems in rivers, lakes and reservoirs. Deterministic vs stochastic models.

EnSci 573. Groundwater Hydrology. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: C E 372.* Principles of groundwater flow, hydraulics of wells, super-position, slug and pumping tests, streamlines and flownets, and regional groundwater flow. Contaminant transport. Computer modeling. Individual and group projects.

EnSci 574. Environmental Impact Assessment. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: Four courses in natural, biological, or engineering sciences and senior or above classification.* Review of federal and state requirements for environmental impact assessment, requirements of the National Environmental Policy Act and Council on Environmental Quality, methods of evaluating the environmental impacts on the physical, biological, socioeconomic, cultural/Historical, human health and psychological environments, public participation in EIS, review and evaluate project environmental impact statements. An environmental impact assessment of a proposed project will be completed in small teams.

EnSci 575. Soil formation and Transformation. (Cross-listed with Agron). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 463 or equivalent.* Advanced study of soil formation, emphasizing relationships among soils, landscapes, environment, humans, and land use.

EnSci 577. Soil Physics. (Cross-listed with Agron). (3-0) Cr. 3. S. *Prereq: Agron 354. Recommended: Math 166.* Horton. The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

EnSci 578. Laboratory Methods in Soil Physics. (Cross-listed with Agron). (0-3) Cr. 1. S. *Prereq: 577 concurrent.* Horton. Methods of measuring soil physical properties such as texture, density, and water content, and transport of heat, water, and gases.

EnSci 579. Surficial Processes. (Dual-listed with 479). (Cross-listed with Geol). (2-2) Cr. 3. F. *Prereq: Geol 100 or 201 or equivalent experience.* Study of surficial processes in modern and ancient geological environments. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory emphasizes aerial photo and topographic map interpretation.

EnSci 580. Engineering Analysis of Biological Systems. (Dual-listed with 480). (Cross-listed with BSE). (2-2) Cr. 3. F. *Prereq: 216; Math 266; Biol 211 or 212; M E 330.* Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues. Students enrolled in EnSci 580 will be required to answer additional exam questions and report on two journal articles.

EnSci 581. Environmental Systems I: Introduction to Environmental Systems. (Dual-listed with 381). (Cross-listed with EEOB). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including biology and chemistry.* Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

EnSci 582. Environmental Systems II: Analysis of Environmental Systems. (Dual-listed with 382). (2-4) Cr. 4. S. *Prereq: EnSci 581.* Continuation of EnSci 581. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

EnSci 584. Ecosystem Ecology. (Cross-listed with EEOB). (3-0) Cr. 3. S. *Prereq: Combined 12 credits in biology and chemistry.* Introduction to the study of ecosystems and the factors that influence their properties and dynamics. Conceptual foundations for ecosystem studies. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems.

EnSci 585. Soil and Environmental Microbiology. (Dual-listed with 485). (Cross-listed with Agron, Micro). (2-3) Cr. 3. F. *Prereq: 402 or Agron 154, Micro 201 (Micro 203 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

EnSci 586. Aquatic Ecology. (Dual-listed with 486). (Cross-listed with EEOB). (3-0) Cr. 3. F. *Prereq: EnSci 301 or 312 or 381 or 402.* Structure and function of

aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine and wetland ecology.

EnSci 586L. Aquatic Ecology Laboratory. (Dual-listed with 486L).(Cross-listed with EEOB). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in 586.* Field trips and laboratory exercises to accompany 586. Hands-on experience with aquatic research and monitoring techniques and concepts.

EnSci 587. Microbial Ecology. (Dual-listed with 487). (Cross-listed with EEOB, Micro). (3-0) Cr. 3. F. *Prereq: Six credits in biology and six credits in chemistry.* Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

EnSci 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of major professor in Environmental Science faculty.* Literature reviews and conference in accordance with needs and interest of the student.

EnSci 599. Creative Component. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of major professor in Environmental Science faculty.* Creative component for nonthesis master of science degree.

Courses for graduate students

EnSci 685. Advanced Soil Biochemistry. (Cross-listed with Agron, Micro). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Agron 585.* Tabatabai. Chemistry of soil organic matter and biochemical transformations brought about by Microorganisms and enzymes in soils.

EnSci 690. Seminar in Environmental Science. Cr. R. Repeatable. F.S. Reports and discussion of recent research and literature.

EnSci 699. Research. Cr. arr. Repeatable. F.S.SS.

Environmental Studies

www.envs.iastate.edu

(Interdepartmental Undergraduate Program)

William G. Crumpton: Coordinator

Environmental Studies deals with the relationship and interactions between humans and the environment. Students in any college at ISU may elect to take a secondary major or minor in Environmental Studies. The curriculum is designed to give students an understanding of current and emerging environmental issues and an appreciation of different perspectives regarding these issues. Courses are provided for students pursuing careers related to the environment and for others who simply want to know more about environmental issues.

Secondary Major

The Environmental Studies secondary major is taken in addition to one's first major and provides the breadth of preparation and integrated perspective necessary to understand environmental issues. Students seeking a major in Environmental Studies complete 24 credits of Env S coursework including (1) at least one general survey course chosen from Env S 101, 120, 173, and 201, (2) at least one integrative/issues course chosen from Env S 160, 204, 324, 342, 404, 424, and 450, and (3) at least two human/Societal perspectives courses chosen from Env S 293 320, 334, 345, 355, 380, 382, 384, 442, 472, 482, 484, and 491. Beyond these three requirements, any Environmental Studies course and up to six credits of approved departmental coursework may be applied toward the 24 credit total for the major. Regardless of their home college, Environmental Studies majors must complete 10 credits of approved coursework in natural science. Unless prohibited by program or college rules, courses used in the major may also be used to satisfy general education and other requirements of departments and colleges. A combined average grade of C or higher is required in courses applied to the major.

Regardless of their primary major, Environmental Studies graduates have a broad foundation in science and humanities, an understanding of major environmental issues, and an appreciation of the varied and sometimes opposing perspectives regarding these issues.

Minor

Students seeking a minor in Environmental Studies complete 15 credits of approved Environmental Studies coursework including (1) at least one general survey course chosen from Env S 101, 120, 173, and 201, (2) at least one integrative/issues course chosen from Env S 160, 204, 324, 342, 404, 424, and 450, and (3) at least two human/Societal perspectives courses chosen from Env S 293, 320, 334, 345, 355, 380, 382, 384, 442, 472, 482, 484, and 491. A combined average grade of C or higher is required in courses applied to the minor, and the minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

Courses primarily for undergraduate students

Env S 101. Environmental Geology: Earth in Crisis. (Cross-listed with Geol). (3-0) Cr. 3. F.S. An introduction to geologic processes and the consequences of human activity from local to global scales. Discussion of human population growth, resource depletion, pollution and waste disposal, global warming and ozone depletion, desertification, and geologic hazards such as earthquakes, landslides, flooding, and volcanism.

Env S 108. Introduction to Oceanography. (Cross-listed with Geol). (3-0) Cr. 3. F. Introduction to study of the oceans. Ocean exploration. Waves and currents. Shape, structure, and origin of the ocean basins. Sedimentary record of oceanic life. Composition of seawater and its significance for life. Ocean circulation and its influence on climate. Life of the oceans, including coral reefs. Use and misuse of ocean resources. Anthropogenic impacts on the oceanic environment.

Env S 120. Introduction to Renewable Resources. (Cross-listed with Agron, NREM). (3-0) Cr. 3. F.S. Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

Env S 130. Natural Resources and Agriculture. (Cross-listed with NREM). (3-0) Cr. 3. S. Survey of the ecology and management of fish, forest, and wildlife resources in areas of intensive agriculture, with emphasis on Iowa. Conservation and management practices for private agricultural lands. Designed for nonmajors.

Env S 160. Water Resources of the World. (Cross-listed with Agron, Geol, Mteor). (3-0) Cr. 3. S. Study of the occurrence, History, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in Society and the environment.

Env S 173. Environmental Biology. (Cross-listed with Biol). (3-0) Cr. 3. F.S. An introduction to the structure and function of natural systems at scales from the individual to the biosphere and the complex interactions between humans and their environment. Discussions of human population growth, biodiversity, sustainability, resource use, and pollution.

Env S 201. Introduction to Environmental Issues. (Cross-listed with EnSci). (2-0) Cr. 2. F.S. Discussion of current and emerging environmental issues such as human population growth, energy use, loss of biodiversity, water resources, and climate change.

Env S 204. Biodiversity. (Cross-listed with Biol). (4-0) Cr. 2. S. *Prereq: One course in life sciences.* Survey of the major groups of organisms and biological systems. Definition, measurements, and patterns of distribution of organisms. Sources of information about biodiversity. Not intended for major credit in the biological sciences. Half semester course.

Env S 250. Environmental Geography. (Cross-listed with EnSci). (3-0) Cr. 3. F. The distribution, origins and functions of the earth's physical systems and the spatial relationship between human activity and the natural world.

Env S 260. Soils and Environmental Quality. (Cross-listed with Agron). (3-0) Cr. 3. F.S. Burras. Role of soils in environmental quality and natural resources management. Emphasis on soil erosion and conservation, water quality, and environmental planning. Saturday field trip.

Env S 293. Environmental Planning. (Cross-listed with C R P, Dsn S). (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Comprehensive overview of the field of environmental relationships and the efforts being made to organize, control, and coordinate environmental, aesthetic, and cultural characteristics of land, air, and water.

Env S 320. Ecofeminism. (Cross-listed with W S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: W S 201 or 3 credits in W S at the 300 level or above.* Women's relationships with the earth, non-human nature, and other humans. The course explores the connections between the mastery of women and the mastery of nature; origins of ecofeminism and its relation to the science of ecology and to other branches of feminist Philosophies. Critique of modern science, technology, political systems as well as solutions will be included.

Env S 324. Energy and the Environment. (Cross-listed with Geol, Mteor). (3-0) Cr. 3. S. Renewable and non-renewable energy resources. Origin, occurrence, and extraction of fossil fuels. Nuclear, wind, and solar energy. Energy efficiency. Environmental effects of energy production and use, including air pollution, acid precipitation, groundwater contamination, nuclear waste disposal, and global climate change.

Env S 334. Environmental Ethics. (Cross-listed with Phil). (3-0) Cr. 3. F. *Prereq: Three credits in Philosophy or junior classification.* Thorough study of some of the central moral issues arising in connection with human impact on the environment, e.g., human overpopulation, species extinction, forest and wilderness management, pollution. Several world views of the proper relationship between human beings and nature will be explored. Nonmajor graduate credit.

Env S 342. World Food Issues: Past and Present. (Cross-listed with Agron, FS HN, T SC). (3-0) Cr. 3. F.S. *Prereq: Junior classification.* Zdorkowski, Ford. Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, Historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects. Nonmajor graduate credit.
H. Honors Section. (Honors Program students only.)

Env S 345. Population and Society. (Cross-listed with Soc). (3-0) Cr. 3. F. *Prereq: Soc 130 or 134.* Human population growth and structure; impact on food, environment, and resources; gender issues; trends of births, deaths, and migration; projecting future population; population policies and laws; comparison of the United States with other Societies throughout the world.

Env S 355. Literature and the Environment. (Cross-listed with Engl). (3-0) Cr. 3. *Prereq: Engl 250.* Study of literary texts that address the following topics, among others: the relationship between people and natural/urban environments, ecocriticism, and the importance of place in the literary imagination. Nonmajor graduate credit.

Env S 380. Environmental and Resource Economics. (Cross-listed with Econ). (3-0) Cr. 3. F. *Prereq: Econ 101.* Natural resource availability, use, conservation, and government policy, including energy issues. Environmental quality and pollution control policies.

Env S 381. Environmental Systems I: Introduction to Environmental Systems. (Cross-listed with Biol, EnSci, Micro). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including Biology and chemistry.*

Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

Env S 382. Environmental Sociology. (Cross-listed with Soc). (3-0) Cr. 3. F.S. *Prereq: Soc 130, 134, or 3 credits of Env S.* Environment-Society relations; social construction of nature and the environment; social and environmental impacts of resource extraction, production, and consumption; environmental inequality; environmental mobilization and movements; U.S. and international examples.

Env S 384. Religion and Ecology. (Cross-listed with Relig). (3-0) Cr. 3. Introduction to concepts of religion and ecology as they appear in different religious traditions, from both a Historical and contemporary perspective. Special attention to religious response to contemporary environment issues. Nonmajor graduate credit.

Env S 390. Internship in Environmental Studies. Cr. arr. Repeatable. F.S.SS. *Prereq: Approval of the Environmental Studies Coordinator.* Practical experience with nature centers, government agencies, schools, private conservation groups, and other organizations. Satisfactory-fail only.

Env S 404. Global Change. (Cross-listed with Agron, EnSci, Mteor). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Nonmajor graduate credit.

Env S 407. Watershed Management. (Cross-listed with EnSci, NREM). (3-3) Cr. 4. S. *Prereq: A course in general biology.* Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

Env S 424. Sustainable and Environmental Horticulture Systems. (Cross-listed with Hort). (2-0) Cr. 2. F. Inquiry into ethical issues and environmental consequences of Horticultural cropping systems and production practices. Emphasis on production systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

Env S 442. The Policy and Politics of Coastal Areas. (Cross-listed with Pol S). (3-0) Cr. 3. SS. Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, trade-offs between conservation and jobs, the quality of coastal lifestyle, ways in which citizens participate in policy for coastal areas.

Env S 450. Issues in Sustainable Agriculture. (Cross-listed with Agron). (3-0) Cr. 3. F. Zdorkowski. Agricultural science as a human activity; contemporary agricultural issues from agroecological perspective. Comparative analysis of intended and actual consequences of development of industrial agricultural practices.

Env S 460. Controversies in Natural Resource Management. (Cross-listed with NREM). (3-0) Cr. 3. F.S. *Prereq: 120, and A Ecl 312 or NREM 301, and Junior classification.* Analysis of controversial natural resource issues using a case approach that considers uncertainty and adequacy of information and scientific understanding. Ecological, social, political, economic, and ethical implications of issues will be analyzed. Nonmajor graduate credit.

Env S 461I. Introduction to GIS. (Cross-listed with EnSci, L A, Ia LL). Cr. 4. SS. Descriptive and predictive GIS modeling techniques, spatial Statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management. Nonmajor graduate credit.

Env S 472. U. S. Environmental History. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* Survey of the interactions of human communities with the North American environment. Focus on the period from presettlement to the present, with a particular concentration on natural resources, disease, settlement patterns, land use, and conservation policies. Nonmajor graduate credit.

Env S 482. Environmental Politics and Policies. (Cross-listed with Pol S). (3-0) Cr. 3. F. *Prereq: Three credits in Political Science or 3 credits in Environmental Studies; Junior classification.* Major ideologies relation to conservation and ecology. Processes, participants, and institutions involved in state, national, and global environmental policymaking. Case studies of environmental controversies and proposals for policy reform. Nonmajor graduate credit.

Env S 484. Sustainable Communities. (Cross-listed with C R P, Dsn S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Senior classification.* The History and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

Env S 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor and approval of Environmental Studies coordinator.* Satisfactory-fail only.

Env S 491. Environmental Law and Planning. (Cross-listed with C R P, Dsn S). (3-0) Cr. 3. S. *Prereq: Six credits in natural sciences.* Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

Env S 496. Travel Course. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Extended field trips to study environmental topics in varied locations. Location and duration of trips will vary. Trip expenses paid by students. Check with department for current offerings.
A. International Tour
B. Domestic Tour

Family and Consumer Sciences

Master of Family and Consumer Sciences (M.F.C.S.)

The College of Human Sciences offers a nonthesis master's degree program that might appeal to individuals with a bachelor's degree in family and consumer sciences/home economics subject area or related disciplines. This program is considered to be a professional master's degree. For students interested in further graduate study beyond the MFCS, the nonthesis degree program may mean additional requirements before completion of a Ph.D. or other terminal degree graduate program.

Students select either a comprehensive option or a specialization option. The comprehensive option can be followed on or off-campus and requires 36 credits covering a variety of family and consumer sciences subject matter. Off-campus courses are offered via the World Wide Web (WWW). Specializations are available in Nutrition; Dietetics; Human Development and Family Studies; Foodservice and Lodging Management; and Textiles and Clothing.

In addition, students may select a 42-credit specialization in Family Financial Planning (FFP), a 36-credit specialization in Gerontology or a 36-credit specialization in Dietetics. The FFP, Gerontology, and Dietetics specializations, offered in collaboration with six to eight other universities in the Great Plains Interactive Distance Education Alliance, are offered exclusively through courses on the Web. The FFP program has been approved by the Board of Examiners of the Certified Financial Planner Board of Standards as a program with the competencies required to permit those completing the degree to sit for the CFP® Certification Examination. CFP® is a certification mark owned by the Certified Financial Planner Board of Standards.

The Program of Study committee, in consultation with the student, establishes the courses to be taken and the acceptability of transfer credits. The major professor is selected from the discipline in which the concentration of coursework will be taken. Written and oral final integrative examinations are required in lieu of a thesis or creative component. A thesis or creative component could be included on mutual agreement of the student and major professor, with approval of the Graduate College.

Admission requirements for the MFCS include a bachelor's degree in a family and consumer sciences/home economics subject area or related disciplines, Graduate Record Examination (GRE) scores (not required for the FFP and Geron specializations), official transcripts, three letters of recommendation, a goal statement, and graduation in the upper one-half of class with a bachelor's degree from a regionally accredited U.S. institution or graduation in the upper one-half of class from a recognized foreign institution. Non-English speaking international students are required to have a TOEFL score of at least 550 at time of admission.

Graduate Certificates

An 18-credit graduate certificate in Family Financial Planning is offered for students who do not need a master's degree and want to obtain the educational requirements of the Certified Financial Planner Board of Standards CFP® Certification Examination.

A 21-credit graduate certificate in Gerontology is offered. For additional information, students should contact the Research and Graduate Education Office, E262 Lagomarcino, Ames, Iowa 50011-3191, mfcsinfo@iastate.edu

Family and Consumer Sciences Education and Studies

(Administrated by the Department of Apparel, Educational Studies and Hospitality Management.)

www.aeshm.hs.iastate.edu/fceds/

Robert Bosselman, Interim Chair of Department

Distinguished Professors (Emeritus): Fanslow, Moyer, Winakor

University Professors (Emeritus): Farrell-Beck

Professors: Bosselman, Damhorst, Fiore, Kadolph

Professors (Emeritus): Anderson, Beavers, Brun, Burnet, Cowan, Crabtree, Gilmore, Smith, Stone, Williams

Associate Professors: Baltzer, Hausafus, Niehm, Parsons

Associate Professors (Emeritus): Amos, Brackelsberg, Brown, Ebert, Huss, Kundel, Kunz, Walsh

Associate Professor (Adjunct): Strohbehn

Assistant Professors: Barker, Hurst, Karpova, Keino, Y. Lee, Marcketti, Rajagopal, Wohlsdorf-Arendt, Zheng

Assistant Professor (Adjunct): Glock

Instructor (Adjunct): Fratzke

Lecturers: Ackerman, Burger, Christensen, Fiihr, Fitzpatrick, Kramer, M. Lee, Sanger, Trost, Wirth, Wise

Undergraduate Study

The program offers one curriculum for the bachelor of science degree in Family and Consumer Sciences Education and Studies. Students in the curriculum choose one of three options, Teacher Licensure, Communications, or Professional Studies. Graduates of the teacher licensure option teach in general and occupational programs of family and consumer sciences in middle, junior, and senior high schools. Graduates of the Communications option have a broad-based knowledge of family and consumer sciences and the ability to communicate in a global and technologically changing Society. They are able to plan, develop, creatively present and evaluate information. Graduates of the Professional Studies option pursue individualized career goals in family and consumer sciences that apply integrative knowledge of family and consumer sciences in diverse careers for global settings.

Admission to all three options is initiated in the course FCEdS 206. In addition, students in Teacher Licensure follow program and university procedures for admission to the university teacher education program. This program option is approved by the Iowa Department of Education for the preparation of career and technical education family and consumer sciences teachers. Every teacher licensure student must demonstrate achievement of the identified teacher licensure standards. Standards will be assessed in all core courses including FCEdS 206, 214, 280, 306, 318, 403, 413, 417, and 460. For additional teacher education requirements, see *Teacher Education*.

Graduates in Family and Consumer Sciences Education and Studies have a broad understanding of individual and family well-being. Graduates apply knowledge of family and consumer sciences content in global professional settings. They use research findings to improve the well-being of individuals, families, and communities. Due to the integrative and synergistic nature of family and consumer sciences, graduates address and act on complex problems confronting individuals, families, and communities.

Opportunities are available for obtaining a minor from other programs through careful selection of elective credits and consultation with an adviser. For example, students pursuing the Communications and Professional Studies options are encouraged to consider obtaining a minor in journalism and mass communications or in one of the subject matter areas of family and consumer sciences such as family finance, housing, and policy. They also are encouraged to enhance their program by electing relevant additional courses in their area of interest. Students in the Teacher Licensure option may choose to add an additional endorsement such as Health Education or Coaching Interscholastic Athletics.

The program offers a minor in family and consumer sciences education. The minor is earned by successfully completing 15 credits including FCEdS 206, 306, 415, and 418. See program for details.

Communication Proficiency Requirement: C or better in Engl 150 and 250.

Graduate Study

The program offers work for the degrees master of science, master of education, and doctor of philosophy, each with the major, family and consumer sciences education. The M.S. degree requires a thesis; the M.Ed. degree requires a creative component; the Ph.D. requires a dissertation. Minors are available. The Family and Consumer Sciences Education Leadership Academy provides opportunity for completion of a graduate degree through condensed summer courses and distance education delivery. For additional information see http://www.aeshm.hs.iastate.edu/academy/.

Programs for advanced degrees with a major in family and consumer sciences education are tailored to fit the educational background, experience, and professional goals of the student. Areas of study provided by the department include program planning, curriculum, evaluation, research methods, supervision and administration, international education and development, and teacher education. Opportunities are available for strengthening one's background in subject matter in other programs in the College of Human Sciences.

Students who complete a graduate program are professional family and consumer sciences educators and teacher educators who foster program planning, implementation, and evaluation at state, national, and international levels. They are producers and disseminators of research and scholarship in family and consumer sciences education and are leaders in programs and services for clientele in diverse settings.

Courses primarily for undergraduate students

FCEdS 102. Learning Community Seminar. Cr. R. Repeatable. F.S. Learning Community seminar for Human Sciences entering transfer students. Group social and professional activities. Satisfactory-fail only.

FCEdS 110. Orientation. (1-0) Cr. arr. F.S. Orientation to the university, the college, and the college curricula. Adjustment to the university; discussion of student responsibilities; interpersonal, critical thinking, and study skills; and management of time and energy. Development of a long-term curriculum plan. Satisfactory-fail only.

FCEdS 206. Professional Roles in Family and Consumer Sciences. (2-3) Cr. 3. F. Historical development of family and consumer sciences. Overview of various roles in professional settings, e.g., community agencies, secondary schools, business and industry, Cooperative Extension. Completion of a 20-hour practicum in an educational setting.

FCEdS 214. Electronic Learning Portfolios. (0-2) Cr. 1. Repeatable. F. Development of an electronic learning portfolio. Selection, reflection and demonstration of evidence of achievement of program outcomes. Satisfactory-fail only.

FCEdS 280. Pre-Student Teaching Experience in Family and Consumer Sciences Education. (0-2) Cr. arr. Repeatable. F.S. *Prereq: Admission to teacher education.* Laboratory experience in foods, textiles and human development in family and consumer sciences secondary programs. Observation of family and consumer sciences laboratories in diverse classrooms. Planning, implementing, managing and assessing laboratory lessons in family and consumer sciences. Satisfactory-fail only.
A. Practicum in FCS Labs
B. Practicum in diverse settings

FCEdS 306. Educational Principles for Family and Consumer Sciences. (2-2) Cr. 3. F. *Prereq: 15 credits in family and consumer sciences subject matter; enrollment in Sp Ed 450.* Principles of teaching and learning applied to family and consumer sciences content. Instructional methods appropriate for formal and nonformal educational settings. Specific strategies for diverse audiences. May be used for family life certification.

FCEdS 318. Occupational, Career and Technical Programs. (Dual-listed with 518). (2-0) Cr. 2. S. *Prereq: 206 and 400 hours work experience in a family and consumer sciences related job.* Planning and implementing programs in occupational family and consumer sciences including FCCLA. Impact of selected legislation on family and consumer sciences programs. Techniques for cooperative education, school-to-work, and work-based education programs. May be used toward Multi-Occupation Cooperative endorsement.

FCEdS 403. Learner Assessment for Family and Consumer Sciences Programs. (2-2) Cr. 3. S. *Prereq: Enrollment in 413.* Philosophy of learner assessment. Development and critique of tests and authentic assessment tools to measure cognitive, affective, and psychomotor learning and to evaluate processes, performances, products, and dispositions. Procedures for grading, interpreting, and reporting assessment data.

FCEdS 413. Curriculum Planning for Family and Consumer Sciences and Family Life Education. (2-2) Cr. 3. S. *Prereq: 306.* Philosophy of career and technical education. Curriculum development in family and consumer sciences programs for school settings. Accommodating exceptional learners. May be used for family life certification.

FCEdS 415. Program Planning and Evaluation in Family and Consumer Sciences. (3-0) Cr. 3. S. *Prereq: 15 credits in Family and Consumer Sciences subject matter.* Program development principles including needs analysis, planning, instruction, promotion, evaluation, grant writing and reporting. Approaches appropriate for diverse groups. Environmental and cultural conditions affecting programs. Nonmajor graduate credit.

FCEdS 417. Supervised Teaching in Family and Consumer Sciences. Cr. arr. Repeatable. F.S. *Prereq: 413, 24 credits in family and consumer sciences subject matter, cumulative grade point of 2.50, full admission to teacher education.* Supervised teaching experience in secondary schools. Examination of ways to implement actions that reflect a professional Philosophy of family and consumer sciences for teaching middle and high school level students. Reservation required.
A. Vocational family and consumer sciences. Cr. 8.
B. Family and consumer sciences. Cr. 3 to 8.

FCEdS 418. Supervised Experiences in a Professional Setting. Cr. arr. Repeatable. F.S.SS. *Prereq: 24 credits in family and consumer sciences.* Supervised professional experience in an approved setting such as Cooperative Extension, business, community, human Service, or government agency. Reservation required.
A. Communications. Prereq: 415, 24 credits in family and consumer sciences.
B. Professional Studies. Prereq: 421, 24 credits in family and consumer sciences

FCEdS 460. Capstone Seminar. (1-0) Cr. 1. S. *Prereq: senior classification in Family and Consumer Sciences Education and Studies.* Ways professionals work across disciplines to address contemporary social issues that affect individuals and families. Methods to initiate public policy at the local, national, and international levels. Transition from student to professional role.

FCEdS 490. Independent Study. Cr. arr. F.S.SS.
A. Adult Education
C. Curriculum
D. Evaluation
E. Cooperative Extension
G. General
H. Honors
I. International
K. Occupational Education
N. Leadership and Human Relations
P. Special Needs/Mainstreaming
R. Vocational Education
S. Technology and Distance Education

Courses primarily for graduate students, open to qualified undergraduate students

FCEdS 500. Short Course: Current Family and Consumer Sciences Offerings. Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education.*
A. Adult Education
B. Supervision and Administration
C. Curriculum
D. Evaluation
E. Teacher Education
F. Occupational, Career and Technical Education
G. General
H. Research Methodology
I. International Education
J. Middle Level Education

FCEdS 501. Trends, Issues and Public Policy. (3-0) Cr. 3. Repeatable. Alt. SS., offered 2010. *Prereq: 6 credits in family and consumer sciences or education.* Discussion of current topics affecting the family and consumer sciences profession.

FCEdS 504. Intellectual Foundations of Family and Consumer Sciences Leadership. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Exposure to a variety of selected readings that provide an intellectual foundation and framework for the family and consumer sciences profession. Connects the historical and Philosophical structure of the profession with perspectives leading to innovative professional action.

FCEdS 506. Curriculum Development in Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2011. Analysis and development of family and consumer sciences curriculum related to Philosophy, design and adaptability within public education programming as influenced by subject matter, professional, national and state educational standards and legislation.

FCEdS 507. Program Development in Family and Consumer Sciences. (3-0) Cr. 3. SS. *Prereq: Professional experience in family and consumer sciences or related area.* Application of principles of program development to formal and nonformal educational settings, e.g., secondary school family and consumer sciences programs, training positions in business, Cooperative Extension, human Services agencies.

FCEdS 508. Models for Teaching Family and Consumer Sciences. (3-0) Cr. 3. S. *Prereq: 6 credits in family and consumer sciences.* Selecting teaching strategies and instructional materials based on theories of learning and human development that reflect a professional Philosophy of family and consumer sciences. Application to formal and nonformal educational settings with diverse audiences.

FCEdS 511. Research Methods. (3-0) Cr. 3. F. *Prereq: Graduate classification.* An overview of diverse research approaches focusing on methods for collecting and analyzing quantitative and qualitative data. Critique of research reports and development of research proposals.

FCEdS 515. Assessment in Family and Consumer Sciences. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Introductory Statistical and program development skills.* Role of assessment in family and consumer sciences education programs. Planning and constructing test items and other assessments of school and nonschool learning.

FCEdS 518. Occupational, Career and Technical Programs. (Dual-listed with 318). (2-0) Cr. 2. S. *Prereq: 400 hours work experience in a family and consumer sciences related job.* Planning and implementing programs in occupational family and consumer sciences including FCCLA. Impact of selected legislation on family and consumer sciences programs. Techniques for cooperative education, school-to-work, and work-based education programs. Critique of national occupational competency standards. May be used toward Multi-Occupation Cooperative endorsement.

FCEdS 519. Reflective Human Action Leadership. (2-0) Cr. 2. Alt. SS., offered 2011. Examination of the meaning and qualities of reflective human action. Analysis of the roles that reflective human action plays in Society, the profession, and family life. Critically and imaginatively address social needs, identify meaningful leadership opportunities and engage in worthwhile actions that benefit individuals, families and communities.

FCEdS 520. Supervision in Family and Consumer Sciences Programs. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: Professional experience or 6 credits in family and consumer sciences.* Examination of change, communication and leadership theories as related to supervision. Application of conferencing techniques, observation skills, and performance evaluation to professional leadership positions in educational settings.

FCEdS 521. International Perspectives of Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2010. *Prereq: 6 credits in family and consumer sciences.* Examination of family and consumer sciences from an international perspective; focus on the roles and responsibilities of women in development. Application and adaptation of content to working with families in other countries and cultures. Student participation in cultural activities and critique of international research articles.

FCEdS 524. International Study Abroad Seminar. Cr. arr. Repeatable. F.S.SS. Orientation to study abroad program considering topics related to country and location; travel arrangements and preparation for study abroad; on-site fieldwork and academic experiences in an international setting. Individually-developed research project on a topic related to study abroad.

FCEdS 579. Educational and Critical Science Perspectives of Family and Consumer Issues. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: Graduate classification.* Examination of social issues within a family and community context from a critical science perspective. Application of critical thinking, diverse perspectives, and reflection to family and social issues. Analysis of family and consumer sciences Philosophy, theory, and research to current social issues.

FCEdS 590. Special Topics. Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education.*
A. Adult Education
B. Administration
C. Curriculum
D. Evaluation E. Teacher Education
F. Occupational, Career and Technical Education
G. General
H. Research Methodology
I. International Education
J. Educational Gerontology
K. Leadership and Human Relations
L. Special Needs
M. Family Life Education
N. Human Sexuality
O. Technology
P. Supervision
Q. Family/Individual Health
R. Consumer Education
S. Distance Education
T. Professional Communications

FCEdS 593. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education.* Concentrated group study of new developments in family and consumer sciences education. Sections offered will vary from year to year.

FCEdS 599. Creative Component. Cr. arr. *Prereq: 9 graduate credits in Family and Consumer Sciences Education.*

Courses for graduate students

FCEdS 601. Advanced Philosophical Critique of Professional Issues. (3-0) Cr. 3. Alt. SS., offered 2010. A critical science examination of current topics affecting the family and consumer sciences profession. Concentrated group study with implications for action. Critical science approach applied to current topics, issues, and public policy. Group examination and exposure to various components of a contemporary problem within a global context.

FCEdS 607. Curriculum Theory and Philosophy in Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: 507 or curriculum development experience.* Integration of Philosophies of education and family and consumer sciences into an operative Philosophy of curriculum development. Study of various curriculum theories and approaches to curriculum development.

FCEdS 610. Seminar. Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Exploration of trends and issues in the profession. Satisfactory-fail only.

FCEdS 611. Program Evaluation in Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2010. *Prereq: 511, 515.* Application of program evaluation approaches and models to family and consumer sciences programs. Standards for program evaluation.

FCEdS 618. Coordination of Educational Programs in Family and Consumer Sciences. (2-0) Cr. 2. Alt. SS., offered 2011. *Prereq: 520.* Approaches to coordination of family and consumer sciences programs in adult education, extension, state department of education, and teacher education. Study of undergraduate programs in family and consumer sciences education, observation and participation in undergraduate courses, and practicum experience.

FCEdS 620. Theories of Administration in Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2010. *Prereq: Professional Experience.* Review of administrative theory; application to family and consumer sciences programs with emphasis on higher education. Administrative leadership roles and their interrelationships. Consideration of current issues.

FCEdS 626. Advanced Research Methods in Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: 511.* Examination of various modes of inquiry used to conduct research in educational and social arenas culminating in development of a research project. Empirical/analytic, interpretive and critical/post-modern inquiries in relation to human context will be discussed.

FCEdS 690. Family and Consumer Sciences Education and Studies Advanced Topics. Cr. arr. *Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E.* Topics for the independent study will be in any of the following areas:
A. Adult Education
B. Administration
C. Curriculum
D. Evaluation
E. Teacher Education
F. Occupational, Career and Technical Education
G. General
I. International Education
J. Educational Gerontology
K. Leadership and Human Relations
L. Special Needs
M. Family Life Education
N. Human Sexuality
O. Technology
P. Supervision
Q. Family/Individual Health
R. Consumer Education
S. Distance Education
T. Professional Education
U. Research Methodology

FCEdS 699. Research. Cr. arr. Repeatable.

Family Financial Planning

www.hs.iastate.edu/online/mfcs/ffp/

(Interinstitutional Graduate Program)

Participating Faculty:

Iowa State University
College of Human Sciences
Pat Swanson, pswanson@iastate.edu

Kansas State University
College of Human Ecology
John Grable, grable@humec.ksu.edu
Esther Maddux, emaddux@humec.ksu.edu

Montanta State University
College of Education, Health and Human Development
George W. Haynes, haynes@montana.edu
Deborah C. Haynes, dhaynes@montana.edu

University of Nebraska
College of Human Resources and Family Sciences
Sheran Cramer, scramer@unomaha.edu

North Dakota State University
College of Human Development and Education
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Oklahoma State University
College of Human Environmental Sciences
David Fournier, frcddgf@okstate.edu
Glenn Muske, muske@okstate.edu

South Dakota State University
College of Family and Consumer Sciences
Bernadine Enevdoldsen, bernadine.enevoldsen@sdstate.edu
Rui Yao, rui.yao@sdstate.edu

Family Financial Planning is an interinstitutional distance education program offered through the Web. The student selects a home institution, which grants the degree. After admission at the home institution, the student takes courses from each of the seven institutions: Iowa State University, Kansas State University, Oklahoma State University, Montana State University, University of Nebraska, North Dakota State University, and South Dakota State University.

At Iowa State University, Family Financial Planning is a specialization within the Master of Family and Consumer Sciences degree program (MFCS-FFP) that consists of 42 semester credits. Neither a thesis nor a creative component is required. Students typically complete the program in three years while employed full time. A computer with minimum specifications, Web access, and an email address are required for completing the program.

FFP Graduate Certificate Program
The Graduate Certificate in Family Financial Planning consists of the six courses from the MFCS-FFP that contain the competencies required for the CFP® Certification Examination. Students interested in attaining the CFP® credential and not a master's degree should enroll in the certificate program.

Courses included in the FFP graduate certificate program include: FFP 530, 540, 545, 555, 565, 583. Both the Master's degree and Graduate Certificate programs at Iowa State University are registered with Certified Financial Planner Board of Standards Inc. As a CFP Board-registered Program, ISU FFP courses satisfy CFP Board's education requirement, allowing an individual to sit for the CFP® Certification Examination.

Iowa State University does not certify individuals to use the CFP®, CERTIFIED FINANCIAL PLANNER™ title. CFP certification is granted only by Certified Financial Planner Board of Standards Inc. to those persons who, in addition to completing an educational requirement such as this CFP Board-Registered Program, have met its ethics, experience and examination requirements. (CFP Board of Standards web site: www.cfp.net.)

Certified Financial Planner Board of Standards Inc. owns the certification marks CFP®, CERTIFIED FINANCIAL PLANNER™ and the federally registered CFP (with flame logo), which it awards to individuals who successfully complete initial and ongoing certification requirements.

Admission Procedures: Admission to the FFP Certificate Program requires exactly the same procedures as admission to the Graduate College. See *Graduate College* section in the catalog.

Registration
Students choosing to receive their degree from Iowa State University complete all the admissions, registration and fee payment processes through ISU.

Courses primarily for graduate students

FFP 520. Family Systems. (3-0) Cr. 3. F.S. Research and theory related to family functioning throughout the life cycle, especially financial decision making during crisis and conflict. Emphasis on factors that shape family values, attitudes, and behaviors from a multicultural perspective. New and emerging issues critical to family functioning are addressed.

FFP 525. Family Economics. (3-0) Cr. 3. SS. Major issues related to the economics of families including household production, and human capital development; the economics of crises, public policy and family life cycle spending, saving and borrowing; new and emerging issues in the field of family economics; special attention to the role of ethics in family economic issues. A theoretical and research perspective are used to illuminate the concepts in the course.

FFP 530. Fundamentals of Family Financial Planning. (3-0) Cr. 3. F. The nature and functioning of financial systems, including currencies, markets, monetary and fiscal policy, and supply/demand for land, labor, and capital. Focus is on the impact of global financial interdependence on individuals and families in the U.S. Current and emerging issues, as well as current research and theory relative to financial systems.

FFP 535. Financial Counseling. (3-0) Cr. 3. S. Theory and research regarding the interactive process between the client and the practitioner, including communication techniques, motivation and esteem building, the counseling environment, ethics, and methods of data intake, verification, and analysis. Other topics include legal issues, compensation, uses of technology to identify resources, information management, and current or emerging issues.

FFP 540. Estate Planning for Families. (3-0) Cr. 3. S. Fundamentals of the estate planning process, including estate settlement, estate and gift taxes, property ownership and transfer, and powers of appointment. Tools and techniques used in implementing an effective estate plan, ethical considerations used in providing estate planning services, and new and emerging issues in the field. Case studies provide experience in developing estate plans suitable for varied family forms.

FFP 541. Housing and Real Estate in Family Financial Planning. (Cross-listed with HD FS). (3-0) Cr. 3. SS. www only. The role of housing and real estate in the family financial planning process, including taxation, mortgages, financial calculations, legal concerns, and ethical issues related to home ownership and real estate investments. Emphasis on emerging issues in the context of housing and real estate.

FFP 545. Retirement Planning, Employee Benefits, and the Family. (3-0) Cr. 3. F. Study of micro and macro considerations for retirement planning. Survey of various types of retirement plans, ethical considerations in providing retirement planning services, assessing and forecasting financial needs in retirement, and integration of retirement plans with government benefits.

FFP 555. Insurance Planning for Families. (3-0) Cr. 3. S. In-depth study of risk management concepts, tools, and strategies for individuals and families, including life insurance; property and casualty insurance; liability insurance; accident, disability, health, and long-term care insurance; and government-subsidized programs. Current and emerging issues and ethical considerations relative to risk management. Case studies provide experience in selecting insurance products suitable for individuals and family study of investment options for clients, including common stocks, fixed income securities, convertible securities, and related choices. Relationships between investment options and employee/employer benefit plan choices. Current and emerging issues and ethics are included.

FFP 565. Personal Income Taxation. (3-0) Cr. 3. F. In-depth information on income tax practices and procedures including tax regulations, tax return preparation, the tax audit processes, the appeals process, preparation for an administrative or judicial forum, and ethical considerations of taxation. New and emerging issues related to taxation. Family/individual case studies provide practice in applying and analyzing tax information and recommending appropriate tax strategies.

FFP 570. Professional Practices in Financial Planning. (3-0) Cr. 3. S. Challenges of managing financial planning practices including, but not limited to: business valuation, personnel, marketing, client services, ethics and technological applications. Relying both on a theoretical as well as an applied approach, students analyze case studies that provide relevant, practical exposure to practice management issues, with a strong emphasis on current research findings.

FFP 583. Investing for the Family's Future. (Cross-listed with HD FS). (3-0) Cr. 3. F. *Prereq: HD FS 483.* Evaluation of investment markets for the household. Analysis of how families choose where to put their savings. Emphasis is on using the family's overall financial and economic goals to help inform investment choices.

FFP 591. Practicum. Cr. arr. F.S.SS. Supervised experience in family financial planning.

FFP 595. Financial Planning - Case Studies. (3-0) Cr. 3. F.SS. *Prereq: FFP 530, 540, 545, 555, 565, 583.* Professional issues in financial planning, including ethical considerations, regulation and certification requirements, communication skills, and professional responsibility. Students are expected to utilize skills obtained in other courses and work experiences in the completion of personal finance case studies, the development of a targeted investment policy, and other related financial planning assignments.

Finance

Marvin Bouillon, Chair of Department

University Professor: Power

Professors: Carter, Cowan, Hayes, Stover

Associate Professors: Campbell, Dark, Sapp

Assistant Professors: Borisova, Floros, Porter, Yunus

Lecturers: Hoff, Mccullough, Nappinnai, Premkumar

Undergraduate Study

For undergraduate curriculum in business, major in finance, see *College of Business, Curricula*.

In addition to the basic business requirements, finance majors must also complete: (1) Fin 310, 320; (2) select four from Fin 330, 361, 371, 380, 415, 424, 425, 427, 445, 462, and 472 of which two must be at the 400 level; and (3) select one from Acct 383, 386, 387, any 400-level accounting course or Finance courses listed in (2) above. Statistics 326 is highly recommended to be taken prior to Fin 310 and Fin 320. Statistics 326 is required for Fin 380 and 400 level finance courses.

The courses in finance constitute a broad program of study designed to provide a descriptive, behavioral, and analytical background of financial management to enable students to qualify for opportunities in financial services, insurance, brokerage, government, real estate, and financial management of business enterprises. Finance is also an excellent area for those who wish to become more knowledgeable as consumers, particularly in the fields of investments, insurance, and real estate.

Areas of study in the field of finance include financial management, investments, insurance, real estate, and financial services. Upper-level courses include a review of contemporary literature in the field, case studies, and financial problem analysis integrating finance courses previously taken.

The instructional objective of the Finance program is to provide a well-rounded professional education in finance. Such an education should provide the student with: (1) a mastery of basic financial concepts and methods of analysis; (2) an

understanding of financial operations in a global setting and of the role of financial institutions in the economics system; (3) an ability to effectively communicate and work with others as the finance member of a team; (4) an ability to demonstrate leadership capabilities in financial analysis and portfolio management.

The department also offers a minor for non-Finance majors in the College of Business. The minor requires 15 credits from an approved list of courses, of which 9 credits must stand-alone. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

The department participates in the M.B.A. full-time and part-time programs. The M.B.A. program is a 48-credit, non-thesis, noncreative component curriculum. Twenty four of the 48 credits are core courses and the remaining 24 are graduate electives. Within the M.B.A. program, students may develop an area of specialization in finance. This specialization requires that 12 of the 24 credits of the graduate electives be from an approved list of graduate finance courses.

Courses primarily for undergraduate students

Fin 301. Principles of Finance. (3-0) Cr. 3. F.S.SS. *Prereq: Acct 284; Econ 101, Stat 226.* Introduction to financial management with emphasis on corporate financing and investment decision making, time value of money, asset valuation, capital budgeting decision methods, cash budgeting, and financial markets.

Fin 310. Corporate Finance. (3-0) Cr. 3. F.S.SS. *Prereq: 301.* Theory used in a firm's investment and financing decisions. Analysis of environment in which financial decisions are made; applications of analytical techniques to financial management problems.

Fin 320. Investments. (3-0) Cr. 3. F.S.SS. *Prereq: 301.* Introduction to various investment media and markets from the viewpoint of the individual investor. Emphasis on mechanics of trading, behavior of security prices, corporate stocks and bonds, mutual funds, individual asset and portfolio selection techniques, and performance evaluation.

Fin 327. Fixed Income Securities. (3-0) Cr. 3. *Prereq: 301; Stat 326.* Valuation of fixed income securities, including pricing conventions, term structure of interest rates, default, duration, and hedging of interest rate risk. Analysis of active and passive investment strategies for managing fixed income portfolios. Nonmajor graduate credit.

Fin 330. Financial Markets and Institutions. (3-0) Cr. 3. F.S. *Prereq: 301.* Introduction to the structure and operations of the United States financial system and its markets and institutions. Emphasis on developing and integrated understanding of markets and financial service providers including global linkages.

Fin 361. Personal Risk Management and Insurance. (3-0) Cr. 3. F.S. *Prereq: Econ 101.* Risk concepts and the use of insurance by individuals and families. Emphasis on the insurance mechanism and methods of dealing with income, property, and liability risks.

Fin 371. Real Estate Principles. (3-0) Cr. 3. SS. *Prereq: Econ 101.* Legal, economic, social and financial aspects of real estate, including property rights, contracts, mortgage instruments, tax factors, brokerage, valuation, risk and return analysis, financing techniques, and investments.

Fin 415. Business Financing Decisions. (3-0) Cr. 3. *Prereq: 301 and Stat 326.* In depth study of the firm's external financing decision. Emphasis on the development of cash flow statements, projected financing needs and the selection of the appropriate financing instrument. Focus on case studies and application of developed techniques on actual field project. Nonmajor graduate credit.

Fin 424. Financial Futures and Options. (3-0) Cr. 3. *Prereq: 320 and Stat 326.* Advanced study of the pricing and use of derivative market instruments, current topics and issues. Nonmajor graduate credit.

Fin 425. Security Analysis and Portfolio Management. (3-0) Cr. 3. F.S. *Prereq: 320, Stat 326 and permission of instructor.* Advanced study of security analysis, security selection techniques and portfolio management. Emphasis on the applications of methods learned via the selection and evaluation of a portfolio of actual securities purchased in securities markets in the U.S. or abroad. Tracking and periodic reporting of the portfolio's performance relative to standard benchmarks is also required.

Fin 428. Advanced Fixed Income Analysis and Portfolio Management. (3-0) Cr. 3. *Prereq: 327, 320, Stat 326 and permission of the instructor.* Advanced analysis of fixed income markets and securities, including valuation and trading of treasury securities, corporate bonds, mortgage backed securities. Students are also required to manage a fixed income portfolio for an institutional investor. A top-down approach to portfolio management is assumed, with active bets taken on market direction, duration, yield curve, and credit spreads. Nonmajor graduate credit.

Fin 445. Bank Management Decisions. (3-0) Cr. 3. F.S. *Prereq: Stat 326 and Fin 330 or Econ 353.* Analysis of operations of depository financial institutions from management viewpoint. Emphasis on evaluating performance, policy formation, asset and liability management, the role of capital, and the operating environment. Nonmajor graduate credit.

Fin 462. Corporate Risk Management and Insurance. (3-0) Cr. 3. F. *Prereq: 301 and Stat 326.* Analysis of an organization's approaches to the management of price, credit, and pure risk. Emphasis on the consideration and selection of risk control and financing treatments and the decision making framework underlying the alternatives selected. Covers commercial insurance, self-insurance, and alternative financing arrangements. Nonmajor graduate credit.

Fin 472. Real Estate Finance. (3-0) Cr. 3. *Prereq: 301 and Stat 326.* Introduction to the techniques of assessing the value of real estate and real estate financing instruments. Nonmajor graduate credit.

Fin 480. International Finance. (3-0) Cr. 3. F.S. *Prereq: 301 and Stat 326.* Advanced study of contemporary topics and issues in international finance.

Fin 490. Independent Study. Cr. arr. Repeatable. *Prereq: 301, Stat 326 and permission of instructor.*

Fin 499. Finance Internship. (3-0) Cr. arr. F.S.SS. *Prereq: GPA 2.5; permission of internship coordinator; Stat 326; 499A: 330, 445; 499B: 361; 499C: 301 plus 3 additional credits in finance; 499D: 320.* Supervised experience in a private sector banking, insurance, real estate or investments organization or in a governmental agency that regulates such organizations. Satisfactory-fail only.
A. Banking
B. Insurance
C. Real Estate
D. Investments

Courses primarily for graduate students, open to qualified undergraduate students

Fin 505. Financial Valuation and Corporate Financial Decisions. (2-0) Cr. 2. *Prereq: Graduate classification.* Shareholder wealth maximization as the goal of the firm, financial Math, valuation of securities, the financial market place as the test of value, estimation of cost of capital, capital investment decisions, capital structure policy, working capital management.

Fin 510. Advanced Financial Management. (3-0) Cr. 3. *Prereq: 505.* Modern theory of corporate finance and its application to financial management problems. Advanced treatment of firm's investment, financing, and dividend decisions and survey of related research. Examples of potential topics are the investment banking process, convertible securities and warrants, financial derivatives, asset leasing, mergers and divestitures, leveraged buyouts, international financial management, executive compensation, and pension fund strategy.

Fin 515. Case Studies in Financial Decision Making. (3-0) Cr. 3. *Prereq: 505.* This course focuses on case studies to develop an integrated set of financial decisions. Topic areas include fixed asset, working capital, capital structure, dividend and merger/acquisition decisions. The objective of the course is to examine different firm settings and establish a framework within which to apply financial tools.

Fin 520. Investments. (3-0) Cr. 3. *Prereq: 505.* A comprehensive survey of the classical and contemporary theories of optimum portfolio construction; determinants of risk-return trade-off in selection of securities; emphasis on the theory and evidence of efficient capital markets and implications for security selection and portfolio management.

Fin 534. Financial Derivatives. (3-0) Cr. 3. F. *Prereq: Graduate classification.* An applied course in derivative markets. Topics covered include futures and options markets, option pricing, swaps, use and rating of insurance products, and alternative forms of reinsurance. Emphasis will be placed on agricultural commodity markets, but energy, interest, currency and stock index contracts will also be covered.

Fin 572. Real Estate Finance. (3-0) Cr. 3. *Prereq: MBA Core.* Survey of techniques for assessing the value of real estate assets. Introduction to real estate financing instruments, their use and appropriateness.

Fin 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor. For students* wishing to do individual research in a particular area of finance.

Food Science and Human Nutrition

www.fshn.hs.iastate.edu

Ruth MacDonald, Chair of Deartment

Distinguished Professors: Birt, Sebranek

Distinguished Professors (Emeritus): N. Jacobson, Roderuck

University Professors: Murphy, P. White, Wilson

University Professors (Emeritus): Glatz, Hammond, Parrish

Professors: Alekel, Hendrich, Hurburgh, Jane, L. Johnson, MacDonald, Nikolau, Prusa, Reitmeier, Robson, Sharp, Spurlock, Van Leeuwen, Wurtele

Professors (Emeritus): Dupont, Garcia, Kaplan, Kraft, Lagrange, Mcmillan, Runyan, Rust, Schafer, Stromer, Swan, Topel, Walker

Professor (Collaborator): Pometto

Associate Professors: Boylston, Campbell, Ford, Love, Mendonca, Reddy, Schalinske, Wang, W. White

Associate Professors (Emeritus): Bohnenkamp, Madden, Mccomber, Oakland

Associate Professor (Collaborator): Marquis

Assistant Professors: Beattie, Brehm-Stecher, Hollis, Jung, Lamsal, Lanningham-Foster, Litchfield, Rowling

Assistant Professors (Collaborators): Beauvais, Klucinec, Lopes

Lecturers: Bassler, Martin

Lecturers: Beirman, Bergquist, Dahlstrom, Hanson, Oldham, St. Germain, Strohl, Svendsen

Senior Clinician: Anderson

Clinicians: Barclay, J. Johnson

The Department of Food Science and Human Nutrition is jointly administered by the College of Agriculture and Life Sciences and the College of Human Sciences. All curricula offered by the department are available to students in either college. These curricula include culinary science,

dietetics, diet and exercise, food science, and nutritional science. Visit the department web site at: www.fshn.hs.iastate.edu/.

Undergraduate Study

Culinary science is an interdisciplinary degree combining a strong food science foundation with acquisition of culinary skills. The program includes chemistry, organic chemistry, biology, microbiology, and biochemistry as well as quantity food production, fine dining management, and food safety and sanitation. Internships in the food industry and culinary business are required. Culinary science graduates are qualified to work as managers and specialists in food research, product development, culinary applications, and food marketing and sales.

The Didactic Program in Dietetics (DPD) is accredited by the American Dietetic Association (ADA) . The dietetics undergraduate curriculum meets the academic requirements as the DPD. Additionally, the curriculum for concurrent Bachelor's and Master's degrees in diet and exercise meets the academic requirements of the DPD. Graduates of the program are eligible to apply for admission to accredited/approved dietetic internships/supervised practice programs. Upon successful completion of the experience program, graduates are eligible to take the national examination administered by the Commission on Dietetic Registration to become a Registered Dietitian (R.D.) and to practice in the field of dietetics. The dietetic program includes study in basic sciences, nutrition, and food science with applications to medical dietetics, nutrition counseling and education, and community nutrition. Foodservice management is also an important aspect of the program. Graduates work in clinical settings, consulting, food companies, food services, sports or athletic programs, corporate wellness programs, care facilities for patients from neonatal to geriatric, and community or school health programs. There is a $30 fee for a statement of verification of completion of the DPD. For information about verification statements provided to non-ISU students or students with degrees from international universities, see the departmental website:www.dietetics.iastate.edu/.

Food science is a discipline in which the principles of biological and physical sciences are used to study the nature of foods, the causes of their deterioration, and the principles underlying the processing and preparation of food. It is the application of science and technology to the provision of a safe, wholesome, and nutritious food supply. Biotechnology and toxicology interrelate with food science in the area of food safety. In the food industry, food scientists work in research and development of products or processes, production supervision, quality control, marketing and sales, test kitchens and recipe development, product promotion and communication. Food scientists also serve in government regulatory agencies and academic institutions.

Three options are available in food science: food science and technology, food science and industry, and consumer food science. The food science and technology and food science and industry options are approved by the Institute of Food Technologists, the national professional organization of food science. Students interested in quality control/assurance; production supervision; management and sales; or research careers in the food industry, government, or academia should elect either the food science and technology or the food science and industry option. Students who wish to go to graduate or professional schools or who are College of Agriculture Scholars of Excellence should elect food science and technology. Students who wish to emphasize business, journalism, or special aspects of food science should elect food science and industry. Students interested in test kitchen positions, food product formulation and recipe development, food promotion, and consumer services in government and industry should elect the consumer food science option.

Students who wish to combine education in engineering with food science may select additional courses in chemical or agricultural engineering. Double majors are available and may require an additional year.

Nutritional science offers students a strong basic science education along with human nutrition expertise that enables them to gain the knowledge and skills necessary to work in research laboratories of colleges and universities, government agencies, industries, and foundations. The curriculum can Serve as a preprofessional program for medicine, dentistry, veterinary medicine, or for graduate study in nutrition or other biological sciences.

Students graduating with degrees in culinary science, dietetics, diet and exercise, food science, or nutritional science will be able to: 1) demonstrate a high level of technical competence in their chosen field, perform successfully in a graduate program, supervised practice program or entry-level professional position; 2) communicate effectively as professionals; 3) successfully solve complex problems on their own and as members of a team; 4) correctly interpret and critically evaluate research literature as well as data from professional practice; 5) critically evaluate information related to food science and nutrition issues appearing in the popular press; 6) prepare and deliver effective presentations, orally and in writing, of technical information to professionals and to the general public; 7) thoughtfully discuss ethical, social, multicultural, and environmental dimensions of issues facing professionals in their chosen field.

Communication Proficiency is certified by a grade of C or better in 6 credits of coursework in composition (Engl 150 and 250 or other communication-intensive courses) and a grade of C or better in 3 credits of coursework in oral communication.

A combined Bachelor of Science and Master of Science (B.S./M.S.) degree in diet and exercise is available. The program is jointly administered by the Department of Food Science and Human Nutrition (FS HN), within the College of Agriculture and Life Sciences and College of Human Sciences, and the Department of Kinesiology within the College of Human Sciences. Students interested in this program enroll as freshmen in the pre-diet and exercise program. In the fall of the junior year, students apply for admission to the B.S./M.S. program. Students not accepted into the program continue toward completion of a B.S. degree in dietetics or kinesiology and health. Coursework has been designed to facilitate a 4-year graduation date for those students not accepted into the program and electing to complete a single undergraduate degree. Students accepted into the program will progress toward completion of B.S./M.S. degrees in diet and exercise.

Well qualified students in food science and technology or in nutritional science who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both B.S. and M.S. degrees in which students take both undergraduate and graduate courses. See the B.S./M.S. program under *Graduate Study.*

The department offers work for minors in food science and in nutrition and participates in the interdepartmental minor in food safety. See department office or web site for requirements: www.fshn.hs.iastate.edu/ugrad/ugminors.php.

Food Safety Minor

Patricia A. Murphy (Coordinator)

The Interdepartmental food safety minor is designed to provide undergraduate students with exposure to the principles of food safety to complement their current major and offer new opportunities for their future careers. Depending on the student's major, the minor enhances the student's expertise in food safety issues pertinent to the student's major. Student learning outcomes include: awareness of food safety issues as they appear in each step of the food chain; ability to analyze a situation, identify food safety problems, use resources to gain additional information; develop a procedure or solution to identified problems; examine proposed solutions for viability and effectiveness; and to be able to speak and write about food safety issues. Graduates with a food safety minor are better prepared for employment in agricultural, medical, and veterinary medical agencies and with state, national and international businesses.

The food safety minor requires 15 credits of coursework with 9 credits from 3 core courses and elective courses to supplement the training in the minor. See approved list for minor courses at www.fshn.hs.iastate.edu/ugrad/ugminors.php.

Postbaccalaureate Program

The dietetic internship program has received initial accreditation from the American Dietetic Association. For more information, refer to Special Interest Programs listed under the College of Human Sciences or visit the website at www.dietetics.iastate.edu. There is a nonrefundable application fee of $75 and a program fee of $500 payable upon acceptance into the program.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in food science and technology and in nutritional sciences, and minors in food science and technology and in nutrition. Graduate work in meat science is offered as a co-major in animal science and food science and technology.

Prerequisite to major work is a baccalaureate degree in food science, nutrition, or other physical or biological sciences or engineering that is substantially equivalent to those at Iowa State University.

Students taking major work for the degree doctor of philosophy either in food science and technology or in nutritional sciences may choose minors from other fields including anthropology, chemistry, biochemistry, economics, education, journalism, microbiology, psychology, physiology, sociology, statistics, toxicology, or other related fields.

The interdepartmental graduate program in nutritional sciences, administered through the Graduate College, under the auspices of the Chairs of FSHN and Animal Science, will provide the structure for coordinating and enhancing interdisciplinary nutrition research and graduate education. Graduate students will be able to select from three specializations: animal nutrition, human nutrition, or molecular/biochemical nutrition.

The two main departments are FSHN and Animal Science, whereas other departments (such as Kinesiology; Biochemistry, Biophysics, and Molecular Biology; Agronomy; Sociology; and Statistics) may also be involved. (See Nutritional Sciences interdepartmental graduate major.)

The department, offers an online Graduate Certificate in Food Safety and Defense, in conjunction with the University of Nebraska, Lincoln, Kansas State University and the University of Missouri through the Great Plains Interactive Distance Education Alliance. Students eligible for admission to the food science master's degree program may be admitted.

The department participates in an online Masters of Family and Consumer Sciences/Dietetics in conjunction with Colorado State University, Kansas State University, North Dakota State University, Oklahoma State University, South Dakota State University, University of Kansas Medical Center, and University of Nebraska through the Great Plains Interactive Distance Education Alliance. Students who are registered dietitians and are eligible for admission to the FSHN Master's degree program may be admitted. The department, in conjunction with the Hotel, Restaurant, and Institution Management department, offers three dietetics certificates of 12 credits each and participates in the master of family and consumer sciences with a dietetics specialization. The certificate program meets continuing education requirements of The American Dietetic Association for advanced preparation in communication and counseling, dietetics management, and medical nutrition therapy. The graduate certificate courses may be applied to the master of family and consumer sciences - dietetics specialization. These programs are open only to registered dietitians. A second master of family and consumer sciences specialization, offered in the area of nutrition, does not require certification as a registered dietitian for admittance. Those interested in these programs should contact the department for details.

The department offers work for concurrent B.S. and M.S. degree programs that allow students to obtain both the B.S. and M.S. degrees in 5 years. The programs are available to students majoring in food science (food science and technology option) nutritional science, or pre-diet and exercise, and students progress toward M.S. degrees in food science and technology, nutritional sciences, or diet and exercise, respectively. Students interested in these programs should contact the department for details. Application for admission to the Graduate College should be made during the junior year. Students begin research for the M.S. thesis during the summer after their junior year and are eligible for research assistantships.

Students graduating with advanced degrees in nutritional sciences and in food science and technology will demonstrate competency in their chosen discipline. Measurable outcomes will include the ability to: 1) design, conduct, and interpret research; 2) apply theoretical information to solve practical problems; 3) prepare and communicate discipline-specific information in written and oral forms to scientific and lay audiences; 4) facilitate learning in the classroom; 5) submit a paper for publication in a peer-reviewed journal; and 6) secure professional-level positions in academia, industry, government, or health care.

Courses primarily for undergraduate students

FS HN 101. Food and the Consumer. (3-0) Cr. 3. F.S. *Prereq: High school biology and chemistry or 3 credits each of biology and chemistry.* The food system from point of harvest to the consumption of the food by the consumer. Properties of food constituents. Protection of food against deterioration and microbial contamination. Introduction of foods into the marketplace. Processes for making various foods. Government regulations. Use of food additives. Current and controversial topics. Electronic communication from web emphasized for class reports, notes and assignments.

FS HN 104. Introduction to Professional Skills in Culinary Science. (0-6) Cr. 1. S. Introduction to culinary science. Students will develop fundamental culinary skills by arranged on-campus work experience (100 hours). Sessions with instructor arranged.

FS HN 110. Professional and Educational Preparation. (1-0) Cr. 1. F.S. Introduction to professional and educational development within the food science and human nutrition disciplines. Focus is on university and career acclimation, enhancement of communication skills, and portfolio development. Satisfactory-fail only.

FS HN 111. Fundamentals of Food Preparation. (2-3) Cr. 3. F.S. *Prereq: 101 or 167; high school chemistry or Chem 160.* Principles involved in preparation of food products of standard quality. Influence of composition and techniques on properties of food products. Standard methods of food preparation with emphasis on quality, nutrient retention, and safety.

FS HN 112. Orientation to Learning and Productive Team Membership. (Cross-listed with NREM, Aer E, Hort, TSM). (2-0) Cr. 2. F. Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

FS HN 114. Developing Responsible Learners and Effective Leaders. (Cross-listed with Hort, NREM, TSM). (2-0) Cr. 2. S. Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

FS HN 167. Introduction to Human Nutrition. (3-0) Cr. 3. F.S.SS. *Prereq: High school biology or 3 credits of biology.* Understanding and implementing present day knowledge of nutrition. The role of nutrition and food intake in the health and well being of the individual and family.

FS HN 203. Contemporary Issues in Food Science and Human Nutrition. (1-0) Cr. 1. F.S. Introduction to published research and discussion of current issues in food science and human nutrition. Emphasis on sources of credible information, ethics, communication and portfolio development.

FS HN 214. Scientific Study of Food. (3-6) Cr. 5. F.S. *Prereq: 167 or 261; Chem 231 or 331.* Composition and structure of foods. Principles and practice of preparation of standard quality food products. Behavior and interactions of food constituents.

FS HN 265. Nutrition for Active and Healthy Lifestyles. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in BBMB 301.* Fundamentals of nutrient metabolism and nutrient requirements. Role of macronutrient metabolism in physical performance and disease prevention. Effect of manipulation of macronutrient metabolism on physical performance and disease prevention. Applications of nutrient metabolism principles to dietary recommendations and planning.

FS HN 272. Basic Principles of Food Processing. (1-6) Cr. 3. F. *Prereq: Credit or enrollment in Chem 231 & 231L and Biol 212.* Biological and physico-chemical principles of food processing as they determine the quality of foods.

FS HN 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department chair; sophomore classification.* Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

FS HN 311. Food Chemistry. (3-3) Cr. 4. F. *Prereq: 203, TSM 115, Chem 231 and 231L or 331 and 331L; credit or enrollment in BBMB 301.* The structure, properties, and chemistry of food constituents and animal and plant commodities. Nonmajor graduate credit.

FS HN 314. Foundations of Culinary Science. (1-0) Cr. 1. S. *Prereq: 214 and junior classification.* Introduction to the roles culinary scientists hold within industry including product development, research, and quality assurance. Discussions focused on professional and educational development, enhancement of communication skills, ethics and emerging issues and trends in culinary science.

FS HN 340. Foundations of Dietetic Practice. (1-0) Cr. 1. F. *Prereq: Junior classification.* Introduction to the profession of dietetics and responsibilities associated with dietetic professional practice. Emphasis on development of a pre-professional portfolio, career options in dietetics and preparation for a dietetic internship. Leadership and professional career development for the dietitian is addressed through self reflection, creation of materials for post-baccalaureate programs and job shadowing experience. Professional issues related to dietetic practice include Code of Ethics, legal credentialing and standards of professional practice, leadership and future trends in the profession. Satisfactory-fail only.

FS HN 342. World Food Issues: Past and Present. (Cross-listed with Agron, Env S, T SC). (3-0) Cr. 3. F.S. *Prereq: Junior classification.* Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects. Nonmajor graduate credit.
H. Honors Section. (Honors Program students only.)

FS HN 351. Unit Operations in Food Processing. (3-0) Cr. 3. S. *Prereq: A course in calculus and Phys 106.* Introduction to material and energy balances. Fluid flow, physical and thermal properties of food materials. Fundamentals of heat and mass transfer. Application of momentum and heat transfer to unit operations in food processing. Calculations and computer applications in food processing. Field trip. Nonmajor graduate credit.

FS HN 360. Advanced Human Nutrition and Metabolism. (3-0) Cr. 3. F. *Prereq: 261, 3 credits in biochemistry; 3 credits in physiology recommended.* Physiological and biochemical basis for nutrient needs; assessment of nutrient deficiency and toxicity; examination of nutrient functions and regulation of metabolism; nutrient-gene interactions. Nonmajor graduate credit.

FS HN 361. Nutrition and Health Assessment. (1-3) Cr. 2. F.S. *Prereq: Credit or enrollment in 360; 3 credits in statistics.* The assessment of nutritional status in healthy individuals. Laboratory experiences in food composition and assessment of dietary intake, body composition, and biochemical indices of nutritional status. Nonmajor graduate credit.

FS HN 362. Nutrition in Growth and Development. (3-0) Cr. 3. S. *Prereq: 360; credit or enrollment in a course in physiology.* Nutrient needs throughout the life cycle. Interrelationships of genes, gene expression and nutrients with physiological outcomes during

human development and aging. Nonmajor graduate credit.

FS HN 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department chair; junior classification.* Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

FS HN 403. Food Laws, Regulations, and the Regulatory Process. (2-0) Cr. 2. S.SS. *Prereq: 3 credits in food science coursework at 200 level or above.* History of the development of the current federal and state food regulations. Guidelines that govern the practice of regulating the wholesomeness of red meats, poultry, and eggs. Presentations by state and federal food regulators. Nonmajor graduate credit.

FS HN 405. Food Quality Assurance. (2-2) Cr. 3. S. *Prereq: 214 or 272 or 471; Stat 101 or 104.* Basis of food quality control/assurance programs and establishment of decision-making processes using official (government and industry) instrumental, chemical, and sensory procedures. Statistical process and quality control procedures and their applications to various food systems. Development of hazard analysis procedures, specifications, grades, and standards. Nonmajor graduate credit.

FS HN 406. Sensory Evaluation of Food. (Dual-listed with 506). (2-3) Cr. 3. F. *Prereq: 214 or 311 or An S 360; 3 credits in statistics.* Sensory test methods and procedures used to evaluate the flavor, color and texture of foods. Relationships between sensory and instrumental measurements of color and texture. Acceptance and preference testing.

FS HN 407. Microbiological Safety of Foods of Animal Origins. (Dual-listed with 507). (Cross-listed with Micro). (3-0) Cr. 3. S. *Prereq: 420.* Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

FS HN 410. Food Analysis. (2-3) Cr. 3. S. *Prereq: 214 or 311 or BBMB 311 or Chem 211; TSM 115.* An introduction to the theory and application of physical and chemical methods for determining the constituents of food. Modern separation and instrumental analysis. Use of food composition data bases. Nonmajor graduate credit.

FS HN 411. Food Ingredient Interactions and Formulations. (1-3) Cr. 2. F.S. *Prereq: 214 or 311.* Application of food science principles to ingredient substitutions in food products. Laboratory procedures for standard formulations and instrumental evaluation, with emphasis on problem-solving and critical thinking. Nonmajor graduate credit.

FS HN 412. Food Product Development. (Dual-listed with 512). (2-6) Cr. 4. S. *Prereq: 311 or 411, 471.* Principles of developing consumer packaged food products. Application of skills gained in food chemistry, formulation, microbiology, and processing. Some pilot plant experiences. Electronic communication from web emphasized for class reports, notes and assignments. Nonmajor graduate credit.

FS HN 419. Foodborne Hazards. (Cross-listed with Micro, Tox). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Micro 201 or 302, a course in biochemistry.* Pathogenesis of human microbiological foodborne infections and intoxications, principles of toxicology, major classes of toxicants in the food supply, governmental regulation of foodborne hazards. Only one of FS HN 419 and 519 may count toward graduation. Nonmajor graduate credit.

FS HN 420. Food Microbiology. (Cross-listed with Micro, Tox). (3-0) Cr. 3. F. *Prereq: Micro 201 or 302.* Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications. Nonmajor graduate credit.

FS HN 421. Food Microbiology Laboratory. (Cross-listed with Micro). (0-6) Cr. 3. F. *Prereq: Micro 201 or 302; 201L or 302L. Credit or enrollment in Micro 420, FS HN 203.* Standard techniques used for the microbiological examination of foods. Independent and group projects on student-generated questions in food microbiology. Emphasis on oral and written communication and group interaction. Nonmajor graduate credit.

FS HN 429. Foodborne Toxicants. (Dual-listed with 529). (0-2) Cr. 2. Alt. F., offered 2009. *Prereq: A course in biochemistry.* Mechanisms of action, metabolism, sources, remediation or detoxification, risk assessment of major foodborne toxicants of current interest. Taught online only.

FS HN 441. Dietetics Management. (1-9) Cr. 5. F.SS. For students enrolled in the dietetic internship program. Supervised participation in and analysis of organizational leadership, human resource management, budget and quantity food production management including quality control, menu planning, work methods and other functions related to business management in food service, health care and other institutions. Satisfactory-fail only.

FS HN 442. Medical Dietetics I. (3-15) Cr. 8. S.SS. For students enrolled in the dietetic internship program. Biological basis of medical, drug, and diet therapy for selected pathologies. Consideration of factors in planning and conducting nutritional care of patients. Integration of principles with clinical experience. Satisfactory-fail only.

FS HN 443. Medical Dietetics II. (1-9) Cr. 5. F.SS. *Prereq: Concurrent enrollment in 442.* For students enrolled in the dietetic internship program. Supervised clinical experience in assessing, implementing and evaluating nutritional care of patients in specialized clinical settings. Satisfactory-fail only.

FS HN 445. Experience in Community Dietetics. (1-6) Cr. 3. S.SS. For students enrolled in the dietetic internship program. Supervised experience in planning and providing nutritional care for individuals and groups in a variety of community settings. Satisfactory-fail only.

FS HN 446. Experience in Dietetics. (2-0) Cr. 2. F.SS. For students enrolled in dietetic internship. Supervised experience in planning and providing nutrition education for individuals and groups in a variety of dietetic settings. Satisfactory-fail only.

FS HN 448. Professional Development Assessment. (Dual-listed with 548). (1-0) Cr. 1. S.SS. For students enrolled in the dietetic internship program. Web-based course providing information and practice for students to assess and evaluate their own professional development and continuing professional education needs. Satisfactory-fail only.

FS HN 461. Medical Nutrition and Disease I. (4-0) Cr. 4. F. *Prereq: 360, 361, 3 credits in physiology at 300 level or above.* (Dual-listed with NutrS 561) Pathophysiology of selected chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state. Recitation section (1 cr.) will focus on refinement of assessment skills, diagnosis of nutritional problem, nutrition care, and documentation.

FS HN 463. Community Nutrition. (3-0) Cr. 3. F. *Prereq: 362.* Dual-listed with NutrS 563. Survey of current public health nutrition problems among nutritionally vulnerable individuals and groups. Discussion of the multidimensional nature of those problems and of community programs addressing them. Grant writing as a means for funding community nutrition program development. Significant emphasis on written and oral communication at the lay and professional level. Field trip. Nonmajor graduate credit.

FS HN 464. Medical Nutrition and Disease II. (3-0) Cr. 3-4. S. *Prereq: 360, 461, 3 credits in physiology at 300 level or above.* (Dual-listed with NutrS 564) Pathophysiology of selected acute and chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state. Recitation section (1 credit) will focus on refinement of assessment skills, diagnosis of nutritional problem, nutrition care, and documentation. Course must be taken for 4 credits for dietetics degree, diet and exercise degree, or if Didactic Program in Dietetics (DPD) verification statement of completion is desired. Students in non-dietetics majors may take the (3 credit) lecture portion without the recitation section.

FS HN 466. Nutrition Counseling and Education Methods. (2-2) Cr. 3. F.S. *Prereq: 362.* Dual listed with Diet 566. Application of counseling and learning theories with individuals and groups in community and clinical settings. Includes discussion and experience in building rapport, assessment, diagnosis, intervention, monitoring, evaluation, and documentation.

FS HN 471. Food Processing. (3-0) Cr. 3. F. *Prereq: Micro 201 or 302; Chem 163; Phys 106.* Food preservation, including packaging, fermentation, irradiation, canning, freezing, dehydration, additives. Sanitation and plant design. Applications to food products. Nonmajor graduate credit.

FS HN 472. Food Processing Laboratory. (Dual-listed with 572). (1-3) Cr. 2. F. *Prereq: 351; credit or enrollment in 471.* Pilot plant experiences such as thermal processing, food fermentations, oil seed processing, high pressure processing, corn wet milling, industrial baking, and waste treatment. Special emphasis on interpreting data, writing project reports, and applying engineering principles from FS HN 351.

FS HN 480. Professional Communication in Food Science and Human Nutrition. (1-0) Cr. 1. F.S. *Prereq: 203, senior classification in the department.* Presentation of current topics and issues of public policy. Emphasis on communication in the profession and portfolio assessment.

FS HN 489. Issues in Food Safety. (Cross-listed with An S, HRI, VDPAM). (1-0) Cr. 1. S. *Prereq: Credit or enrollment in FS HN 101 or 272 or HRI 233; FS HN 419 or 420; FS HN 403.* Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

FS HN 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Independent work in food science, nutrition, or dietetics. A maximum of 6 credits of FS HN 490 may be used toward graduation.
A. Dietetics
B. Food Science
C. Nutrition
D. International Experience
E. Entrepreneurship
H. Honors

FS HN 491. Supervised Work Experience. Cr. arr. Repeatable. F.S.SS. *Prereq: Advance approval of instructor and adviser.* Supervised off-campus work experience relevant to the academic major. A maximum of 4 credits of FS HN 491 may be used toward graduation. Satisfactory-fail only.
A. Dietetics
B. Food Science
C. Nutrition
D. Culinary Science

FS HN 492. Research Concepts in Human Nutrition. (1-3) Cr. 2. F. *Prereq: junior or senior classification.* Students will develop and implement a research project with faculty supervision, based on knowledge gained from nutrition, biology and chemistry courses. Students will prepare a research proposal, conduct research and report results. Students will gain appreciation for independent research and experience creative and innovative aspects of nutrition research.

FS HN 496. Food Science and Human Nutrition Travel Course. (Dual-listed with 596). Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* (One credit per week traveled.) Limited enrollment. Tour and study of food industry, dietetic and nutritional agencies in different regions of the world. Pre-travel session arranged. Travel expenses paid by students.
A. International travel
B. Domestic travel

FS HN 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department chair; senior classification.* Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

FS HN 499. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of staff member with whom student proposes to work.* Research under staff guidance. A maximum of 6 credits of FS HN 499 may be used toward graduation.

Courses primarily for graduate students, open to qualified undergraduate students

FS HN 502. Advanced Food Science-Chemistry. (1-0) Cr. 1. S. *Prereq: 3 credits in organic chemistry.* Key principles and applications in the chemistry of food.

FS HN 503. Advanced Food Science-Processing. (1-0) Cr. 1. Alt. S., offered 2010. *Prereq: 3 credits each in physics and mathematics.* Key principles and applications in the processing of food.

FS HN 504. Advanced Food Science-Microbiology. (1-0) Cr. 1. S. *Prereq: 3 credits each in Microbiology and organic chemistry.* Key principles and applications in the Microbiology of food.

FS HN 505. Short Course in Food Science. Cr. arr. F.S.SS. *Prereq: Permission of instructor.*

FS HN 506. Sensory Evaluation of Food. (Dual-listed with 406). (2-3) Cr. 3. F. *Prereq: 214 or 311 or An S 360; 3 credits in statistics.* Sensory test methods and procedures used to evaluate the flavor, color and texture of foods. Relationships between sensory and instrumental measurements of color and texture. Acceptance and preference testing.

FS HN 507. Microbiological Safety of Foods of Animal Origins. (Dual-listed with 407). (Cross-listed with Micro). (3-0) Cr. 3. S. *Prereq: Micro 420.* Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

FS HN 512. Food Product Development. (Dual-listed with 412). (2-6) Cr. 4. S. *Prereq: 311 or 411, 471.* Principles of developing consumer packaged food products. Application of skills gained in food chemistry, formulation, microbiology, and processing. Some pilot plant experiences. Electronic communication from web emphasized for class reports, notes and assignments.

FS HN 515. Regulatory Toxicology. (Cross-listed with Tox). (1-0) Cr. 1. Alt. F., offered 2010. *Prereq: BBMB 404 or FS HN 403.* Regulatory toxicology in the real world. Approaches used by toxicologists in regulatory agencies for generating, enforcing and complying with laws and regulations in an unambiguous, defensible manner. Different obligations of scientists in research and regulatory settings. Perform simple risk assessments and suggest way to dealing with data gaps. Examine strengths and weaknesses of common approaches used by regulatory agencies.

FS HN 519. Food Toxicology. (Cross-listed with Tox, NutrS). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: A course in biochemistry.* Basic principles of toxicology. Toxicants in the food supply: modes of action, toxicant defense systems, toxicant and nutrient interactions, risk assessment. Only one of FS HN 419 and 519 may count toward graduation.

FS HN 529. Foodborne Toxicants. (Dual-listed with 429). (0-2) Cr. 2. Alt. F., offered 2009. *Prereq: a course in biochemistry.* Mechanisms of action, metabolism, sources, remediation or detoxification, risk assessment of major foodborne toxicants of current interest, design of HACCP plans for use in food industries targeting foodborne toxicants. Taught online only.

FS HN 542. Introduction to Molecular Biology Techniques. (Cross-listed with BBMB, BCB, B M S, EEOB, GDCB, Hort, NREM, NutrS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

FS HN 543. Medical Dietetics II. (1-6) Cr. 3. F.SS. *Prereq: Concurrent enrollment in dietetic internship or MFCS Dietetic Option.* Discussion of the assessment, diagnosis, intervention, and outcomes of nutritional problems in complex medical conditions.

FS HN 548. Professional Development Assessment. (Dual-listed with 448). (Cross-listed with Diet). (1-0) Cr. 1. F.S.SS. *Prereq: RD credential or enrollment in GPIDEA MFCS in Dietetics.* Web-based course providing information and practice for student to assess and evaluate own professional development and continuing professional education needs. Completion of professional 5-year plan. Satisfactory-fail only.

FS HN 566. Nutrition Counseling and Education Methods. (Dual-listed with 466). (Cross-listed with Diet). (2-2) Cr. 3. F.S. *Prereq: Graduate student status.* Application of counseling and learning theories with individuals and groups in community and clinical settings. Includes discussion and experience in building rapport, assessment, diagnosis, intervention, monitoring, evaluation, and documentation. Literature review of specific counseling and learning theories.

FS HN 567. Nutrition for Dietitians. (Cross-listed with Diet). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 360; BBMB 301, undergraduate course in physiology. RD credential or enrollment in GPIDEA MFCS in Dietetics.* Study of the current scientific literature to evaluate current trends and issues in nutrition science and dietetic practice. Emerging areas of research investigating the role of nutrients in health and disease in humans will be explored. Emphasis on the impact of emerging research on nutrition recommendations and interventions designed to promote human health.

FS HN 572. Food Processing Laboratory. (Dual-listed with 472). (1-3) Cr. 2. F. *Prereq: 503 or equivalent.* Pilot plant experiences such as thermal processing, food fermentation, oil seed processing, high pressure processing, corn wet milling, industrial baking, and waste treatment. Special emphasis on interpreting data, writing project reports, applying engineering principles from FS HN 351, and special projects for each exercise.

FS HN 575. Processed Foods. (3-0) Cr. 3. F. *Prereq: 214 or 311; a course in nutrition.* Survey of the effects of home and commercial food preparation and processing on the nutrients in food.

FS HN 580. Orientation to Food Science and Nutrition Research. (1-0) Cr. 1. F. Orientation to and discussion of research interests in food science and nutrition. Discussion of policy and ethical issues in the conduct of research. Intended for entering students in FS HN and related disciplines. Satisfactory-fail only.

FS HN 581. Seminar. (1-0) Cr. 1. S. Discussion and practice of oral presentation of scientific data in a professional setting. Discussion of issues related to data presentation. Satisfactory-fail only.

FS HN 590. Special Topics. Cr. arr. Repeatable. F.S.SS.
A. Nutrition
B. Food Science
C. Teaching

FS HN 595. Grant Proposal Writing for the Working Professional. (Cross-listed with Diet). (1-0) Cr. 1. Alt. F., offered 2009. *Prereq: Enrollment in GPIDEA MFCS in Dietetics* Grant proposal preparation experiences including writing and critiquing of proposals and budget planning. Designed for the working professional. Not intended for the MS or PhD student. Satisfactory-fail only.

FS HN 596. Food Science and Human Nutrition Travel Course. (Dual-listed with 496). Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* (One credit per week traveled.) Limited enrollment. Tour and study of food industry, dietetic and nutritional agencies in different regions of the world. Pre-travel session arranged. Travel expenses paid by students.
A. International travel
B. Domestic travel

FS HN 599. Creative Component. Cr. arr. Nonthesis option only.

Courses for graduate students

FS HN 606. Instrumental Measurement of Food Quality. (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: 311 or 411 or 502 or BBMB 404.* Principles of instrumental measurements of color, aroma, flavor, texture, and rheology. Techniques and instrumentation for measuring the quality of foods; relationship of these methods to food color, taste, flavor, texture, and rheological quality. Application of methods to various foods and biorenewable materials.

FS HN 610. Food Enzymology. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 311 or 411 or 502 or BBMB 404.* Properties of enzymes important in food processing and production including flavor, texture and color. Quantitative evaluation of substrates, enzyme, and inhibitors, pH, pressure and temperature on enzyme activity. Experimental determination of specificity and mechanisms important to food biochemistry. Techniques to purify food enzymes.

FS HN 612. Lipid Chemistry and Applications. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 311 or 411 or 502 or BBMB 404.* Structure and analysis of lipids; glyceride structure; crystal form and texture; autoxidation and chemical modification; extraction, refining and processing; applications of fats and oils in food, biofuel and biobased products.

FS HN 613. Food Proteins. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 311 or 411 or 502 or BBMB 404.* Properties of proteins found in milk, eggs, meat, legumes, and cereal grains. Effect of processing on food proteins.

FS HN 614. Carbohydrates: Structures, Properties, and Applications. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 311 or 411 or 502 or BBMB 404.* Study of chemical structures and physical properties of carbohydrates, applications of carbohydrates in foods and as biomaterial, and changes they undergo during processing and storage.

FS HN 626. Advanced Food Microbiology. (Cross-listed with Micro, Tox). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 420 or 421 or 504.* Topics of current interest in food Microbiology, including new foodborne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials.

FS HN 627. Rapid Methods in Food Microbiology. (Cross-listed with Micro, Tox). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 420 or 421 or 504.* Provides an overview of rapid microbial detection methods for use in foods. Topics include historical aspects of rapid microbial detection, basic categories of rapid tests

(phenotypic, genotypic, whole cell, etc.), existing commercial test formats and kits, automation in testing, sample preparation and "next generation" testing formats now in development.

FS HN 681. Seminar. (1-0) Cr. 1. F.S.SS. Presentation of thesis or dissertation research. May be taken once for M.S. program and twice for the Ph.D. program.

FS HN 690. Special Problems. Cr. arr. Repeatable. F.S.SS. *Prereq: 502 or 503 or 504 or 553 or 554.*

FS HN 695. Grant Proposal Writing. (Cross-listed with NutrS). (1-0) Cr. 1. F. *Prereq: 3 credits of graduate course work in food science and/or nutrition.* Grant proposal preparation experiences including writing and critiquing of proposals and budget planning. Formation of grant writing teams in food science and/or nutrition. Satisfactory-fail only.

FS HN 699. Research in Food Science and Technology. Cr. arr. Repeatable. F.S.SS. Satisfactory-fail only.

Genetics, Development and Cell Biology

www.gdcb.iastate.edu/

Martin Spalding, Chair of Department

University Professor: Horner

University Professors (Emeritus): Dolphin, Stadler

Professors: Brendel, Dobbs, Enger, Gu, Henderson, Howell, Johansen, Lee, Mayfield, Oliver, P. Peterson, T. Peterson, Rodermel, Schnable, Shen, Spalding, Wurtele

Professors (Emeritus): Atherly, Bishop, Buss, Imsande, Lamotte, Miller, Pattee, Pollak, Robertson, Smith, Stewart, Swenson, Welshons

Professors (Collaborators): Link, Shoemaker, Voytas

Associate Professors: Bassham, Becraft, Chou, Colbert, Dorman, Ingebritsen, McCloskey, Powell-Coffman, Sakaguchi, Viles

Associate Professor (Adjunct): Duvick

Associate Professors (Collaborators): Danilevskaya, Tucker

Assistant Professors: Coffman, Essner, Kuhlman, Schneider, Vollbrecht, Yang, Yin

Assistant Professors (Adjunct): Ilarslan, McGrail, Muszynski

Assistant Professors (Collaborators): Buell, Hopkins, Lawrence, Sen

Lecturer: Bastawros, Krumhardt

The Department of Genetics, Development and Cell Biology (GDCB) is dedicated to biological discovery and excellence in undergraduate and graduate education. The research and teaching mission of the department is to achieve a greater understanding of fundamental principles of life by focusing on basic cellular and subcellular processes, including genome dynamics, cell structure and function, cellular response to environmental and developmental signals, and molecular mechanisms of development. Recognizing that student education is of paramount importance, GDCB strives for excellence in teaching and research. GDCB plays a leading role in undergraduate and graduate training through a variety of activities including traditional courses, undergraduate internships in research laboratories, and advanced graduate seminar and literature-based courses. Innovative approaches to learning are emphasized throughout the curriculum.

Undergraduate Study

The GDCB Department offers undergraduate majors in conjunction with other departments. Students interested in the areas of genetics, development and cell biology should major in Biology, Genetics Bioinformatics and Computational Biology (BCBio). The Biology Major is administered and offered jointly by the GDCB and EEOB departments. The GDCB faculty, together with those in EEOB and BBMB, administer and offer the Genetics Major. Each of these majors is available through the College of Liberal Arts and Sciences or through the College of Agriculture and Life Sciences. BCBio is administered by the Departments of Computer Science, GDCB, and mathematics and is available through the college of Liberal Arts and Sciences.

The Biology Major and the Genetics Major prepare students for a wide range of careers in biological sciences. Training in Biology or Genetics may lead to employment in teaching, research, or any of a variety of health-related professions. Some of these careers include biotechnology, human and veterinary medicine, agricultural sciences and life science education. BCBio majors are prepared for careers at the interfaces of biological, informational and computational sciences in the above fields. These majors are also excellent preparation for graduate study in bioinformatics, molecular genetics, cell and developmental biology, neuroscience and related fields. Faculty members in GDCB contribute to the undergraduate courses listed below. The full descriptions of these courses can be found in the Biology, Genetics and BCBio sections of the catalog.

Biol 101, 110, 111, 155, 211, 211L, 212, 212L, 255, 255L, 256, 256L, 258, 305, 305L, 313, 313L, 314, 314L, 330, 352, 394, 423, 423L, 428, 436, 444, 490, 494, 495, Gen 110, 260, 308, 410, 411, 490, 491, 495, BCBio 110, 211, 401, 402 and 442.

Graduate Study

Understanding the genetic blueprint and the functions of cells is critical to virtually all aspects of biology. The basic mission of the Department of Genetics, Development and Cell Biology is to achieve a greater understanding of fundamental principles of life. The GDCB faculty and students conduct hypothesis-driven research into the biology of animals, plants and microbes. While research in GDCB is often based on discovery and analysis of molecular mechanisms of life processes, a true understanding of living organisms will ultimately require the integration of molecular mechanisms in the context of dynamic structural components of the living cell. Thus, research efforts within GDCB use molecular, genetic, biochemical, computational and imaging techniques to study systems at increasingly complex levels of organization.

GDCB faculty contribute to a broad but integrated array of cutting-edge research topics, implementing interactive and multidisciplinary approaches that bridge conventional boundaries, and incorporating experimental and computational biology as complementary approaches. Examples include using genetics and molecular biology to investigate the cellular basis of development, or combining biochemical and computational approaches to study basic subcellular functions, signal transduction or metabolism.

The faculty in the GDCB department train graduate students in several interdepartmental majors/programs including Bioinformatics and Computational Biology, Ecology and Evolutionary Biology, Genetics, Immunobiology, Plant Physiology, Interdisciplinary Graduate Studies, Microbiology, Molecular, Cellular and Developmental Biology, Neuroscience and Toxicology. Graduate work leading to both Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees are available.

Prospective graduate students need a sound background in the physical and biological sciences, as well as Mathematics and English. Interested students should check the links on the GDCB web site (www.gdcb.iastate.edu/) for specific admissions procedures and the latest information about individual faculty and their research programs. The interdepartmental majors and programs require submission of Graduate Record Examination (GRE) aptitude test scores. Advanced GRE scores are recommended. International students whose native language is other than English must also submit TOEFL scores with their application.

Students who are enrolled in the interdepartmental graduate majors with affiliations with GDCB are required to actively participate in seminars, research activities, and to show adequate progress and professional development while pursuing their degree. For both the M.S. and Ph.D. degrees, it is expected that research conducted by the student will culminate in the writing and presentation of a thesis or dissertation. The Graduate College, the GDCB Faculty, and the individual student's major professor and Program of Study Committee provide requirements and guidelines for study. General information about graduate study requirements can be found at the web site for the Graduate College (www.grad-college.iastate.edu/) and requirements for the interdepartmental majors can be found by following the links from the GDCB web site above. Although not a formal requirement, the GDCB faculty recommends that students pursuing the Ph.D. include teaching experience in their graduate training.

Courses primarily for graduate students, open to qualified undergraduate students

GDCB 508. Biotechnology in Agriculture, Food, and Human Health. (3-0) Cr. 3. F.S. *Prereq: Biol 211 and 212.* Scientific principles and techniques in biotechnology. Products and applications in agriculture, food, and human health. Ethical, legal, and social implications of biotechnology. A research paper is required for graduate credit.

GDCB 510. Transmission Genetics. (3-0) Cr. 3. F. *Prereq: Gen 410 or graduate standing.* An in-depth investigation of the modern research practices of transmission genetics. Designed for students interested in genetic research. Topics include: Mendelian genetic analysis, analysis of genetic pathways, mutational analysis of gene function, chromosomal mechanics, gene mapping, extranuclear inheritance, human genetic analysis.

GDCB 511. Molecular Genetics. (Cross-listed with MCDB). (3-0) Cr. 3. S. *Prereq: Biol 313 and BBMB 405.* The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes.

GDCB 512. Plant Growth and Development. (Cross-listed with MCDB, PlBio). (2-0) Cr. 2. S. *Prereq: Biol 330 or a course in developmental biology; GDCB 545 or BBMB 404, 405 or GDCB 520.* Plant growth and development and its molecular genetic regulation. Hormone biosynthesis, metabolism, and action. Signal transduction in plants.

GDCB 513. Plant Metabolism. (Cross-listed with PlBio). (2-0) Cr. 2. F. *Prereq: Biol 330, Phys 111, Chem 331; one semester of biochemistry recommended.* Photosynthesis, respiration, and other aspects of plant metabolism.

GDCB 520. Genetic Engineering. (Cross-listed with BBMB, MCDB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Gen 411 or BBMB 405.* Strategies and methods of gene cloning, restriction endonuclease mapping, southern hybridization, isolation and manipulation of plasmid DNA, and detection of specific genes in bacteria.

GDCB 528. Cellular Growth and Regulation. (Cross-listed with MCDB). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Courses in cell biology and BBMB 404, 405.* Cell cycle, regulation of cell growth, cell division, membranes, transport processes, and regulation of cellular activities.

GDCB 529. Plant Cell Biology. (Cross-listed with MCDB). (2-0) Cr. 2. *Prereq: Biol 313, 314, 330 or BBMB 405.* Organization, function, and development of plant cells and subcellular structures.

GDCB 533. Principles of Developmental Biology. (Cross-listed with MCDB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 314.* Fundamental principles in multicellular development. Emphasis on cellular and molecular regulation of developmental processes, and experimental approaches as illustrated in classical studies and current literature.

GDCB 536. Statistics for Population Genetics. (Cross-listed with Stat). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Stat 401, 447; Gen 320 or Biol 313.* Statistical models for population genetics covering: selection, mutation, migration, population structure, and linkage disequilibrium. Applications to gene mapping (case-control, TDT), inference about population structure, DNA and protein sequence analysis, and forensic and paternity identification.

GDCB 537. Statistics for Molecular Genetics. (Cross-listed with Stat). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 401, 447; Gen 320 or Biol 313.* Statistical models, inference, and computational tools for linkage analysis, quantitative trait analysis, and molecular evolution. Topics include; quantitative trait models, variance component mapping, interval and composite-interval mapping, and phylogenetic tree reconstruction.

GDCB 538. Computational Genomics and Evolution. (Cross-listed with BCB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 313.* Introduction to evolutionary sequence analysis at the genome level. Topics include sequence alignment, phylogenetic inference, molecular clock analysis, ancestral state inference, sequence/structure relation, functional divergence and prediction, evolutionary development, genome duplication, and comparative genomics. Focus will be on data analysis and biological interpretation.

GDCB 539. Statistical Methods for Computational Biology. (Cross-listed with BCB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: BCB 568.* Gu. Advanced discussion about statistical modeling of DNA and amino acid sequences, microarray expression profiles and other genome-wide data interpretation.

GDCB 542. Introduction to Molecular Biology Techniques. (Cross-listed with B M S, BBMB, BCB, EEOB, FS HN, Hort, NREM, NutrS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

GDCB 544. Introduction to Bioinformatics. (Cross-listed with BCB, Cpr E, Com S). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics.

GDCB 545. Plant Molecular Biology. (Cross-listed with MCDB, PlBio). (3-0) Cr. 3. F. *Prereq: Biol 314, 330.* Organization and function of plant nuclear and organelle DNA; regulation of gene expression. Methods of generating novel genetic variation. Impact of plant biotechnology on agriculture.

GDCB 556. Cellular, Molecular and Developmental Neuroscience. (Cross-listed with Neuro, B M S). (3-0) Cr. arr. F. *Prereq: Biol 335 or Biol 436; physics recommended.* Fundamental principles of neuroscience including cellular and molecular neuroscience, nervous system development, sensory, motor and regulatory systems.

GDCB 557. Advanced Neuroscience Techniques. (Cross-listed with Neuro). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Neuro 556 or equivalent course.* Research methods and techniques; exercises and/or demonstrations representing individual faculty specialties.

GDCB 568. Bioinformatics II (Advanced Genome Informatics). (Cross-listed with BCB, Stat, Com S). (3-0) Cr. 3. S. *Prereq: BCB 567, BBMB 301, Biol 315, Stat 430, credit or enrollment in Gen 411.* Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

GDCB 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology). (Cross-listed with Com S, BCB, Stat, Cpr E). (3-0) Cr. 3. S. *Prereq: BCB 567, Biol 315, Com S 311 and either 208 or 228, Gen 411, Stat 430.* Algorithmic and Statistical approaches in computational functional genomics and systems biology. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Ontology-driven, network based, and probabilistic approaches to information integration.

GDCB 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

GDCB 596. Genomic Data Processing. (Cross-listed with Com S, BCB). (3-0) Cr. 3. F. *Prereq: Some basic knowledge of programming.* Study the practical aspects of genomic data processing with an emphasis on hands-on projects. Students will carry out common data processing steps using bioinformatics tools. Topics include base-calling, raw sequence cleaning and contaminant removal; shotgun assembly procedures and EST clustering methods; genome closure strategies and practices; sequence homology search and function prediction; annotation and submission of GenBank reports; and data collection and dissemination through the Internet. Important post-genomic topics like microarray design and data analysis will also be covered.

Courses for graduate students

GDCB 632. Current Topics in Signal Transduction. Cr. 2-3. *Prereq: Permission of instructor.* Selected topics in signal transduction events, their molecular mechanisms and their relation to cellular processes. Topics may include cell recognition, second messenger systems, information integration and transfer, cell cycle, cell differentiation, and pattern formation.

GDCB 640. Signal Transduction. (Cross-listed with BBMB, MCDB). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: GDCB 528, BBMB 404.* Mechanisms and components of cellular signal transduction including receptors, G-proteins, second messengers, protein phosphorylation, other post-translational protein modifications, and transcriptional regulation.

GDCB 661. Current Topics in Neuroscience. (Cross-listed with Neuro, BBMB). Cr. arr. Alt. S., offered 2010. Repeatable. *Prereq: Permission of instructor.* Topics may include communication, hormones and behavior, neural integration, membrane biophysics, molecular and cellular neuroscience, developmental neurobiology, neuroanatomy and ultrastructure, sensory biology, social behavior, techniques in neurobiology and behavior.

GDCB 679. Light Microscopy. (Cross-listed with Micro, EEOB). (2-9) Cr. 5. Alt. F., offered 2010. *Prereq: Permission of instructor.* Current theories encompassing light optics and their applications for specimen preservation, paraffin and resin sectioning, general staining, histochemistry, cytophotometry, immunocytochemistry, autoradiography, image digitization, processing and presentation, and digital macro- and micrography. Limit of 10 students.

GDCB 680. Scanning Electron Microscopy. (Cross-listed with Micro, EEOB). (2-9) Cr. 5. Alt. F., offered 2009. *Prereq: Permission of instructor.* Current theories encompassing scanning electron optics and their applications for high and low vacuum microscopy, specimen chemical and cryopreservation methods, x-ray microanalysis, backscattered and topographic imaging, image digitization, processing and presentation. Limit of 10 students.

GDCB 681. Transmission Electron Microscopy. (Cross-listed with Micro, EEOB). (2-9) Cr. 5. Alt. S., offered 2011. *Prereq: GDCB 679 and permission of instructor.* Current theories encompassing electron optics and their applications for chemical and physical specimen preservation, ultramicrotomy, general staining and cytochemistry, immunocytochemistry, autoradiography, negative staining and shadowing, x-ray microanalysis, image digitization, processing and presentation.

GDCB 690. Seminar in GDCB. Cr. 1. Repeatable. Journal article critique and discussion by faculty and graduate students. Satisfactory-fail only.
A. Cellular, Molecular, and Developmental Biology
C. Neurobiology
D. Physiology
E. Evolution
F. Animal Models of Gene Therapy
H. Bioinformatics and Computational Biology

GDCB 691. Faculty Seminar. Cr. 1. Repeatable. Faculty research series.
G. Genetics. F. Prereq: Permission of instructor.
H. Bioinformatics and Computational Biology. (Same as BCB 691H).
P. Plant Development. S. Prereq: GDCB 512 (can be taken concurrently).

GDCB 696. Research Seminar. (Cross-listed with Agron, BBMB, PlBio, Hort, for). Cr. 1. Repeatable. Research seminars by faculty and graduate students. Satisfactory-fail only.

GDCB 698. Seminar in Molecular, Cellular, and Developmental Biology. (Cross-listed with MCDB, BBMB, Micro, V MPM). (2-0) Cr. arr. Repeatable. F.S. Student and faculty presentations.

GDCB 699. Research. Cr. arr. Repeatable. Research for thesis or dissertation. Satisfactory-fail only.

GDCB 699I. Research. (Cross-listed with Ia LL, A Ecl, Anthr, EEOB). Cr. arr. Repeatable.

Genetics - Interdisciplinary

www.genetics.iastate.edu

e-mail: genetics@iastate.edu

(Interdepartmental Graduate Major)

Supervisory Committee: P. Becraft, Chair; Jo Anne Powell-Coffman, Associate Chair; D. Hannapel, T. Peterson, D. Spurlock, T. Lubberstedt.

Participating Faculty: D. Bassham, T. Baum, G. Beattie, P. Becraft, J. Beetham, M. Bhattacharyya, D. Birt, J. Blanchong, T. Bobik, A. Bogdanove, B. Bonning, V. Brendel, A. Bronikowski, H. H. Chou, C. Coffman, J. Dekkers, D. Dobbs, M. Ellinwood,

J. Essner, S-Z Fei, R. Fernando, D. Garrick,J. R. Girton, X. Gu, R. B. Hall, L. Halverson, D. J. Hannapel, E. R. Henderson, F. Janzen, K. M. Johansen, A. Kanthasamy, S. J. Lamont, N. Lauter, D. Lavrov, C. Lawrence, M. Lee, T. Lubberstedt, G. MacIntosh, W. A. Miller, F. C. Minion, J. Nason, B. J. Nikolau, M. Nilsen-Hamilton, L. Nolan, D. Oliver, P. A. Peterson, T. Peterson, G. Phillips, J. Powell-Coffman, J. Reecy, K. Roe, M. Rowling, S. R. Rodermel, M. F. Rothschild, P. S. Schnable, M. P. Scott, J. Serb, R. C. Shoemaker, R. Singh, M. H. Spalding, D. Spurlock, C. K. Tuggle, N. Valenzuela, E. Vollbrecht, K. Wang, J. F. Wendel, S. Whitham, R. P. Wise, E. Wurtele, B. Yang, Y. Yin, Q. Zhang

Undergraduate Preparation

Undergraduates wishing to prepare for graduate study in Genetics should elect courses in basic biology, chemistry at least through organic chemistry, one year of college-level physics, mathematics at least through calculus, and at least one thorough course in basic transmission and molecular genetics. One year of upper level statistics and a year of biochemistry are strongly encouraged.

See Genetics - Undergraduate for information on a bachelor of science degree in Genetics.

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in Genetics in thirteen cooperating departments: Agronomy; Animal Science; Biochemistry, Biophysics and Molecular Biology; Biomedical Sciences; Ecology, Evolution and Organismal Biology; Entomology; Food Science and Human Nutrition; Genetics, Development and Cell Biology; Horticulture; Plant Pathology; Natural Resource Ecology and Managment; Veterinary Microbiology and Preventive Medicine; and Veterinary Pathology.

The diversity of faculty in the Interdepartmental Genetics major ensures a broad, well-balanced education from the best instructors, while offering flexibility in choice of research area. Genetics faculty have strengths in many areas, from fundamental studies at the molecular, cellular, organismal, and population levels, to research with immediate practical application. Ongoing research projects span all the major areas of theoretical and experimental genetics, including genomics, molecular studies of gene regulation, gene mapping, transposable element studies, developmental genetics, quantitative and mathematical genetics, computational molecular biology, evolutionary genetics, and population genetics.

Students are admitted by the approval of the Chair after review by the Genetics Admissions Committee. Students are admitted either to participate in research rotations with several faculty or by direct admission into a specific lab and department. First year students participating in rotations with Genetics faculty will take Genet 697 (graduate research rotation). All Ph.D. candidates take a core curriculum comprising one course each from the following four categories and attend seminars and workshops as described: Transmission Genetics (GDCB 510), Molecular Genetics (GDCB 511 or BBMB 502), Quantitative, Population, and Evolutionary Genetics (An S/Agron 561 or EEOB 562 or EEOB 563 or EEOB 566 or EEOB 567), Biochemistry (BBMB 404 or BBMB 501). Students will give three research presentations (Genet 690), attend two genetics faculty seminar series (Genet 691), and participate in three Workshops in Genetics (Genet 591) during their training period. First-year graduate students will also take Genet 692 (Seminar in the Conceptual Foundations of Genetics).

Students may elect a computational molecular biology speciality within the genetics major. This requires that the research project be in the field of computational molecular biology. IG majors will be expected to complete all of the courses required for the major, except that one semester of Student Seminar in Bioinformatics and Computational Biology (BCB 690). Students will be expected to take additional courses in the area of specialization.

M.S. students will take the above core courses and seminars with the following changes: participate in two of the Workshops in Genetics (Genet 591) and present their research once (Genet 690). Additional coursework may be selected to satisfy individual interests or departmental requirements.

The course designator Genet applies to graduate courses taught by the interdepartmental major in Genetics.

Students wishing to minor in genetics must submit a complete application to the graduate program. Requirements for the successful completion of a minor at the Ph.D. or M.S. levels are: completion of three of the four categories of the common-core required lecture courses listed above. One semester of seminar in Genetics (Genet 690 or 691 or 692) is recommended. One member of the POS committee must be a Genetics faculty member.

Student Outcomes: Most students awarded doctoral degrees continue their training as postdoctoral associates at major research institutions in the U.S. or abroad in preparation for research and/or teaching positions in academia, industry, or government. A few go directly to permanent research positions in industry. Many students awarded master's degrees continue their training as doctoral students; however, some choose research support positions in academia, industry, or government. A more thorough list of outcomes is available at our Web site.

Courses for graduate students

Genet 590. Special Topics. Cr. arr. Repeatable. F.S.SS. Contact individual faculty for special projects or topics. Graded.

Genet 591. Workshop in Genetics. (1-0) Cr. 1. Repeatable. S. *Prereq: Permission of instructor.* Current topics in genetics research. Lectures by off-campus experts. Students read background literature, attend preparatory seminars, attend all lectures, meet with lecturers.

Genet 690. Seminar in Genetics. (1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor.* Research presentations by students to improve their ability to: orally present scientific work in a clear and meaningful way, critically evaluate oral presentations, and give and receive constructive criticism.

Genet 691. Seminar in Genetics. (1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor.* Faculty research seminars that introduce students to the variety of genetics research projects on campus and provide an opportunity for students to become engaged in the scientific presentation to the point where they can think critically and ask meaningful questions.

Genet 692. Conceptual Foundations of Genetics. (1-0) Cr. 1. F. *Prereq: Permission of instructor.* Landmark papers in the development of genetics concepts. Papers are presented and discussions led by students, guided and mentored by the instructors. Instructors provide a broad overview and history of the development of fundamental concepts in genetics.

Genet 697. Graduate Research Rotation. Cr. arr. Repeatable. F.S.SS. Graduate research projects performed under the supervision of selected faculty members in the graduate Genetics major.

Genet 699. Research. Cr. arr. Repeatable. F.S.SS.

Genetics - Undergraduate

Jack R. Girton, Chair, Genetics Major Committee

http://www.iastate.edu/~ugradgen/

Genetics is the scientific study of heredity. Understanding the basis of heredity is fundamental to all aspects of the life sciences, from the most basic molecular study to applied studies of agricultural species. At Iowa State University the study of the life sciences is interdepartmental, involving faculty in the basic, agricultural, and veterinary sciences. Faculty in 20 different departments are involved in genetics research. This large group of faculty presents a broad range of possibilities for students to learn from faculty who are at the forefront of research in many areas of genetics.

Undergraduate Study

Undergraduate study in genetics is jointly administered by three departments: Biochemistry, Biophysics, and Molecular Biology; the Department of Genetics, Development, and Cell Biology; and the Department of Ecology, Evolution, and Organismal Biology. Undergraduate degrees are offered through both the College of Agriculture and the College of Liberal Arts and Science. Programs of study for genetics majors leading to a B.A. or a B.S. degree are available. A minor in genetics is also offered for students majoring in several areas of the life sciences.

Training in genetics may lead to employment in teaching, research, or a variety of health-related professions. Although some students find employment directly after their baccalaureate training, many students continue their education in graduate or professional programs. Students with the B.S. or B.A. degree may find employment in the biotechnology, health, or food industries. Recent graduates have also developed careers in conservation biology, technical writing, science journalism, technical sales, business, and genetic counseling.

The required course work and associated electives provide students with the foundation in basic life sciences, mathematics, chemistry, and physics that is essential for professions involving modern biological/biomedical sciences. As part of these courses students develop skills in problem solving, critical thinking, writing, research-related activities in the biological sciences.

The respective communications and communication proficiency requirements of both colleges are met by an average of C or better in Engl 150, 250 or 250H, and an additional English writing course. The lowest grade acceptable in any of these courses is C-. Students in the College of Agriculture must also achieve a C or better in an oral communications course.

A grade of C– or better is required in all biological science courses within the major and a cumulative GPA of at least 2.0 is required for graduation.

Specific entrance requirements for medical and health-related professions are established by the professional schools. Students interested in fulfilling pre-professional requirements for such professions as dentistry, human medicine, nursing, optometry, pharmacy, physical therapy, physicians assistant, and veterinary medicine can major in genetics while fulfilling the pre-professional requirements. (See *Preprofessional Study.*)

Graduate Study

Graduate study in genetics leading to the Master of Science and doctor of philosophy degrees is offered at ISU. Graduate study is organized as a separate interdepartmental graduate major from the undergraduate program. For more information on graduate study in genetics see: *Genetics - Interdisciplinary.*

Curriculum in Genetics

In addition to basic degree requirements listed in the Curricula in Agriculture or in Liberal Arts and Sciences, genetics majors must satisfy the following requirements:

1. Biol 211, 211L, 212, 212L, 313, 313L, 314, 314L, 315, and Micro 302.
2. Gen 110, 409, 410, 491, and either 462 or EEOB 563.
3. Eleven credits of calculus and Statistics including at least one course in each.
4. Three years of chemistry and biochemistry.

. Eight credits of general college physics.

6. Additional credits of biological science support electives chosen from an approved list. For degrees in the College of Agriculture nine credits are required, for degrees in the College of Liberal Arts and Sciences six credits are required.
7. Majors in the College of Liberal Arts and Sciences must take one course that involves both humanities and biology such as history of science, or bioethics. This course may also count toward a college group requirement. A list of acceptable courses is available from the program office.
8. Majors in the College of Agriculture must include Biol 312 in their program.

The minor in genetics may be earned by completing Gen 313, 313L, 314, 314L, Gen 409, 410 and 491. A Genetics major may not double major or minor in Biology.

Courses primarily for undergraduate students

Gen 110. Genetics Orientation. (1-0) Cr. 1. F. Orientation to the area of genetics. For students considering a major in genetics. Specializations and career opportunities. Satisfactory-fail only.

Gen 260. Human Heredity and Society. (3-0) Cr. 3. F. *Prereq: One semester of college biology or Anthr 202.* A survey course in genetics for non-biology majors interested in heredity and its importance, and implications to self and Society. Not recommended for those intending to take advanced courses in genetics. Credit for graduation will not be allowed for more than one of the following: Gen 260, 313, 320, Biol 313 and 313L and Agron 320.

Gen 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Gen 308. Biotechnology in Agriculture, Food, and Human Health. (3-0) Cr. 3. F.S.SS. *Prereq: Biol 211 and 212.* Scientific principles and techniques in biotechnology. Products and applications in agriculture, food, and human health. Ethical, legal, and social implications of biotechnology.

Gen 313. Principles of Genetics. (Cross-listed with Biol). (3-0) Cr. 3. F.S. *Prereq: Biol 211, 211L, 212, and 212L.* Introduction to the principles of transmission and molecular genetics of plants, animals, and bacteria. Recombination, structure and replication of DNA, gene expression, cloning, quantitative and population genetics. Credit for graduation will not be allowed for more than one of the following: Gen 260, Gen 313 and 313L, Gen 320, Biol 313 and 313L, and Agron 320.

Gen 313L. Genetics Laboratory. (Cross-listed with Biol). (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 313.* Laboratory to accompany 313. Students may receive graduation credit for no more than one of the following: Biol 313 and 313L, Gen 260, Gen 313, Gen 320, and Agron 320.

Gen 320. Genetics, Agriculture and Biotechnology. (Cross-listed with Agron). (3-0) Cr. 3. F.S. *Prereq: Biol 212.* Transmission genetics with an emphasis on applications in agriculture, the structure and expression of the gene, how genes behave in populations and how recombinant DNA technology can be used to improve agriculture. Credit for graduation will not be allowed for more than one of the following: Gen 260, 313, 320, Biol 313 and 313L and Agron 320.

Gen 340. Human Genetics. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Biol 313 or Gen 313.* Fundamental concepts and current issues of human genetics. Human chromosome analysis, pedigree analysis, gene mapping, the human genome project, sex determination, genetics of the immune system, genetics of cancer, gene therapy, the genetic basis of human diversity, eugenics.

Gen 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Gen 409. Molecular Genetics. (3-0) Cr. 3. F. *Prereq: Biol 314.* The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes. Nonmajor graduate credit.

Gen 410. Analytical Genetics. (3-0) Cr. 3. S. *Prereq: 313 or Biol 313.* The principles and practice of genetic analysis. Mendelian genetic analysis, mutational analysis of gene function, linkage and gene mapping, chromosomal aberrations, aneuploidy and polyploidy, extrachromosomal inheritance, analysis of genetic pathways, genetics of quantitative traits. Nonmajor graduate credit.

Gen 444. Introduction to Bioinformatics. (Cross-listed with BCB, Biol, Com S, Cpr E). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics. Nonmajor graduate credit.

Gen 462. Evolutionary Genetics. (Cross-listed with Biol). (3-0) Cr. 3. S. *Prereq: Biol 315.* The genetic basis of evolutionary processes in higher organisms. The role of genetic variation in adaptation, natural selection, adaptive processes, and the influence of random processes on evolutionary change. Nonmajor graduate credit.

Gen 490. Independent Study. Cr. arr. Repeatable. *Prereq: 313, junior or senior classification, permission of instructor.* Students in the College of Agriculture may use no more than 6 credits of Gen 490 toward the total of 128 credits required for graduation; students in the College of Liberal Arts and Sciences may use no more than 9 credits of Gen 490 toward graduation.
R. Genetics research. Cr. 1 to 5 each time taken.
S. Attendance and critique of genetics seminars. cr. 1. Offered on a satisfactory-fail grading basis only.
U. Laboratory teaching experience. For students registering to be undergraduate laboratory assistants. Cr. 1 to 2. Offered on a satisfactory-fail grading basis only.

Gen 491. Undergraduate Seminar. (1-0) Cr. 1. F. *Prereq: Junior classification.* The investigation of current issues in genetics. Graduate school and employment opportunities discussed. Practice in resume writing and interview techniques. Required for majors in genetics.

Gen 495. Molecular Biology for Computational Scientists. (Cross-listed with BCB). (3-0) Cr. 3. F. Survey of molecular cell biology and molecular genetics for nonbiologists, especially those interested in bioinformatics/computational biology. Basic cell structure and function; principles of molecular genetics; biosynthesis, structure, and function of DNA, RNA, and proteins; regulation of gene expression; selected topics. Provides biological background for BCB 594. Credit for graduation will not be allowed for more than one of Gen 411 and Gen/BCB 495. Nonmajor graduate credit.

Gen 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Geological and Atmospheric Sciences

www.ge-at.iastate.edu/

Carl E. Jacobson, Chair of Department

Distinguished Professor (Emeritus): Vondra

Professors: Arritt, Beresnev, Burras, Chen, Gallus, Gutowski, Iverson, Jacobson, Sandor, Simpkins, Spry, Takle, Thompson

Professors (Emeritus): Seifert, Yarger

Professors (Collaborators): Kato, Koch

Associate Professors: Cervato, Windom, Wu

Associate Professor (Emeritus): Cody

Associate Professors (Collaborators): Brake, Burkart, Hasiotis, Tomer

Assistant Professors: Franz, Harding, Hornbuckle

Assistant Professors (Collaborators): Burke, Jones

Senior Lecturer: Dawson

Lecturers: Flory, Noggle

Undergraduate Study

The department offers courses in Geology and Meteorology. Majors can be earned in earth science (B.A., B.S.), geology (B.S.), and meteorology (B.S.). Candidates for all degrees must satisfy the requirements established by the College of Liberal Arts and Sciences (see *Liberal Arts and Sciences, Curriculum*). In addition, the department has requirements for each major.

The bachelor of science in Geology prepares the student for a professional career and/or graduate study in the geological sciences. Students selecting geology as a major will elect an option in traditional geology or environmental geology/hydrogeology. The traditional option prepares a student for employment in state and U.S. geological surveys, mineral and petroleum exploration, and graduate study in most aspects of geology. Required courses in this option include Geol 100, 100L, 102, 102L, 302, 311, 356, 365, 368, 479 and at least 9 credits of geology electives. The environmental geology/hydrogeology option prepares a student for employment in environmental consulting, state and U.S. geological surveys, regulatory agencies, and graduate study in the environmental aspects of geology. Required courses in this option include Geol 100, 100L, 102, 102L, 302, 311, 356, 368, 411, 419 or 426 or 434, 479, and at least 6 credits of geology electives. Required supporting courses include Chem 177, 177L, 178, 178L; Phys 111, 112; Math 165, 166 or Math 181, 182; at least 6 additional credits from an approved departmental list of courses in the science, engineering, or mathematical disciplines outside of geology. No more than 9 credits in 490 may be counted toward a degree in Geology.

A minor in Geology may be earned by taking 15 credits of geology coursework, including Geol 100 and 100L (or 201), 102, and 102L. The remainder should be at the 300 level or above.

Graduates work to understand natural processes on Earth and other planets. They are able to apply their knowledge of forces and factors that shape the Earth to reconstruct the past and anticipate the future. Graduates provide essential information for solving problems for resource management, environmental protection, and public health, safety, and welfare. They work as consultants on engineering and environmental problems, explorers for new minerals and hydrocarbon resources, researchers, teachers, writers, editors, and museum curators. Graduates are able to integrate field and laboratory data and to prepare reports. They are able to make presentations that include maps and diagrams that illustrate the results of their studies.

The study of Meteorology involves the description of the earth's atmosphere and the processes responsible for its behavior. Students majoring in Meteorology earn the bachelor of science. Successful preparation for professional or graduate work in Meteorology requires that the student develop and integrate a diverse range of skills and knowledge bases. These include weather observing, the physics and dynamics of the global atmosphere, application of new weather technologies, advanced mathematical tools, computer programming and modeling, and effective oral and written communication. The faculty view the senior thesis (Meteorology 499), in particular, as a capstone experience in which students demonstrate they have achieved this integration. Also, contemporary meteorology is an earth-system science with ties to a variety of human experiences. The electives and general education requirements of the college are further experiences that the meteorology student must integrate with their core meteorology knowledge in order to function effectively in a global-oriented profession. The program requires the following courses: Mteor 111, 201, 206, 227, 301, 311, 341, 342, 411, 417, 432, 443, 454, and 499. An additional 9 credits must be chosen from Mteor 402, 404, 406, 407, 452, 490, and Geol 415 or C E 372 (some experimental Mteor courses can also be used). Supporting work is required in areas at least equivalent to Chem 163, 163L; Phys 221, 222; Math 165, 166, 265, 266; Stat 105; Sp Cm 212. A grade of C or better (not C-) is required in each of the following courses to meet minimum graduation requirements for a bachelor of science degree in Meteorology: 206, 301, 311, 341, 342, and 443.

Several co-op programs are available for upper division undergraduates. Although a range of opportunities exists for men and women who terminate their studies with a bachelor of science, students who meet the necessary academic standards are encouraged to continue their studies in a graduate program. For these students, minor work is recommended in a mathematical or physical science. Other students can choose a wide range of supporting courses that will contribute to their particular area of interest in meteorology.

The department offers a minor in Meteorology which may be earned by completing 15 credits including Mteor 111 (only 1 credit may count toward the minor), Mteor 206 and Mteor 301. Further information concerning programs of study, including sample degree programs, is available from the department.

The Earth Science major is a broad program that typically emphasizes an interdisciplinary field. Programs leading to the bachelor of science may be individually designed but will include required courses in Geology and Meteorology, and required supporting work in chemistry, physics, and mathematics. Specific programs have been designed for students interested in a geology, meteorology, or an environmental earth science emphasis. Programs leading to the bachelor of arts for earth science teaching are available. The latter program must satisfy the requirements of the Teacher Education Program (see *Index, Teacher Education*).

Communication Proficiency requirement: The department requires a grade of C or better in each of English 150 and 250 (or 250H), and a C or better in English 314 or 302 or JI MC 347.

Graduate Study

The department offers programs leading to the master of science and doctor of philosophy with majors in Earth Science, Geology, and Meteorology. Program options are available for the M.S. and Ph.D. degrees in earth science leading to careers in teaching. The department also cooperates in the interdepartmental major in Water Resources (see *Index*). Students desiring a major in the above fields normally will have a strong undergraduate background in the physical and mathematical sciences. Individuals desiring to enter a graduate program are evaluated by considering their undergraduate background and performance and their expressed goals.

Programs of study are designed on an individual basis in accordance with requirements of the Graduate College and established requirements for each departmental major. Minor work is normally taken in aerospace engineering, Agronomy (soil science), chemistry, civil and construction engineering, computer engineering, computer science, engineering mechanics, materials engineering, mathematics, mechanical engineering, microbiology, physics, or Statistics. Departmental requirements provide a strong, broad background in the major and allow considerable flexibility in the program of each individual.

A dissertation is required of all Ph.D. candidates. M.S. students in Geology are required to complete a thesis. The M.S. in Earth Science is available to students electing the non-thesis (Creative Component) option in Geology or Meteorology. A non-thesis option is also offered for the M.S. degree in Meteorology.

Graduates in Geology specialize in a subdiscipline, but they comprehend and can communicate the basic principles of geology and supporting sciences. They possess the capacity for critical and independent thinking. They are able to write a fundable research proposal, evaluate current relevant literature, carry out the proposed research, and communicate the results of their research to peers at national meetings and to the general public. They work as consultants on engineering and environmental problems, explorers for new minerals and hydrocarbon resources, researchers, teachers, writers, editors, and museum curators.

All candidates for an advanced degree in Meteorology are expected to complete Mteor 542, 543, and 552. In addition, students without prior synoptic course-work must complete Mteor 511; other students must complete Mteor 507 or Agron 507. Students must also complete Mteor 504 (or Agron 504) or Mteor 605 or Agron 505.

Graduates in Meteorology have a good comprehension of basic principles, a capacity for critical and independent thought and an ability to communicate effectively with scientific colleagues. They have an appropriate breadth in their understanding of meteorology with a suitable specialization. Graduates are able to undertake thorough research and explain the results in a scientifically reasonable fashion.

Geology (Geol)

Courses primarily for undergraduate students

Geol 100. The Earth. (3-0) Cr. 3. F.S.SS. How does the earth work, what is it made of, and how does it change through time? Plate tectonics, Earth materials, land forms, structures, climate, and natural resources. Emphasis on the observations and hypotheses used to interpret earth system processes. Students may also enroll in Geol 100L.

Geol 100L. The Earth: Laboratory. (0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in 100.* Characterization of rocks and minerals; interpretation of structures and landforms.

Geol 101. Environmental Geology: Earth in Crisis. (Cross-listed with Env S). (3-0) Cr. 3. F.S. An introduction to geologic processes and the consequences of human activity from local to global scales. Discussion of human population growth, resource depletion, pollution and waste disposal, global warming and ozone depletion, desertification, and geologic hazards such as earthquakes, landslides, flooding, and volcanism.

Geol 102. History of the Earth. (3-0) Cr. 3. S. *Prereq: 100 or 201.* The Earth's physical and biological evolution; concepts of global tectonics. Methods used to decipher earth history. Students majoring in geology must also enroll in Geol 102L.

Geol 102L. History of the Earth: Laboratory. (0-2) Cr. 1. S. *Prereq: Credit or enrollment in 102.* Introduction to the use of sedimentary rocks and fossils in reconstructing the Earth's history.

Geol 108. Introduction to Oceanography. (Cross-listed with Env S). (3-0) Cr. 3. F. Introduction to study of the oceans. Ocean exploration. Waves and currents. Shape, structure, and origin of the ocean basins. Sedimentary record of oceanic life. Composition of seawater and its significance for life. Ocean circulation and its influence on climate. Life of the oceans, including coral reefs. Use and misuse of ocean resources. Anthropogenic impacts on the oceanic environment.

Geol 160. Water Resources of the World. (Cross-listed with Mteor, Env S, Agron). (3-0) Cr. 3. S. Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in society and the environment.

Geol 201. Geology for Engineers and Environmental Scientists. (2-2) Cr. 3. F. Introduction to Earth materials and processes with emphasis on engineering and environmental applications.

Geol 290. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

Geol 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: 100 or 201, 100L, 102, 102L, and permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing the work period.

Geol 302. Summer Field Studies. Cr. 6. SS. *Prereq: 102, 356, 368.* Geologic mapping; structural, stratigraphic, sedimentologic, and geomorphic analyses. Study areas include world-class dinosaur localities. A 6-week summer field course required of all geology majors. Nonmajor graduate credit.

Geol 306. Geology Field Trip. Cr. arr. Repeatable. F.S. *Prereq: 100 or 201, permission of instructor.* Geology of selected regions studied by correlated readings followed by a field trip to points of geologic interest. Ten-day field trip required.

Geol 311. Mineralogy and Earth Materials. (3-6) Cr. 5. F. *Prereq: 100 or 201, Chem 163. Introduction to mineral classification, elementary crystal chemistry, crystal morphology, mineral stability, and associations.* Laboratory problems in mineral identification methods, including hand-specimen identification, optical microscopy, and x-ray diffraction. Nonmajor graduate credit.

Geol 324. Energy and the Environment. (Cross-listed with Env S, Mteor). (3-0) Cr. 3. S. Renewable and non-renewable energy resources. Origin, occurrence, and extraction of fossil fuels. Nuclear, wind, and solar energy. Energy efficiency. Environmental effects of energy production and use, including air pollution, acid precipitation, groundwater contamination, nuclear waste disposal, and global climate change. Geol 324 does not count toward credits required in the Geology major.

Geol 356. Structural Geology. (3-6) Cr. 5. S. *Prereq: 100 or 201; Phys 111, Math 165 or 181.* Principles of stress and strain. Brittle and ductile behavior of rocks. Description and classification of joints, faults, folds, fractures, foliation, and lineation. Plate tectonics and regional geology. Laboratory includes application of geometrical techniques to solve structural problems; emphasizes map interpretation and use of stereonet and computer methods. Nonmajor graduate credit.

Geol 365. Igneous and Metamorphic Petrology. (2-3) Cr. 3. S. *Prereq: 311.* Nature and origin of igneous and metamorphic rocks. Emphasis on important rock-forming environments and processes and their influence on rock characteristics. Laboratory includes thin section study of rock textures and mineralogy and the interpretation of these features. Field trips. Nonmajor graduate credit.

Geol 368. Stratigraphy and Sedimentation. (3-2) Cr. 4. F. *Prereq: 311.* Origin of sedimentary rocks and the characteristics of major depositional systems, geologic time, stratigraphic nomenclature, methods of correlation, facies and facies analysis, sequence stratigraphy, sedimentary tectonics and basin analysis. Required field and laboratory-based problem with a comprehensive written report. Nonmajor graduate credit.

Geol 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 100 or 201, 100L, 102, 102L, and permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Geol 402. Watershed Hydrology. (Dual-listed with 502). (Cross-listed with Agron, EnSci, Mteor, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

Geol 409. Field Methods in Hydrogeology. (Dual-listed with 509). (Cross-listed with EnSci). (0-4) Cr. 2. Alt. SS., offered 2010. *Prereq: 402 or 411 or C E 473.* Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, electronic instrumentation for data collection, and geophysics. Field trips to investigate water resource, water quality, and remediation projects.

Geol 411. Hydrogeology. (Dual-listed with 511). (Cross-listed with EnSci). (3-2) Cr. 4. F. *Prereq: Geol 100 or 201; Math 165 or 181; Phys 111 or 221.* Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations. Nonmajor graduate credit.

Geol 414. Applied Groundwater Flow Modeling. (Dual-listed with 514). (Cross-listed with EnSci). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 411 or C E 473; Math 165 or 181.* Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course. Nonmajor graduate credit.

Geol 415. Paleoclimatology. (Dual-listed with 515). (Cross-listed with EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Four courses in biological or physical science.* Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods; utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~1 million years). Nonmajor graduate credit.

Geol 419. Environmental Geochemistry. (Dual-listed with 519). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: 402 or 411 or equivalent.* Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling. Nonmajor graduate credit.

Geol 426. Stable Isotopes in the Environment. (Dual-listed with 526). (Cross-listed with EnSci). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Four courses in biological or physical science.* Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance. Nonmajor graduate credit.

Geol 434. Contaminant Hydrogeology. (Dual-listed with 534). (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: Geol 411 or equivalent.* Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface Microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies. Nonmajor graduate credit.

Geol 451. Applied and Environmental Geophysics. (Dual-listed with 551). (Cross-listed with EnSci). (2-2) Cr. 3. S. *Prereq: 100 or 201, Math 181 or equivalent experience.* Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic - and resistivity-imaging systems and radar. Nonmajor graduate credit.

Geol 452. GIS for Geoscientists. (Dual-listed with 552). (Cross-listed with Agron, EnSci). (2-2) Cr. 3. F. *Prereq: 100, 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses. Nonmajor graduate credit.

Geol 457. Exploration Seismology. (Dual-listed with 557). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: 100 or 201, Math 181 or equivalent experience.* Physics of elastic-wave propagation. Seismic surveys in environmental imaging, engineering, and petroleum exploration. Reflection and refraction techniques. Data collection, processing, and geological interpretation. Field work with state-of-the-art equipment. Nonmajor graduate credit.

Geol 474. Glacial and Quaternary Geology. (Dual-listed with 574). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 100 or 201 or equivalent experience.* The study of the depositional and erosional processes of glaciers using modern glacier analogs and landforms. Discussion of glaciology, glacier hydrology, Quaternary history and stratigraphy, paleoclimatology, and causes of glaciation. Laboratory emphasizes aerial photo and topographic map interpretation and the Quaternary stratigraphy of Iowa. Two required field trips. Nonmajor graduate credit.

Geol 479. Surficial Processes. (Dual-listed with 579). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: 100 or 201 or equivalent experience.* Study of surficial processes in modern and ancient geological environments. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory emphasizes aerial photo and topographic map interpretation. Nonmajor graduate credit.

Geol 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in geology and permission of instructor.* No more than 9 credits of Geol 490 may be counted toward graduation.

Geol 495. Undergraduate Seminar. Cr. 1. F.S. *Prereq: Junior or senior classification.* Weekly seminar on topics of current research interest.

Geol 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Geol 100 or 201, 100L, 102, 102L, and permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

Geol 502. Watershed Hydrology. (Dual-listed with 402). (Cross-listed with EnSci, Mteor). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

Geol 506. Geology Field Trip. Cr. arr. Repeatable. F.S. *Prereq: Graduate classification.* Geology of selected regions studied by correlated readings, followed by a field trip to points of geologic interest. Ten-day field trip.

Geol 507. Midwestern Geology Field Trip. Cr. 1. Repeatable. F. *Prereq: Geol 365.* On-site inspection of various ore deposits, mining operations, and terrains dominated by igneous or metamorphic rocks. Satisfactory-fail only.

Geol 509. Field Methods in Hydrogeology. (Dual-listed with 409). (Cross-listed with EnSci). (0-4) Cr. 2. Alt. SS., offered 2010. *Prereq: 402 or 411 or C E 473.* Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, electronic instrumentation for data collection, and geophysics. Field trips to investigate water resource, water quality, and remediation projects.

Geol 511. Hydrogeology. (Dual-listed with 411). (Cross-listed with EnSci). (3-2) Cr. 4. F. *Prereq: Geol 100 or 201; Math 165 or 181; Phys 111 or 221.*

Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations.

Geol 514. Applied Groundwater Flow Modeling. (Dual-listed with 414). (Cross-listed with EnSci). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 411 or C E 473; Math 165 or 181.* Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course.

Geol 515. Paleoclimatology. (Dual-listed with 415). (Cross-listed with EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Four courses in biological or physical science.* Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods; utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~ 1 million years).

Geol 519. Environmental Geochemistry. (Dual-listed with 419). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: 511 or equivalent.* Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling.

Geol 526. Stable Isotopes in the Environment. (Dual-listed with 426). (Cross-listed with EnSci). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Four courses in biological or physical science.* Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance.

Geol 534. Contaminant Hydrogeology. (Dual-listed with 434). (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: Geol 511 or equivalent.* Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface Microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies.

Geol 542. Optical Mineralogy. (1-2) Cr. 2. F. *Prereq: 311.* Introduction to using the microscope for mineral identification. Optical properties of minerals in immersion oils and in thin section. Research project required.

Geol 551. Applied and Environmental Geophysics. (Dual-listed with 451). (Cross-listed with EnSci). (2-2) Cr. 3. S. *Prereq: 100 or 201, Math 181 or equivalent experience.* Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic- and resistivity-imaging systems and radar.

Geol 552. GIS for Geoscientists. (Dual-listed with 452). (Cross-listed with Agron, EnSci). (2-2) Cr. 3. F. *Prereq: Geol 100, 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

Geol 555. Soil Clay Mineralogy. (Cross-listed with Agron). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Agron 473, Chem 178. Recommend: Geol 311.* Structure and behavior of clay minerals in soil environments, with emphasis on layer silicates and on Fe, Mn, and Al oxides.

Geol 555L. Soil Clay Mineralogy Laboratory. (Cross-listed with Agron). (0-3) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in 555.* Thompson. Application of X-ray diffraction, thermal analysis, infrared spectroscopy, and chemical analyses to identification and behavior of clay minerals in soils.

Geol 557. Exploration Seismology. (Dual-listed with 457). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: 100 or 201, Math 181 or equivalent experience.* Physics of elastic-wave propagation. Seismic surveys in environmental imaging, engineering, and petroleum exploration. Reflection and refraction techniques. Data collection, processing, and geological interpretation. Field work with state-of-the-art equipment.

Geol 558. Introduction to the 3D Visualization of Scientific Data. (Cross-listed with HCI, Com S). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate-student standing in the Mathematical or natural sciences.* Introduction to visualizing scientific information with 3D computer graphics and their foundation in human perception. Overview of different visualization techniques and examples of 3D visualization projects from different disciplines (natural sciences, medicine, engineering). Class project in interactive 3D visualization using the OpenDX, VTK or a similar system.

Geol 574. Glacial and Quaternary Geology. (Dual-listed with 474). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 100 or 201.* The study of the depositional and erosional processes of glaciers using modern glacier analogs and landforms. Discussion of glaciology, glacier hydrology, Quaternary history and stratigraphy, paleoclimatology, and causes of glaciation. Laboratory emphasizes aerial photo and topographic map interpretation and the Quaternary stratigraphy of Iowa. Two required field trips.

Geol 579. Surficial Processes. (Dual-listed with 479). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: Geol 100 or 201 or equivalent experience.* Study of surficial processes in modern and ancient geological environments. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory emphasizes aerial photo and topographic map interpretation.

Geol 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
A. Surficial Processes
B. Stratigraphy
C. Sedimentation
D. Paleontology
E. Petrology
F. Structural Geology
G. Geochemistry
H. Hydrogeology
I. Earth Science
J. Mineral Resources
K. Geophysics
L. Mineralogy
M. Tectonics
N. Paleoecology and Paleoclimatology
O. Isotope Geochemistry
P. Computational Methods and GIS
R. Surface Hydrology

Geol 595. Graduate Seminar. Cr. 1. Repeatable. F.S. *Prereq: Senior or graduate classification.* Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester. Satisfactory-fail only.
A. Cr. 1. Presentation required.
B. Cr. R. Attendance only.

Geol 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

Geol 610. Advanced Seminar. Cr. arr. Repeatable. F.S. *Prereq: Graduate standing and permission of instructor.*
A. Earth Materials
B. Economic Geology
C. Environmental Geochemistry
D. Geophysics
E. Geotectonics
F. Hydrogeology
G. Surficial Processes
H. Sedimentation and Stratigraphy
I. Paleoecology and Paleoclimatology
J. Isotope Geochemistry
K. Computational Methods and GIS

Geol 699. Research. Cr. arr. Repeatable.
A. Surficial Processes
B. Stratigraphy
C. Sedimentation
D. Paleontology
E. Petrology
F. Structural Geology
G. Geochemistry
H. Hydrogeology
I. Earth Science
J. Mineral Resources
K. Geophysics
L. Mineralogy
M. Tectonics
N. Paleoecology and Paleoclimatology
O. Isotope Geochemistry
P. Computational Methods and GIS
R. Surface Hydrology

Meteorology (Mteor)

Courses primarily for undergraduate students

Mteor 111. Synoptic Applications. (1-0) Cr. 1. Repeatable. F. *Prereq: Credit or enrollment in Math 165.* Current weather discussions and introduction to synoptic-scale interpretation of meteorology. Application and use of calculus in meteorology. Course restricted to majors. Others with permission of instructor.

Mteor 160. Water Resources of the World. (Cross-listed with Geol, Env S, Agron). (3-0) Cr. 3. S. Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in Society and the environment.

Mteor 201. Introductory Seminar. (1-0) Cr. R. F. An overview of the atmospheric sciences, the meteorology program at Iowa State, and the major research journals used in the discipline.

Mteor 206. Introduction to Meteorology. (Cross-listed with Agron). (3-0) Cr. 3. F.S. Basic concepts in meteorology, including atmospheric measurements, radiation, stability, precipitation, winds, fronts, forecasting, and severe weather. Applied topics include global warming, ozone depletion, world climates and weather safety. Self-study laboratory assignments utilize interactive computerized exercises, worksheets and computerized real-time forecasting. Self-study section may be available to distant education students.

Mteor 227. Computational Meteorology I. (3-1) Cr. 3. F. *Prereq: Credit or concurrent enrollment in Mteor 206, credit or concurrent enrollment in Phys 221.* An introduction to computer programming using FORTRAN with focus on meteorological applications. Emphasis on basics of good programming techniques and style through extensive practice in top-down design, writing, running, and debugging small programs. Topics include operations and functions, selective execution, repetitive execution, arrays, input/output, file processing, and subprograms. This course is designed for majors.

Mteor 265. Scientific Balloon Engineering and Operations. (Cross-listed with Aer E). (0-2) Cr. 1. F. Engineering aspects of scientific balloon flights. Integration of science mission objectives with engineering requirements. Operations team certification. FAA and FCC regulations, communications, and command systems. Flight path prediction and control.

Mteor 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing the work period.

Mteor 301. General Meteorology. (4-0) Cr. 4. S. *Prereq: Math 166, credit or enrollment in Phys 222.* Global distribution of temperature, wind, and atmospheric constituents; atmospheric thermodynamics, radiative transfer, global energy balance, storms and clouds, introductory dynamics. Nonmajor graduate credit.

Mteor 311. Introduction to Synoptic Meteorology. (1-2) Cr. 2. F. *Prereq: 301.* Concepts of weather map plotting and analysis. Introduction to forecasting and to the use of real-time UNIDATA computer products. Nonmajor graduate credit.

Mteor 321. Meteorology Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: 311; junior or senior standing; permission of co-op program coordinator; acceptance by sponsoring agency.* Supervised practical experience in a professional meteorological agency. Experiences may include providing weather information for radio, TV, utilities, government agencies, construction, or agribusiness.

Mteor 324. Energy and the Environment. (Cross-listed with Env S, Geol). (3-0) Cr. 3. S. Renewable and non-renewable energy resources. Origin, occurrence, and extraction of fossil fuels. Nuclear, wind, and solar energy. Energy efficiency. Environmental effects of energy production and use, including air pollution, acid precipitation, groundwater contamination, nuclear waste disposal, and global climate change. Mteor 324 does not count toward credits required in the meteorology major.

Mteor 341. Atmospheric Physics I. (3-0) Cr. 3. F. *Prereq: Phys 222, credit or enrollment in Math 266.* Basic laws of thermodynamics, thermodynamics of water vapor, mixtures of gases, stability, hydrostatics, cloud physics. Nonmajor graduate credit.

Mteor 342. Atmospheric Physics II. (3-0) Cr. 3. S. *Prereq: 341.* Precipitation physics, radar, atmospheric radiation, atmospheric optics, atmospheric electricity. Nonmajor graduate credit.

Mteor 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing the work period.

Mteor 402. Watershed Hydrology. (Dual-listed with 502). (Cross-listed with Agron, EnSci, Geol, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

Mteor 404. Global Change. (Dual-listed with 504). (Cross-listed with Agron, EnSci, Env S). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Nonmajor graduate credit.

Mteor 405. Environmental Biophysics. (Dual-listed with 505). (Cross-listed with Agron, EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities.

Mteor 406. World Climates. (Cross-listed with Agron, EnSci). (3-0) Cr. 3. F. *Prereq: Agron/Mteor 206.* Arritt. Distribution and causes of different climates around the world. Effects of climate and climate variations on human activities including Society, economy and agriculture. Current issues such as climate change and international efforts to assess and mitigate the consequences of a changing climate. Semester project and in-class presentation required. Nonmajor graduate credit.

Mteor 407. Mesoscale Meteorology. (Dual-listed with 507). (Cross-listed with Agron). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 166 and Mteor 454.* Gallus. Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

Mteor 411. Synoptic Meteorology. (Dual-listed with 511). (1-4) Cr. 3. F. *Prereq: Credit or enrollment in 454.* Current weather forecasting and discussion. Applications of atmospheric physics and dynamics in real-time weather situations. Use of UNIDATA computer products. Nonmajor graduate credit.

Mteor 417. Mesoscale Forecasting Laboratory. (Dual-listed with 517). (1-5) Cr. 3. S. *Prereq: Credit or enrollment in 411.* Real-time computer analysis of current weather, with emphasis on small-scale features. Studies of severe weather, lake-effect snow, CSI, cold-air damming. Nonmajor graduate credit.

Mteor 432. Instrumentation and Measurements. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in Stat 105, Math 266, Phys 222.* Measurement of meteorological variables and instruments used, including surface, upper air, and remote sensors; measurement errors, signal processing, recording and archiving; quality assurance. Nonmajor graduate credit.

Mteor 443. Dynamic Meteorology I. (3-0) Cr. 3. S. *Prereq: 341.* Conservation laws, governing equations, circulation and vorticity. Development of quasi-geostrophic theory. Nonmajor graduate credit.

Mteor 452. Physics of Climate. (Dual-listed with 552). (3-0) Cr. 3. F. *Prereq: Mteor 301.* Exploration of the fundamental physical principles that govern the climate systems of the Earth and other planets. Emphasis on coupled, nonlinear-system interactions of physical processes such as circulation dynamics, radiative transfer, and cloud/precipitation physics, starting with fairly simple 0- and 1-dimensional analytical and numerical models based on energy, mass, and momentum conservation. Observational study of seasonally evolving weather patterns that form climates around the world. Nonmajor graduate credit.

Mteor 454. Dynamic Meteorology II. (3-0) Cr. 3. F. *Prereq: 443.* Planetary boundary layer, linear perturbation theory, atmospheric wave motions, baroclinic and convective instability, mesoscale circulations. Nonmajor graduate credit.

Mteor 471. History of Modern Meteorology. (Dual-listed with 571). (1-0) Cr. 1. Alt. S., offered 2010. *Prereq: Mteor 341, 342, 411, 443, 452* Development of meteorological theories and numerical weather prediction, discoveries of important meteorological phenomena, and impact of weather and climate on important historical events.

Mteor 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in meteorology, permission of instructor.* No more than 9 credits in Mteor 490 may be counted toward graduation.
A. Synoptic Meteorology.
B. Dynamic Meteorology.
C. Physical Meteorology.
D. Instrumentation.
E. Hydrology.

Mteor 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Mteor 499. Senior Research. (2-0) Cr. 2. F. Required of all senior meteorology majors. Research projects in collaboration with faculty. Written and oral presentations of results at the end of the semester.

Courses primarily for graduate students, open to qualified undergraduate students

Mteor 502. Watershed Hydrology. (Dual-listed with 402). (Cross-listed with EnSci, Geol). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

Mteor 504. Global Change. (Dual-listed with 404). (Cross-listed with Agron, EnSci). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior, senior, or graduate standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change.

Mteor 505. Environmental Biophysics. (Dual-listed with 405). (Cross-listed with Agron, EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities. Semester project required.

Mteor 507. Mesoscale Meteorology. (Dual-listed with 407). (Cross-listed with Agron). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 166 and Mteor 454.* Gallus. The physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure. Semester project and in-class presentation required.

Mteor 511. Synoptic Meteorology. (Dual-listed with 411). (1-4) Cr. 3. F. *Prereq: Credit or enrollment in 454.* Current weather forecasting and discussion. Applications of atmospheric physics and dynamics in real-time weather situations. Use of UNIDATA computer products.

Mteor 517. Mesoscale Forecasting Laboratory. (Dual-listed with 417). (1-5) Cr. 3. S. *Prereq: Credit or enrollment in 411.* Real-time computer analysis of current weather, with emphasis on small-scale features. Studies of severe weather, lake-effect snow, CSI, cold-air damming.

Mteor 518. Microwave Remote Sensing. (Cross-listed with Agron, E E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 265 or equivalent or permission of instructor.* Hornbuckle. Microwave remote sensing of Earth's surface and atmosphere. Overview of relevant electromagnetic theory and antenna theory. Planck emission and the radiative transfer equation. The electrical properties of natural materials at microwave frequencies. Specific examples include remote sensing of atmospheric temperature and water vapor, precipitation, and soil and vegetation water content.

Mteor 542. Physical Meteorology. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 342, Math 266, Phys 222.* Planetary atmospheres, radiative equilibrium models, radiative transfer, the upper atmosphere, remote sounding from satellites.

Mteor 543. Advanced Dynamic Meteorology I. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 455.* The first half of a two semester sequence. Governing equations, scale analysis, simple types of wave motion in the atmosphere, instability theory.

Mteor 544. Advanced Dynamic Meteorology II. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 543.* Continuation of 543. General circulation and dynamics of zonally symmetric circulations, atmospheric energetics, nonlinear dynamics of planetary waves.

Mteor 552. Physics of Climate. (Dual-listed with 452). (3-0) Cr. 3. F. *Prereq: Mteor 301.* Exploration of the fundamental physical principles that govern the climate systems of the Earth and other planets. Emphasis on coupled, nonlinear-system interactions of physical processes such as circulation dynamics, radiative transfer, and cloud/precipitation physics, starting with fairly simple 0- and 1-dimensional analytical and numerical models based on energy, mass, and momentum conservation. Observational study of seasonally evolving weather patterns that form climates around the world.

Mteor 561. Geophysical Fluid Dynamics. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 455 or E M 378 or M E 335 or Phys 361.* Basic concept of rotating fluid dynamics, governing equations and boundary conditions, dynamics of vorticity, potential vorticity and geostrophic motion, wave motion in a rotating system, dynamics of Ekman and Stewartson layers, ocean circulation.

Mteor 571. History of Modern Meteorology. (Dual-listed with 471). (1-0) Cr. 1. Alt. S., offered 2010. *Prereq: Mteor 341, 342, 411, 443, 452.* Development of meteorological theories and numerical weather prediction, discoveries of important meteorological phenomena, and impact of weather and climate on important historical events.

Mteor 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics of current interest.
A. Boundary-layer Meteorology
B. Tropical Meteorology
C. Mesoscale Meteorology
D. Global Climate Systems
E. Climate Modeling
F. Numerical Weather Prediction
G. Satellite Observations
H. Statistical Methods in Meteorology
I. Field Observations
J. Low Frequency Modes
K. Cloud Physics
L. Atmospheric Radiation
M. Hydrology

Courses for graduate students

Mteor 605. Micrometeorology. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 443.* Atmospheric boundary layer, structure and dynamics. Turbulence, soil influences, measurements and empirical relations for wind and temperature profiles near the ground. Simulation of boundary layer structure and dynamics.

Mteor 699. Research. Cr. arr. Repeatable.

Gerontology

www.iastate.edu/~gerontology

(Interdepartmental Minor and Interinstitutional Program)

Advisory Committee: P. Martin, Director; L. Alekel, W. Franke, J. Lempers, Fred Lorenz, Jennifer Margrett, Mack Shelley, A. Smiley-Oyen, R. West

The gerontology program is designed for students desiring careers in aging-related fields and for students interested in improving their understanding of aging persons in American Society. Students are expected to take courses to develop the necessary interdisciplinary breadth which, in combination with other disciplinary training, can prepare them to work with older adults.

Graduates understand the ways in which individual and Societal aging influence, and are impacted by, developments in their major field of study. They have an appreciation and understanding of the cross-disciplinary aspects of human aging.

Gerontology courses are offered in the interdepartmental gerontology program in the following participating departments and programs: Architecture; Biochemistry, Biophysics, and Molecular Biology; Economics; Apparel, Educational Studies, and Hospitality Management, Food Science and Human Nutrition; Health and Human Performance; Human Development and Family Studies; Political Science; Psychology; and Sociology.

Undergraduate Study

Christine Cook, Coordinator

Undergraduate study in this program provides the student with an opportunity to develop a minor in gerontology. A balanced grouping of courses assists the student in developing both a sensitivity to the issues and the ability to synthesize ideas from the variety of disciplines important to the study of the aging process.

Undergraduate students may minor in gerontology by taking 16 semester hours of gerontology related courses. Nine of these credits must come from the following courses: Geron 373, 377, 378, 463. Students will participate in a prepracticum seminar, Geron 466, and will complete a supervised field practicum after all gerontology coursework is completed (Geron 467). A minimum of 3 semester credits must be selected from a list of supportive gerontology related courses. Supportive courses include units or topics related to aging and can be used to complement the student's major interests. The student's minor program must be approved by the undergraduate gerontology coordinator.

Graduate Study

Karen Bermann, Coordinator

A declared graduate minor in gerontology consists of a minimum of 12 credits taken from a list of acceptable courses, and from at least two departments. Nine of the 12 credits must be in courses that are focused specifically on aging. One 590 course (3 credits maximum) can be taken as part of the 12 credits. Geron 510 is required for all minor students. At least one member of the gerontology faculty will be on a student's advisory committee; this person must be a member of the Graduate Faculty. Contact the coordinator to determine whether courses other than those listed below are available.

Interinstitutional Program

Contact: Peter Martin

Participating Faculty:

Iowa State University
Gerontology Program
Peter Martin, pxmartin@iastate.edu
Christine Cook, cccook@iastate.edu
Jennifer Margrett, margrett@iastate.edu

Kansas State University
College of Arts and Sciences
Gayle Doll, gdoll@ksu.edu
Lyn Norris-Baker, lyn@ksu.edu

College of Human Ecology
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North Dakota State University
College of Human Development and Education
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Texas Tech University
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University of Missouri
Terasa Cooney. cooneyT@missouri.edu
Marilyn Coleman, ColemanMA@missouri.edu
Timothy Killian, TKillian@uark.edu

Gerontology is an interinstitutional distance education program offered through the Web. The student selects the home institution, which grants the degree. After admission at the home institution, the student takes courses from each of the six institutions: Iowa State University, Kansas State University, North Dakota State University, Oklahoma State University, Texas Tech University, and the University of Missouri.

At Iowa State University, gerontology is an area of specialization in the Master of Family and Consumer Sciences degree program of 36 semester hours, 24 of these hours are from the following courses: Geron 530, 534, 540, 545, 563, 577, 584, 594. The remaining 12 credits will include electives and specific courses needed to meet the requirements of the institution awarding the degree. Neither a thesis nor a creative component is required. A computer with a CD-ROM drive, the capacity to access and download materials from the Internet, and a browser equivalent to Netscape/Explorer 4.0 or newer are required for completing the program. An e-mail address is essential as well, plus access to a VCR and a FAX.

Gerontology Graduate Certificate Program

The 21-credit Graduate Certificate Program in Gerontology includes five courses from the list of core courses: Geron 530, 534, 540, 585, 594. The additional six credits required for the certificate can be chosen from the remaining core courses or from other approved elective courses. A maximum of three credits of practicum also can be included in the elective credits.

Admission Procedures: Admission to the Gerontology Certificate Program requires exactly the same procedures as admission to the Graduate College. See *Graduate College* section of the catalog.

Registration: Students choosing to receive their degree from Iowa State University complete all the admissions, registration, and fee payment processes through ISU.

Courses primarily for undergraduate students

Geron 373. Death as a Part of Living. (Cross-listed with HD FS). (3-0) Cr. 3. F.S.Alt. SS., offered 2010. *Prereq: HD FS 102.* Consideration of death in the life span of the individual and the family with opportunity for exploration of personal and Societal attitudes.

Geron 377. Aging and the Family. (Cross-listed with HD FS). (3-0) Cr. 3. *Prereq: HD FS 102.* Interchanges of the aged and their families. Emphasis on role changes, social interaction, and independence as influenced by health, finances, life styles, and community development.

Geron 378. Economics of Aging. (Cross-listed with Econ, HD FS). (3-0) Cr. 3. S. *Prereq: 3 credits in principles of economics and 3 credits in human development and family studies.* Economic Status of the aging, retirement planning and the retirement decision, role of Social Security, public transfer programs for the elderly, intrafamily transfers to/from the elderly, private pensions, financing medical care and housing for the elderly, prospects and issues for the future.

Geron 463. Environments for the Aging. (Dual-listed with 563). (Cross-listed with HD FS, ArtID). (3-0) Cr. 3. S. *Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies.* Emphasis on independent living within residential settings including specialized shelter, supportive services, and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities.

Geron 466. Gerontology Prepracticum Seminar. (1-0) Cr. 1. F.S.SS. *Prereq: 9 credits in core courses for the gerontology minor and approval of the gerontology undergraduate coordinator.* Prepracticum training for students planning a gerontology practicum. Exploration of possible agencies for the practicum, in-depth study of a selected agency, and development of goals and objectives for the practicum.

Geron 467. Gerontology Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: 466, advance reservation.* Supervised field experience related to aging. Satisfactory-fail only.

Geron 490. Independent Study. Cr. arr. Consult program coordinator for procedure.

Courses primarily for graduate students, open to qualified undergraduate students

Geron 501. Seminar. Cr. arr. Repeatable. F.S.SS.

Geron 510. Survey of Gerontology. Cr. arr. Repeatable. S. Provides an overview of important gerontological issues.

Geron 530. Perspectives in Gerontology. (Cross-listed with HD FS). (3-0) Cr. 3. F. WWW only. Overview of current aging issues including theory and research, critical social and political issues in aging, the interdisciplinary focus of gerontology, career opportunities, and aging in the future.

Geron 534. Adult Development. (Cross-listed with HD FS). (3-0) Cr. 3. F: on campus. S: WWW only. Exploration of the biological, psychological, and social factors associated with aging. Although the focus is on the later years, information is presented from a life-span developmental framework. Empirical studies are reviewed and their strengths, limitations and implications for normative and optimal functioning are discussed.

Geron 540. Nutrition and Physical Activity in Aging. (Cross-listed with Diet). (3-0) Cr. 3. Alt. F., offered 2010. WWW only. Basic physiologic changes during aging and their impacts in health and disease. The focus will be on successful aging with special emphasis on physical activity and nutrition. Practical application to community settings is addressed.

Geron 545. Economics, Public Policy, and Aging. (Cross-listed with HD FS). (3-0) Cr. 3. Alt. F., offered 2010. WWW only. Policy development in the context of the economic Status of the older adult population. Retirement planning and the retirement decisions; social security and public transfer programs; intra-family transfers to/from the aged; private pensions; financing medical care; prospects and issues for the future.

Geron 563. Environments for the Aging. (Dual-listed with 463). (Cross-listed with HD FS). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies.* Emphasis on independent living within residential settings including specialized shelter, supportive services and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities.

Geron 571. Design for All People. (Cross-listed with Arch, Dsn S). (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Principles and procedures of universal design in response to the varying ability level of users. Assessment and analysis of existing buildings and sites with respect to standards and details of accessibility for all people, including visually impaired, mentally impaired, and mobility restricted users. Design is neither a prerequisite nor a required part of the course. Enrollment open to students majoring in related disciplines. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Geron 577. Aging in the Family Setting. (Cross-listed with HD FS). (3-0) Cr. 3. *Prereq: 9 credits in social sciences.* Alt. S., offered 2008: on campus. Alt. S. offered 2009: WWW only. Theories and research related to personal and family adjustments in later life affecting older persons and their intergenerational relationships. Related issues including demographics also are examined through the use of current literature.

Geron 584. Program Evaluation and Research Methods in Gerontology. (Cross-listed with HD FS). (3-0) Cr. 3. Alt. SS., offered 2010. WWW only. Overview of program evaluation, research methods, and grant writing in gerontology. Includes application of quantitative and qualitative methods in professional settings.

Geron 590. Special Topics. Cr. arr. Repeatable. Consult program coordinator for procedure.

Geron 594. Professional Seminar in Gerontology. (Cross-listed with HD FS). (3-0) Cr. 3. Alt. SS., offered 2011. WWW only. An integrative experience for gerontology students designed to be taken near the end of the degree program. By applying knowledge gained in earlier coursework, students will strengthen skills in ethical decision-making behavior, applying these skills in gerontology-related areas such as advocacy, professionalism, family and workplace issues. Students from a variety of professions will bring their unique perspectives to bear on topics of common interest.

Global Resource Systems

www.globe.iastate.edu

Gail R. Nonnecke, Faculty Coordinator

Supervisory Committee: David Acker, Richard Hall, Arne Hallam, Jeffery Iles, Kendall Lamkey, Ruth MacDonald, and Robert Martin

Global Resource Systems is a cutting-edge, interdisciplinary, college-wide major that prepares students to make a difference in the world. This major is offered by the College of Agriculture and Life Sciences. The major emphasizes global and cross-cultural engagement while equipping students with a strong technical competency in a resource area of their choice. The interdisciplinary program is designed to prepare students to work on complex global resource issues through leadership positions in global businesses, governmental agencies engaged in international trade and development, non-governmental organizations and globally engaged foundations, educational institutions, and volunteer organizations. It aims to produce systemic thinkers and problem solvers with a global perspective who are trained in resource issues and able to lead teams representing high levels of cultural diversity. Students interested in this major are encouraged to contact the Faculty Coordinator at globe@iastate.edu.

Undergraduate Study

The Global Resource Systems undergraduate major employs a truly interdisciplinary and systemic approach to understanding complex global resource issues. The major allows students to develop a core set of technical competencies in a resource area selected from among the 23 minors and certificates offered by the College of Agriculture and Life Sciences. Students choose a world region in which to specialize, develop competency in a relevant world language, participate in a significant cross-cultural living and working immersion experience in their chosen world region, and carry out a senior project related to their resource specialization within the context of the world region.

Multidisciplinary themes will be developed in the context of the physical, biological and sociological factors affecting global resource systems. In this context, resource systems will include agricultural (including crops, livestock and aquaculture), food, fuel, natural, environmental, biological, financial, governmental, institutional, human, knowledge, and other resources. Graduates of this program will have developed transnational leadership skills and will be successful integrators of various specializations on a team. They will be skilled in developing a systemic perspective and accomplished at solving complex global resource systems problems.

Courses for undergraduate students

Globe 110. Orientation.. (1-0) Cr. 1. F. An introduction to Global Resource Systems (GRS) program, development of student and professional skills, participation in GRS Learning Community and service learning project.

Globe 201. Global Resource Systems. (3-0) Cr. 3. F.S. A comparative analysis of global resources and the various natural and human Systems affecting those resources.

Globe 211. Issues in Global Resource Systems. (1-0) Cr. 1. Repeatable. F.S. *Prereq: credit or enrollment in 201.* Discussion of topics of current importance in global resource systems. A maximum of 3 credits of 211 may be used towards degree requirements.

Globe 221. Apprenticeship. Cr. R. Repeatable. F.S.SS. *Prereq: Approval by the Global Resource Systems Faculty Coordinator.* Practical work experience in approved domestic or international settings such as with a company, research laboratory, governmental agency or non-governmental organization. Satisfactory-fail only.

Globe 290. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator.* Independent study on topics of special interest to the student. Comprehensive report required. Intended primarily for freshmen and sophomores. H. Honors

Globe 301. Resource Systems of Industrialized Nations. (2-2) Cr. 3. F. *Prereq: 201, Econ 101 or 102.* In-depth analysis of the opportunities, constraints and consequences of the resource systems common in industrialized nations. Topics integrate natural resources with land tenure, societal structure, food security, agriculture, shelter, energy and wealth dynamics.

Globe 302. Resource Systems of Developing Nations. (2-2) Cr. 3. S. *Prereq: 201, Econ 101 or 102.* In depth appraisal of resource systems common throughout the developing world. Topics integrate natural resources with land tenure, societal structure, food security, agriculture, shelter, energy and wealth dynamics.

Globe 321. Internship - Global. Cr. arr. Repeatable. *Prereq: Junior or Senior and enrollment in Global Resource Systems major; permission of the instructor and approval by the Global Resource Systems Faculty Coordinator.* A supervised learning experience including an analysis of an international location's resource system via immersion in a foreign culture lasting at least five weeks. The experience should focus on the region consistent with the student's degree track. A maximum of 12 credits of 321 and 322 may be used for degree requirements.

Globe 322. Internship - United States. Cr. arr. Repeatable. *Prereq: Junior or Senior and enrollment in Global Resource Systems major; permission of the instructor and approval by the Global Resource Systems Faculty Coordinator.* A supervised learning experience including an analysis of a domestic location's resource system via immersion in a different culture within the United States lasting at least five weeks. Designed for international students and for students who are not in a position to leave the United States. A maximum of 12 credits of 321 and 322 may be used for degree requirements.

Globe 401. Senior Project. Cr. 3. F.S. *Prereq: Senior classification in Global Resource Systems.* Research project in collaboration with faculty that complements and furthers a student's experiences from Globe 321 and 322 while simultaneously bringing into focus entire four-year experience. Student will write a research report and make either an oral or poster presentation
H. Honors

Globe 402. Responses to Global Resource System Challenges. (1-4) Cr. 3. S. Capstone analysis of critical challenges facing global resources and, especially, identification of alternative solutions.

Globe 446. International Issues and Challenges in Sustainable Development. (Cross-listed with Agron, IntSt). Cr. 4. S. *Prereq: 3-credit biology course, Sophomore or higher classification, permission of Instructor.* Mullen. Interdisciplinary study and analysis of agricultural, biophysical, environmental, sociological, economical, political, and historical factors affecting sustainable development of communities and countries from art and science perspectives. International field experience with foreign language training required. A program fee is charged to students for international study abroad.

Globe 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator.* Independent study on topics of special interest to the student. Comprehensive report required. Intended primarily for juniors and seniors. A maximum of 4 credits may be used for degree requirements.
E. Entrepreneurship
H. Honors
Z. Service Learning

Globe 495. Global Resource Systems Study Abroad Course Preparation. Cr. R. Repeatable. F.S. *Prereq: Permission of instructor.* Global resource systems topics will include the agricultural industries, climate, crops, culture, economics, food, geography, government, history, livestock, marketing, natural resources, public policies, soils, and preparation for travel to locations to be visited. Students enrolled in this course intend to register for Globe 496 or 497 the following term.

Globe 496. Global Resource Systems Study Abroad. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Extended field trips abroad to study global resource systems. Location and duration of trips will vary. Pre-trip sessions arranged through Globe 495. Trip expenses paid by students.

Globe 497. Deans Global Ag and Food Leadership Program. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* An integrated agricultural and food production and policy program that allows students to assess, analyze and evaluate complex, country-specific situations and to develop their skills, knowledge and abilities via team-oriented projects that involve complex issues such as development of effective foreign food aid and agricultural and food production systems, drivers of world hunger, sustainable resource management and efficacy of policy, and the role of the USA and the United Nations and other development agencies in these systems. International location and duration of program will vary. Pre-trip sessions arranged through Globe 495. Trip expenses paid by students.

Globe 499. Undergraduate Research. Cr. arr. F.S. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator.* Research projects in collaboration with faculty.

Graduate Studies

No major is granted in Graduate Studies. At the recommendation of the major professor and/or the department chair, graduate students may enroll in the following graduate courses to fulfill certain enrollment requirements.

Courses for graduate students

Gr St 585. Preparing Future Faculty Introductory Seminar. Cr. 1. *Prereq: One year of graduate course work; admission into PFF program.* Introduction to faculty life issues such as hiring, tenure, teaching, and service at a variety of higher education institutions. Includes presentations from faculty at other institutions.

Gr St 586. Preparing Future Faculty Intermediate Seminar. Cr. 1-3. *Prereq: Admission into PFF program; completion of 585 or permission of instructor.* Consideration of a wide range of faculty life issues. Includes topics such as higher education trends, diversity issues, learning styles, assessment, grant and proposal writing, and legal and ethical issues. Written components include job and teaching portfolios.

Gr St 587. Preparing Future Faculty Teaching Practicum. Cr. 1. *Prereq: Permission of instructor, 585, credit for or concurrent enrollment in 586.* Students complete a stand-alone teaching assignment at Iowa State or another higher education institution. Written components include pedagogical documents.

Gr St 588. Preparing Future Faculty Special Topics. Cr. 1-3. *Prereq: Permission of instructor, 585, credit for or concurrent enrollment in 586.* In-depth study of topic providing academic professional development.

Gr St 600. Examination Only. Cr. R. Reserved for graduate students the term they take the final oral examination. Students must have completed all required coursework and not be registered for another course.

Gr St 601. Required Enrollment. Cr. R. Reserved for graduate students who must be registered for a particular term, but are not required to take additional coursework.

Gr St 680. Doctoral Post Prelim (Continuous) Registration. Cr. R. Repeatable. Reserved for Ph.D. candidates only. See the Graduate College Handbook for specific requirements.

Gr St 697. Curricular Practical Training. Cr. R. Repeatable. F.S.SS. Professional work period.

History

www.history.iastate.edu/

Charles Dobbs, Chair of Department

University Professors (Emeritus): Schwieder

Professors: Adeleke, Cravens, Dobbs, Goedeken, Liu, Riney-Kehrberg, Wilson

Professors (Emeritus): Bennett, Dobson, Geiger, Keller, Kottman, Lowitt, Marcus, McJimsey, Plakans, Rawson, Schofield

Associate Professors: Andrews, Bix, Griffiths, Hollander, Monroe

Associate Professors (Emeritus): Avraamides, Pope, Whitaker

Assistant Professors: Bailey, Byars, Delcastillo, Hilliard, Houghtby, Sadosky

Assistant Professors (Emeritus): Madison, Osborn, Zaring

Assistant Professor (Adjunct): Schneider

Lecturer: Hill

The History department offers curricula leading to the B.A. and B.S. degrees in history, the M.A. degree in history, the M.A. and Ph.D. degrees in the history of technology and science, and the Ph.D. degree in agricultural history and rural studies.

The department offers a variety of survey courses (200 series) designed to serve primarily first- and second-year students as either general education courses or as introductions to advanced courses in history or other subject areas. In addition to 200-level survey courses, it offers advanced undergraduate courses in the history of Europe, Asia, Latin America, the United States, technology and science, agriculture, and other selected topics.

Undergraduate Study

The History major. For a description of the undergraduate curriculum with a major in History see *Liberal Arts and Sciences, Curriculum*. History majors may earn either a bachelor of arts or bachelor of science degree. The minimum required for a major in history is 36 credits, of which at least 24 must be in courses numbered 300 or above. Students may take a maximum of 12 credits at the 200-level, a maximum of 15 credits at the 300-level, and must take a minimum of 12 credits at the 400-level or above. A minimum of 15 credits numbered 300 or above must be taken in residence at Iowa State. Candidates for the B.A. must complete two years of university-level study in one foreign language or the equivalent.

Objectives for History Majors

1. Display the appropriate level of cognitive knowledge of historical themes and events based upon the student's course of study.
2. Display an understanding of past cultures and social organizations, based on the course of study.
3. Develop the fundamental methodological skills of the historical craft:
- The ability to contextualize and analyze primary source evidence.
- Familiarity with the concepts of historical argument and interpretation, and the ability to formulate effective argumentation in written and oral forms.
- Awareness of the basic historiography in selected research area.
- The ability to conduct research and to write a historical essay based upon primary and secondary source research.

4. Display a sophisticated understanding of the relationship between past events and the present.

For purposes of outcomes assessment, all History majors must complete three credits of History 495 or, if qualified and willing, one graduate level writing/research seminar.

Communication Proficiency requirement: History majors must receive a grade of C or better in each of Engl 150 and 250 (or 250H), and Hist 495 or any graduate seminar.

For a description of the major in History as preparation for professional programs, see *Preprofessional Study*. Students majoring in History may also earn a second major in International Studies; see *International Studies*.

Majors must distribute their courses across geographic and chronological areas such that they take at least 3 credits at the 300-level or above in five of the following six areas:

• U.S. history, European history, African/Asian/Latin American history

• Ancient history (pre-500), medieval and early-modern history (ca. 500-1750), and modern history (post-1750)

It is expected that individual courses will fulfill both a geographic and a chronological area. For example, a course on nineteenth century France would count as both European history and modern history. No single course, however, may be used to fulfill more than one geographic and one chronological area. If a course stretches significantly across two or more areas, students will select which geographic and/or which chronological area they want the course to fulfill. The History Department undergraduate adviser should be consulted as to which courses fulfill what areas. History 495 may not be used to fulfill any area.

The department offers a minor in History, which may be earned with 15 credits in History courses, of which at least 9 must be in courses numbered 300 or above, excluding Hist 490. A minimum of 9 credits numbered 300 or above must be taken at Iowa State. The College of Liberal Arts and Sciences requires students to earn a C or higher in at least 6 of the required 300-level credits. The History minor is most frequently chosen by students majoring in Political Science, English, Journalism, Computer Science, and Business.

Graduate Study

Graduate students may take any 400-level history course except 490 and 495 for graduate credit. No more than 12 credits of 400-level courses, however, may be used toward the minimum credits required for a graduate degree in history. Additional work is required for graduate credit in 400-level courses.

Most history graduate courses are either proseminars or seminars. Proseminars acquaint students with the historical literature of a field and prepare them for careers in teaching and research. Seminars require students to conduct original historical research and to write extensive research papers reporting the results.

The M.A. in history. For the M.A. in history, students may elect a thesis or a nonthesis program. See the departmental website on the M.A. in History for a full discussion of the options and requirements. An M.A. in History serves as the basis for continued study in history, as well as preparation for careers in law, education, business, and government service. For international students, a TOEFL score of 600 is required at the time of admission.

The M.A. and Ph.D. in history of technology and science. The graduate program in the history of technology and science examines the role of technology and science in the formation of modern Societies and their attitudes toward people and the world. The program is structured in a sequence of courses leading to the M.A. and Ph.D. degrees. Since these courses approach their subject in the context of social and cultural change, they are also open to and appropriate for students in engineering, the sciences, science education, and science journalism. For a thorough description of the program requirements, see the department's website on the history of technology and science program.

The Ph.D. in agricultural history and rural studies. The program is designed as a Ph.D. program, but students without an M.A. in history will be expected to qualify for the departmental M.A. in history while progressing toward the doctorate. In some cases, the M.A. may be recommended as the terminal degree. Thirty semester hours of graduate credit are required for the M.A. and 72 for the Ph.D. Students who continue beyond the M.A. are expected to pass preliminary examinations in four areas of specialization, complete a dissertation, and defend it orally in the Ph.D. final examination. See the departmental website on the program for a full description of requirements.

Courses primarily for undergraduate students

Hist 201. Introduction to Western Civilization I. (3-0) Cr. 3. F. Western civilization from ancient Mediterranean world to 1500. Social and cultural developments; economic and political ideas and institutions; problems of historical change and continuity.

Hist 202. Introduction to Western Civilization II. (3-0) Cr. 3. S. Western civilization from 1500 to present. Social and cultural developments; economic and political ideas and institutions; problems of historical change and continuity.

Hist 207. Chinese Civilization. (3-0) Cr. 3. Origins, development, decline and transformation of China from earliest times to present.

Hist 221. Survey of United States History I. (3-0) Cr. 3. F. Colonial foundations: revolution, confederation, and constitution; nationalism and democracy; sectional disunity, Civil War, and reunion.

Hist 222. Survey of United States History II. (3-0) Cr. 3. S. Industrialization; emergence as a great power; boom and depression; war, internationalism and Cold War; modern industrial Society.

Hist 245. Introduction to Latin American History. (3-0) Cr. 3. Latin America from pre-conquest times to the present. Economic, social, political, and cultural developments; problems of historical change and continuity.

Hist 280. Introduction to History of Science I. (3-0) Cr. 3. F. Ideas of nature from ancient Greece to the seventeenth-century scientific revolution.

Hist 281. Introduction to History of Science II. (3-0) Cr. 3. S. Science from seventeenth-century scientific revolution to Darwin and Einstein.

Hist 284. Wonders of the World, Ancient to Early Modern. (3-0) Cr. 3. F. Starting from the classical "Seven Wonders of the World," examines machines, structures, buildings, innovations, and technologies from Sumer, Egypt, Greece, and Rome, through China, Latin America, and the Islamic world, up to Europe's Industrial Revolution. Topics include developments in warfare and weaponry, architecture, agriculture, printing, religious ceremony, entertainment, and major engineering achievements.

Hist 285. Modern Wonders of the World. (3-0) Cr. 3. S. Examines machines, structures, buildings, innovations, and technologies from the Industrial Revolution to the twenty-first century, including the US, Europe, Asia, and Middle East. Topics include developments in manufacturing, communication, electrification, automobiles, airplanes, warfare, computers, the atom bomb, and major engineering achievements.

Hist 304. Cultural Heritage of the Ancient World. (Cross-listed with Cl St). (3-0) Cr. 3. *Prereq: Sophomore classification.* Historical examination of art, literature, thought, and religious beliefs of major civilizations of the ancient Mediterranean countries until the end of the 8th century.

Hist 305. Cultural Heritage of the Modern World. (3-0) Cr. 3. *Prereq: Sophomore classification.* Examination of parallel formal and structural elements in scientific and social thinking, technological design, and composition in literature and the arts from the late medieval period to the 20th century.

Hist 307. American Popular Culture. (3-0) Cr. 3. *Prereq: Sophomore classification.* Social practices, beliefs and material traits of everyday life in America from the mid-19th century to the present. Includes literature, music, theater and other entertainments. Dime novels, vaudeville, rock and roll music, Hollywood and establishment of professional athletic leagues are among the cultural artifacts and phenomena considered.

Hist 316. History of Medieval Europe, 300-1500. (3-0) Cr. 3. *Prereq: Sophomore classification.* Survey of political, social, and cultural developments in western Europe for the entire medieval period, 300-1500.

Hist 323. Science and Religion. (Cross-listed with Relig). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of changing interplay of science and religion in our understanding nature, from the trial of Galileo to the reception of Darwin.

Hist 325. Society and Politics in England, 1525-1700. (3-0) Cr. 3. *Prereq: Sophomore classification.* Social, cultural, demographic, and economic experiences. Religious Reformation. Growth of the State (and Empire) and political institutions.

Hist 336. History of Modern China I. (3-0) Cr. 3. *Prereq: Sophomore classification.* China from 1644 to 1912; internal and external stimuli on traditional structure leading to reform and revolution.

Hist 337. History of Modern China II. (3-0) Cr. 3. *Prereq: Sophomore classification.* China from 1912 to present; search for a new order and continuing Chinese revolution.

Hist 338. Modern Japanese History. (3-0) Cr. 3. *Prereq: Sophomore classification.* Japan 1600 to the present; emphasis on transformation of feudal Japan into a post-industrial Society.

Hist 339. US-Asian Relations. (3-0) Cr. 3. *Prereq: Sophomore classification.* A survey of US-East Asian (Japan, China, Korea) relations from the late 18th century to the end of the Cold War.

Hist 340. History of Latin America I. (3-0) Cr. 3. *Prereq: Sophomore classification.* Colonial Latin America from European discovery and colonization to wars for independence.

Hist 341. History of Latin America II. (3-0) Cr. 3. *Prereq: Sophomore classification.* Modern Latin America national origins from 1800 to present.

Hist 351. Social and Cultural History of American People I. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of ordinary Americans since 1800; development of Society; dissemination of popular ideas; living conditions, work, and play; the arts, music, architectural styles, material culture; rural and urban lifestyles; majority-minority and gender relations; religion, mass culture, corporations, and technology in modern times from 1800.

Hist 352. Social and Cultural History of American People II. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of ordinary Americans since 1900; development of Society; dissemination of popular ideas; living conditions, work, and play; the arts, music, architectural styles, material culture; rural and urban lifestyles; majority-minority and gender relations; religion, mass culture, corporations, and technology in modern times.

Hist 353. History of African Americans I. (Cross-listed with Af Am). (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines African roots of black culture and the African American experience in the United States from the colonial period through the Civil War. Topics include Atlantic Slave Trade, slavery and American identity, abolition, the emergence of Black Nationalism, and black participation in the Civil War.

Hist 354. History of African Americans II. (Cross-listed with Af Am). (3-0) Cr. 3. *Prereq: Sophomore classification.* Explores African American political thought and political action from Reconstruction to the present. Topics include rise of Jim Crow segregation, urban migration, Garvey movement, Harlem Renaissance, Depression and world wars, Pan-Africanism, civil rights, Black Power, and black feminism.

Hist 355. Slavery and the Crisis of Union. (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines causes and primary events of the sectional crisis over slavery leading up to the Civil War. Missouri Crisis through Presidential Election of 1860.

Hist 356. The U.S. Civil War and Reconstruction. (3-0) Cr. 3. *Prereq: Sophomore classification.* Political, military, and social aspects of the Civil War and Southern Reconstruction. Secession crisis through Reunion.

Hist 360. U.S. 1900 to 1945. (3-0) Cr. 3. *Prereq: Sophomore classification.* America in transition and crisis: Progressivism, World War I, the twenties, the Great Depression, and World War II.

Hist 361. U.S. 1945 to the Present. (3-0) Cr. 3. *Prereq: Sophomore classification.* From the Cold War to the Baby Boom to the liberal swing of the 1960s, back to the conservative counter-swing thereafter.

Hist 365. History of American Agriculture I. (3-0) Cr. 3. *Prereq: Sophomore classification.* American agricultural development from colonial times: European background, colonial period to 1865.

Hist 366. History of American Agriculture II. (3-0) Cr. 3. *Prereq: Sophomore classification.* American agricultural development from 1865 to present.

Hist 367. Topics in American Agriculture. (3-0) Cr. 3. *Prereq: Sophomore classification.* Thematic approach to the development of the American agricultural system. Topics vary; examples include food and agriculture, animals in agriculture, and systems of production.

Hist 370. History of Iowa. (3-0) Cr. 3. *Prereq: Sophomore classification.* Survey of major social, cultural, and economic developments in Iowa from the late 1700s. Emphasis on minority groups, pioneer life, early economic development, industrial development, educational and religious development, and outstanding personalities.

Hist 374. Women in the Ancient Mediterranean World. (Cross-listed with Cl St, W S). (3-0) Cr. 3. Repeatable. S. *Prereq: Any one course in Cl St, W S, Latin, or Greek.* Chronological and topical survey of the Status of women in the Ancient Mediterranean world; study of constructs of the female and the feminine. Readings from ancient and modern sources. Emphasis on either the Greek world and Hellenistic Egypt, or Hellenistic Egypt and Rome.
A. Hellenic World and Hellenistic Egypt
B. Roman World including Roman Egypt

Hist 376. Classical Archeology. (Cross-listed with Cl St, Relig). (3-0) Cr. 3. Repeatable. Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.
A. Bronze Age (Minoan and Mycenaean palatial cultures) and Early Iron Age Greece. (ca 3000-700 BC).
B. Archaic through Hellenistic Greece (ca 700-30 BC).

Hist 380. History of Women in Science, Technology, and Medicine. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of women's relationship to the fields of science, technology, and medicine, as students and professionals, consumers, subjects and patients, family members, workers and citizens. Concentrates especially on 19th and 20th century United States, concluding with an examination of current issues of special interest to women in science, technology, and medicine.

Hist 383. Technology, Public Science, and European Culture, 1715-Present. (3-0) Cr. 3. *Prereq: Sophomore classification.* A survey from the Age of Enlightenment to the end of the twentieth century of the relationship between science, technology, and public or popular culture in a comparative European context (including Russia and the former Soviet Union).

Hist 386. History of Women in America. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification.* A survey of social, economic, and political aspects of women's role from colonial era to present; emphasis on employment, education, concepts of sexuality, and changing nature of the home.

Hist 388. History of Modern Astronomy. (3-0) Cr. 3. *Prereq: Sophomore classification.* Changing conception of the universe from Galileo to Edwin Hubble and beyond.

Hist 389. American Military History. (3-0) Cr. 3. *Prereq: Sophomore classification.* American military history from the colonial wars to the present, including Revolutionary War, Mexican War, Civil War, First and Second World Wars, Korean War, Vietnam War, and Gulf Wars.

Hist 390. World Military History. (3-0) Cr. 3. *Prereq: Sophomore classification.* Covers military history from the Napoleonic era through the mid- and late-19th century wars, the First and Second World Wars, and wars of national liberation and regional conflicts since 1945.

Hist 391. American Diplomatic History. (3-0) Cr. 3. *Prereq: Sophomore classification.* A study of US foreign relations during the twentieth century, including the rise to global power, the First World War, diplomacy during prosperity and depression, the Second World War, the Cold War, relations with Latin America, East and South Asia, and Africa, the search for markets, and the perceptions of American foreign policy held by the US, its allies and adversaries, and others.

Hist 402. Greek Civilization. (Cross-listed with Cl St). (3-0) Cr. 3. *Prereq: Sophomore classification.* Ancient Greece from the Bronze Age to the Hellenistic period; evolution of the Greek polis and its cultural contributions, with a particular emphasis on the writings of Herodotus and Thucydides. Nonmajor graduate credit.

Hist 403. Roman Civilization. (Cross-listed with Cl St). (3-0) Cr. 3. *Prereq: Sophomore classification.* Ancient Rome from the Regal Period to the fall of the Western Empire; evolution of Roman institutions and Rome's cultural contributions studied through original sources. Nonmajor graduate credit.

Hist 404. Roman Social History. (Cross-listed with Cl St). (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines major topics in Roman social history during the late Republic and early Empire, such as class, family, slavery, religion, and the economy. Nonmajor graduate credit.

Hist 405. History of the Early Middle Ages. (3-0) Cr. 3. *Prereq: Sophomore classification.* General coverage of political, economic, social, and cultural developments in early medieval Europe, 300-1000; in depth coverage of particular issues and topics. Nonmajor graduate credit.

Hist 406. History of the High Middle Ages. (3-0) Cr. 3. *Prereq: Sophomore classification.* General coverage of political, economic, social, and cultural developments in high medieval Europe, 1000-1300; in-depth coverage of particular issues and topics. Nonmajor graduate credit.

Hist 408. Europe, 1500-1648. (3-0) Cr. 3. *Prereq: Sophomore classification.* Northern Renaissance; Church and Luther; Protestant reform and Roman-Catholic counter-reform; social, cultural, and economic changes; Spain in triumph and decline; religious wars and emergence of France. Nonmajor graduate credit.

Hist 414. European Cultural and Intellectual History. (3-0) Cr. 3. *Prereq: Sophomore classification.* A study of the development of key themes in European thought: nature, man, God, society, history, and creativity from Rousseau to Post-Modernism. Nonmajor graduate credit.

Hist 419. History of Modern France. (3-0) Cr. 3. *Prereq: Sophomore classification.* From absolutism to revolution and the rise of modern democracy. Nonmajor graduate credit.

Hist 420. France's Revolutionary Century, 1715-1815. (3-0) Cr. 3. *Prereq: Sophomore classification.* An in-depth investigation of the French Revolution, its causes and consequences, beginning in the Ancien Regime and ending with the fall of Napoleon. Nonmajor graduate credit.

Hist 421. History of Russia I. (3-0) Cr. 3. *Prereq: Sophomore classification.* Russia to 1850. Origins of Russian people; Byzantine influences; Mongol invasion; rise of Moscow; Westernization. Nonmajor graduate credit.

Hist 422. History of Russia II. (3-0) Cr. 3. *Prereq: Sophomore classification.* Russia since 1850. Reform and revolution; transformation of Society; USSR as a world power; recent changes. Nonmajor graduate credit.

Hist 424. History of Modern Germany. (3-0) Cr. 3. *Prereq: Sophomore classification.* Political, social, and cultural history of Germany from the 19th century to the present. Nonmajor graduate credit.

Hist 427. Crime and Policing in England 1550-1850. (3-0) Cr. 3. *Prereq: Sophomore classification.* Course examines different forms and ideas of criminality and the nature and development of law enforcement in England between 1550 and 1856. Significant issues will include the nature of criminal records and Statistics, the legal system, the politics of the law and its links with social relations, policing, female crime, juvenile delinquency, organized crime, riots, "social crime," and the treatment of crime in creative literary texts. Nonmajor graduate credit.

Hist 428. Punishment, Mentalities, and Society in England, 1550-1868. (3-0) Cr. 3. *Prereq: Sophomore classification.* Explores the history of punishing criminals in England and shows how interdisciplinary perspectives, ideas, and practices of punishment are related to mentalities, and Socio-economic change. Issues of significance examined: violence, civility, manners, madness, public punishment, execution, imprisonment, transportation, mercy, the rise of asylums, and penal reform. Nonmajor graduate credit.

Hist 429. "Monstrous London": London's Histories 1500-1800. (3-1) Cr. 4. *Prereq: Sophomore classification.* Study of London's social, economic, cultural, political, and environmental history 1500-1800, using both quantitative and qualitative methods to examine contemporary and secondary sources. Course combines standard lecture and discussion format with one week of intensive study abroad for 4th hour of course credit. Nonmajor graduate credit.

Hist 431. Modern England. (3-0) Cr. 3. *Prereq: Sophomore classification.* England since 1850. Parliamentary and constitutional development; social reform and economic change; imperial Britain; welfare state. Nonmajor graduate credit.

Hist 443. Science, Technology, and Medicine in Latin America. (3-0) Cr. 3. *Prereq: Sophomore classification.* Development of science, technology, and medicine in Latin America from pre-colonial times to the present. Themes include: intersection of science, medicine, and technology with colonization, impact of human populations on environments, formation of nation-states, spread of disease, and how perceptions of accepted scientific knowledge change over time. Nonmajor graduate credit.

Hist 450. Colonial America. (3-0) Cr. 3. *Prereq: Sophomore classification.* Exploration, colonization, and development of political, economic, religious, and cultural institutions of North American colonies before 1754. Topics also include social history, emergence of African-American Slavery, relations with American Indians. Nonmajor graduate credit.

Hist 451. American Revolutionary Era. (3-0) Cr. 3. *Prereq: Sophomore classification.* Participants, ideas, and events leading to independence and the foundation of the United States, 1754 to 1789. Topics include political, military, social, cultural history, also issues of gender and race relations. Nonmajor graduate credit.

Hist 456. American Family History. (3-0) Cr. 3. *Prereq: Sophomore classification.* The impact on American families from colonial times onward of agricultural change, industrialization, urbanization, and wars and depressions. Nonmajor graduate credit.

Hist 461. The Rural South. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of the American South from colonial period to present. Emphasis on economic, social, and political change in this rural region. Nonmajor graduate credit.

Hist 462. History of American Thought I. (3-0) Cr. 3. *Prereq: Sophomore classification.* American religious, social, and political thought; development of democracy and nationalism and of the arts and sciences from colonial times to late nineteenth century. Nonmajor graduate credit.

Hist 463. History of American Thought II. (3-0) Cr. 3. *Prereq: Sophomore classification.* Religious, social, and political thought; development of democracy and nationalism, the arts and sciences from late nineteenth century to modern and post-modern times. Nonmajor graduate credit.

Hist 464. Nineteenth Century America. (3-0) Cr. 3. *Prereq: Sophomore classification.* Development of the modern American Nation. Examines social, political, and institutional transformation wrought by modern industrial Society. Nonmajor graduate credit.

Hist 465. The American West. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of trans-Mississippi West from 1800 to present, concentrating on settlement and regional identity. Emphasis on the state, the environment, urbanization, agriculture, Native Americans, and minority communities. Nonmajor graduate credit.

Hist 466. Empires in North American. (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines imperial contests to claim and settle interior of North American continent from 15th to 19th century. Focuses on growth of Spanish empire, experiences of various Plains Indian nations, expansion of United States. Nonmajor graduate credit.

Hist 468. History of Rural America. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of rural America from the colonial period to the present. Emphasizes immigration, ethnicity, religion, social and cultural change, and agriculture in relation to rural settlement, institution building, demographic change, gender, class, and political and economic development. Nonmajor graduate credit.

Hist 472. U. S. Environmental History. (Cross-listed with Env S). (3-0) Cr. 3. *Prereq: Sophomore classification.* Survey of the interactions of human communities with the North American environment. Focus on the period from presettlement to the present, with a particular concentration on natural resources, disease, settlement patterns, land use, and conservation policies. Nonmajor graduate credit.

Hist 473. Civil Rights and Black Power. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of the civil rights and Black Power movements in the U.S. from World War II to the present. Topics include institutional foundations, leadership, gender dynamics, and the intersection of local grassroots organizing and national and international politics. Nonmajor graduate credit.

Hist 474. Tradition and Transformation of China's Foreign Affairs. (3-0) Cr. 3. *Prereq: Sophomore classification.* Evolution of China's external relations from the antiquities to our own times; conceptions, practices, and relationships that characterized the inter-state relations of the so-called "Chinese world order," interactions between "Eastern" and "Western," and "revolutionary" and "conventional" modes of international behaviors. Nonmajor graduate credit.

Hist 479. China and the Cold War. (3-0) Cr. 3. *Prereq: Sophomore classification.* Important events in China's Cold War involvement, connections between domestic and foreign affairs, factors and rationales in China's foreign policy making the relationship between China's Cold War experience and recent developments. Nonmajor graduate credit.

Hist 482. Birth, Death, Medicine, and Disease. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of medicine, sickness, and public health from ancient times to the twenty-first century in the US, Europe, and around the world. Topics include changing ideas of health and illness, development of doctors and hospitals, social and ethical issues in health care, and epidemics from cholera to AIDS. Nonmajor graduate credit.

Hist 483. Modern Science and Human Nature. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of the sciences of humankind since the 18th century: evolutionary natural and social science, the modern social sciences; anthropology, psychology, economics, law, psychiatry, human growth and development, political science, city planning, public administration, business administration, among others, and the uses of the human Sciences in education, politics, advertising, corporate functioning, warfare, psychotherapy, childrearing, and other pursuits in modern times, as well as the impact of postmodernism on the human Sciences. Nonmajor graduate credit.

Hist 486. History of Medicine, Gender, and the Body. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of medicine, history of science, and women's history combine for an intensive examination of topics related to health, the body, and medical care over the centuries. Topics include gender and sexuality, reproduction, historical interpretations of gender differences, and the politics of women's health. Nonmajor graduate credit.

Hist 488. American Stuff, Colonial Times to the Present. (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines inventions, machines, innovations, artifacts, and material culture in the US, from homespun cloth and the Colt revolver through the transcontinental railroad and Model T, to the Big Mac and iPod. Nonmajor graduate credit.

Hist 489. History of American Science. (3-0) Cr. 3. *Prereq: Sophomore classification.* Science as a cultural and social activity in America from the eighteenth century to present. Scientific discovery; interaction of scientific and social ideas; science and war; science and health, environment; role of science as expertise in a nationalistic democracy. Nonmajor graduate credit.

Hist 490. Independent Study. (3-0) Cr. arr. Repeatable. *Prereq: 9 credits in history; permission of department chair.* Reading and reports on problems selected in conference with each student. No more than 6 credits of Hist 490 may be counted toward graduation with a major in History. No credits of Hist 490 may count toward a minor in History.

Hist 495. Historiography and Research Writing. (3-0) Cr. 3. F.S. *Prereq: Senior history majors with at least 12 credits of 300+ level history courses.* Variable topics seminar that focuses on historiographical and research skills and writing. Required of majors.

Courses primarily for graduate students, open to qualified undergraduate students

Hist 510. Proseminar in East Asian History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Readings in East Asian history. Topics vary each time offered.

Hist 511. Proseminar in American History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Readings in American history. Topics vary each time offered.
A. Colonial Period
B. Nineteenth Century
C. Twentieth Century
D. Environment
E. Social and Cultural

Hist 512. Proseminar in European History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Readings in European history.
A. Ancient (Same as Cl St 512A)
B. Medieval
C. Modern

Hist 513. Proseminar in Latin American History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Readings in Latin American history. Topics vary each time offered.

Hist 530. Proseminar in Modern Russian/Soviet History. (3-0) Cr. 3. Repeatable. *Prereq: Hist 422.* Readings in modern Russian history. Topics vary each time offered.

Hist 550. Proseminar in European Rural and Agricultural History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.*
A. Modern European Rural Life
B. Twentieth Century Europe

Hist 552. Proseminar in American Rural and Agricultural History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.*
A. American Agriculture
B. Agrarian Reform Movements
C. Midwestern Rural Society
D. Women in Rural Life

Hist 570. Seminar in General History of Science I. (3-0) Cr. 3. *Prereq: Permission of instructor.* The history of science from pre-classical civilizations to the Age of Isaac Newton with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research.

Hist 571. Seminar in General History of Science II. (3-0) Cr. 3. *Prereq: Permission of instructor.* The history of science from Isaac Newton to modern times, with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research.

Hist 575. Seminar in General History of Technology. (3-0) Cr. 3. *Prereq: Permission of instructor.* The history of technology from the 11th century to the present, with emphasis on the historical literature, differing interpretations of major problems, and problems identified for college-level teaching and for further scholarly research.

Hist 576. Colloquium in Historiography of Technology and Science. Cr. R. F. Topical lectures, reports, and discussion of methodology and research in history of technology and science. Required of all graduate students in history of technology and science program.

Hist 580. Museum or Archive Internship. (3-0) Cr. arr. *Prereq: 15 graduate credits in history and permission of instructor.* Introduction to work and research in either a museum or archive setting.

Hist 583. Historical Methods. (3-0) Cr. 3. Study of evidence, theory, and methods.
A. Historical Narrative
B. Statistical Evidence and Analysis

Hist 585. Teaching Methods. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics vary each time offered.

Hist 586. Proseminar in Women's History and Feminist Theory. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Permission of instructor.* Feminist theory from the 1960s to the present as it relates to the writing of women's history. Analysis of interpretations of U.S. women's history from patriarchal to postmodernist perspectives.

Hist 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

Hist 592. Seminar in East Asian History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Topics vary each time offered.

Hist 593. Seminar in American History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Topics vary each time offered.
A. Colonial Period
B. Nineteenth Century
C. Twentieth Century
D. Environmental

Hist 594. Seminar in European History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Topics vary each time offered.
A. Ancient (Same as Cl St 594A)
B. Medieval
C. Modern

Courses for graduate students

Hist 602. Seminar on History of Science and Technology. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Emphasis varies each time offered.

Hist 610. Seminar on American Rural Life. (3-0) Cr. 3. *Prereq: Permission of instructor.* Emphasis varies each time offered.

Hist 699. Research. Cr. arr. Repeatable. Graduate student thesis research.

Honors Program

http://www.honors.iastate.edu/

Susan Yager, Chair, University Honors Committee

The Honors Program provides a vehicle for highly motivated and able students to pursue an innovative and challenging undergraduate education. Oversight of students' progress toward this goal is primarily the responsibility of the undergraduate colleges, each of which operates its own Honors Program. The college Honors Program committees admit students into the Program, approve programs of study, and are responsible for the administration of their college Honors Program. The University Honors Program Committee, which includes the chairs of the college Programs, is responsible for the general coordination of the college Honors Programs and the First-year Honors Program.

Students in the Honors Program are offered a variety of academic opportunities designed to help them derive the fullest benefit from their undergraduate education. To enhance their individualized programs of study, students are offered numerous Honors courses, seminars, and independent research opportunities.

Honors courses and Honors sections of regular courses are offered by several departments and programs. These courses, open only to Honors Program members, have limited enrollment and are taught by specially selected instructors. Most of these courses are listed by department or program. (See *Economics, Engineering, English, Mathematics, Physics, Psychology, and Speech Communication*.)

In addition to established Honors courses, Honors students may designate any course as an Honors course by making appropriate arrangements with the course instructor and obtaining approval of the Honors Program Director. Most departments offer opportunities for independent study and research under 290 and 490; when designated by an H, these courses also carry Honors credit.

Research grants are available to support Honors research.

Listed below are those courses that are offered directly by the University Honors Program. Specific information about the full range of Honors courses and seminars for the current academic year, including the Honors courses offered by individual departments and programs, may be obtained from the Honors Program Office in Jischke Honors Building.

Courses primarily for undergraduate students

Hon 121. First-Year Honors Seminar. (0-2) Cr. 1. F. *Prereq: Membership in the First-year Honors Program.* Orientation to Iowa State University and to the University Honors Program. Satisfactory-fail only.

Hon 290. Special Problems. Cr. arr. *Prereq: Membership in and permission of the University Honors Program.* Independent study on topics of an interdisciplinary nature. Intended primarily for freshmen and sophomores. Satisfactory-fail only.
H. Honors.
U. Undergraduate Research

Hon 302. Honors Leadership Seminar. (1-2) Cr. 2. F. *Prereq: Selection as a leader of a First-year Honors Seminar. For students* serving as leaders of First-year Honors Seminars, under faculty supervision. Development of teaching and leadership skills within the context of an Honors education experience. Satisfactory-fail only.

Hon 321. University Honors Seminars. Cr. arr. F.S.SS. *Prereq: Membership in the University Honors Program.* Interdisciplinary seminars on topics to be announced in advance. Satisfactory-fail only.

Hon 322. University Honors Seminars. Cr. arr. F.S.SS. *Prereq: Membership in the University Honors Program.* Interdisciplinary seminars on topics to be announced in advance. Satisfactory-fail only.

Hon 323. University Honors Seminars. Cr. arr. F.S.SS. *Prereq: Membership in the University Honors Program.* Interdisciplinary seminars on topics to be announced in advance. Satisfactory-fail only.

Hon 324. University Honors Seminars. Cr. arr. F.S.SS. *Prereq: Membership in the University Honors Program.* Interdisciplinary seminars on topics to be announced in advance. Satisfactory-fail only.

Hon 490. Independent Study. Cr. arr. Repeatable. *Prereq: Membership in and permission of the University Honors Program.* Independent study on topics of an interdisciplinary nature. Intended primarily for juniors and seniors.

Horticulture

www.hort.iastate.edu

Jeffery Iles, Chair of Department

University Professors: Christians, Nonnecke

Professors: Arora, Domoto, Gleason, Graves, Hannapel, Iles, Minner, Taber

Professors (Emeritus): Chaplin, Hall, Hodges

Professor (Collaborator): Yadav

Associate Professors: Delate, Fei, Gladon, Haynes, Stephens, VanDerZanden

Associate Professors (Collaborators): Beeson, Krebs

Assistant Professor: Reinert

Assistant Professors (Collaborators): Sharma, Widrlechner

Senior Lecturers: Osborn, Rollenhagen

Lecturer: Nilles

Undergraduate Study

For undergraduate curriculum in Horticulture leading to the Bachelor of Science degree, see *Horticulture, Curriculum*.

To meet the educational needs of a student population with interests ranging from landscape design/installation to fruit and vegetable production to golf course construction and management, considerable flexibility is built into the Horticulture curriculum. And the diversity of interests and need for flexibility is reflected in our impressive array of Horticulture courses.

The Department of Horticulture offers nine options within the Horticulture major; (1) Environmental Horticulture, (2) Greenhouse Production and Management, (3) Fruit & Vegetable Production and Management, (4) Horticultural Communications and Public Education, (5) Nursery Crops Production and Garden Center Management, (6) Landscape Design, Installation and Management, (7) Public Garden Management and Administration, (8) Science, and (9) Turfgrass Management. Students considering graduate degrees should participate in the Science option.

Graduates possess the technical knowledge and skills to become professional Horticulturists. They understand plant growth and development and are familiar with cultural and management principles for a wide assortment of Horticultural crops. They are able to work and communicate effectively with fellow Horticultural professionals and with ordinary citizens who share an interest in Horticulture. Graduates also understand the ethical and environmental dimensions of problems and issues facing Horticultural professionals.

A degree in Horticulture opens the door to employment opportunities with production nurseries, seed companies, interior landscaping firms, greenhouses, garden centers, conservatories, landscape design/installation firms, public gardens and arboreta, orchards and vineyards, food processing companies, vegetable farms, golf courses, sports fields, sod production companies and lawn care businesses. Several industries closely related to Horticulture provide employment opportunities in the areas of sales, management, and communication. Opportunities also exist for careers in research, teaching, and business after obtaining advanced training in graduate school.

Undergraduate students have the option of selecting a secondary major in one of several interdepartmental programs including, seed science, agricultural education, environmental studies, or international agriculture (see *Index*).

The Department of Horticulture offers work for a minor in Horticulture that is earned by taking Hort 221 plus 12 additional credits with a maximum of 3 credits at the 200-level and a minimum of 9 credits at the 300-level or above.

Visit our departmental website at www.hort.iastate.edu

Graduate Study

The graduate major in Horticulture leads to the M.S. (thesis required) and Ph.D. A nonthesis master's degree is offered through the master of agriculture program. Some faculty members of the department serve as major professors for students in interdepartmental graduate majors in plant biology; genetics; molecular, cellular, and developmental biology; ecology and evolutionary biology; sustainable agriculture; and environmental science.

Graduate students majoring in Horticulture usually take minor course work in Agronomy, botany (cytology, morphology, or physiology), biochemistry, chemistry, entomology, food science and human nutrition, genetics, plant pathology, or Statistics. There is no uniform foreign language requirement for the Master of Science or Doctor of Philosophy degree.

Graduates possess a broad understanding of horticulture and the allied plant sciences. They are able to communicate effectively with members of the scientific community, industry groups, and other interested citizens. They are experienced in conducting research and communicating the results from that research. They are capable of addressing and solving complex problems that confront the many Horticultural, agricultural and plant science professions. They also understand the ethical, legal, social, and environmental issues associated with modern agricultural/horticultural practices.

Courses primarily for undergraduate students

Hort 110. Orientation in Horticulture. (1-0) Cr. 1. F. Introduction to the field of Horticulture.

Hort 112. Orientation to Learning and Productive Team Membership. (Cross-listed with Aer E, FS HN, TSM, NREM). (2-0) Cr. 2. F. Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

Hort 114. Developing Responsible Learners and Effective Leaders. (Cross-listed with NREM, FS HN, TSM). (2-0) Cr. 2. S. Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

Hort 121. Home Horticulture. (2-0) Cr. 2. F.S. Growing plants in and around the home including requirements for growing house plants; plant propagation; designing and maintaining flower, fruit, and vegetable gardens; lawn, tree, and shrub maintenance.

Hort 122. Hands-On Home Horticulture. (1-0) Cr. 1. F.S. Demonstration and activities that illustrate principles of growing plants for the home garden. Topics include plant identification, propagation, selection, and management for indoor and outdoor gardens.

Hort 193. Topics in Horticulture. Cr. arr. Repeatable. F.S.SS. Off Campus. Offered as demand warrants. Includes practical courses in the field of Horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.
A. Greenhouse Crops
B. Nursery Crops
C. Turfgrass
D. Fruit Crops
E. Vegetable Crops
F. Cross-Commodity
G. Landscape Horticulture

Hort 221. Principles of Horticulture. (2-2) Cr. 3. F.S. *Prereq: Biol 211.* Biological principles of growing Horticultural crops including anatomy, reproduction, light, temperature, water, nutrition, and growth and development. Laboratory exercises emphasize environmental factors and permit detailed observation of plant growth.

Hort 233. Foliage Plants for Interiorscapes. (2-2) Cr. 3. F. *Prereq: 221.* Identification, nomenclature, selection and culture of foliage plants for interior landscapes. Planning, cost-estimating, installation, and maintenance of foliage plants and flowering potted plants in homes, offices, and public buildings.

Hort 240. Trees, Shrubs, and Woody Vines for Landscaping. (3-0) Cr. 3. F. Students will learn to identify trees, shrubs, and woody vines. Factors influencing the horticultural use of woody plants also will be taught.

Hort 280. Landscape Graphics. (3-0) Cr. 3. S. Introduction to computer and hand rendering techniques of landscape graphics. Students will gain proficiency in plan view, section and elevation graphics. Intensive studio and computer based instruction.

Hort 282. Educating Youth Through Horticulture. (2-3) Cr. 3. Alt. S., offered 2010. Planning, developing, and implementing science-based educational programs in a public garden setting. Through hands-on experiences students will learn about Horticulture, learning theory, and the application of science principles as they pertain to educating youth.

Hort 283. Pesticide Application Certification. (Cross-listed with Ent, for, Agron). (2-0) Cr. 2. S. Holscher. Core background and specialty topics in agricultural, and Horticultural pesticide applicator certification. Students can Select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

Hort 321. Horticulture Physiology. (3-0) Cr. 3. F. *Prereq: 221 or Biol 211.* Principles of plant physiology relating to growth and development of Horticultural plants including plant water relations, membrane transport, photosynthesis, photomorphogenesis, respiration, and phytohormones. Emphasis on plant's responses to environmental factors (temperature, water, and light) including cellular and whole-plant physiology under stressful environments.

Hort 322. Plant Propagation. (2-2) Cr. 3. S. *Prereq: 221 or Biol 212.* Fundamental principles underlying sexual and asexual propagation of plants; practice in reproducing plants by use of seeds, leaves, stems, and roots.

Hort 330. Herbaceous Ornamental Plants. (2-2) Cr. 3. F. *Prereq: 221 or by permission of instructor.* Identification, botanical characteristics, origins, propagation, uses and general culture of herbaceous annual and perennial plants for Midwestern gardens and landscapes.

Hort 332. Greenhouse Operation and Management. (3-3) Cr. 4. S. *Prereq: 221.* Principles of greenhouse and other controlled environment operation and management. Methods of monitoring and manipulating environmental factors such as light, temperature, fertility, production media, etc., to maximize production rate and quality and minimize production costs and time. Field trip(s) outside scheduled class time required. Nonmajor graduate credit.

Hort 338. Seed Science and Technology. (Cross-listed with Agron). (2-3) Cr. 3. F. *Prereq: Agron 114 or Hort 221, Biol 211.* Goggi. Seed production, maturation, dormancy, vigor, deterioration, and related aspects of enhancement, conditioning, storage, and quality evaluation. Aspects of the seed industry and regulation of seed marketing.

Hort 341. Woody Plant Cultivars: Shade Trees. (1-0) Cr. 1. S. *Prereq: 240 or L A 221 or L A 222.* Students will learn how to identify and care for the most Horticulturally important shade tree taxa suitable for the Midwest. Cultivars of the most prevalent species also will be taught.

Hort 342. Landscape Installation and Establishment. (2-3) Cr. 3. F. *Prereq: 240 or L A 221 or L A 222.* Principles and practices involved with establishment of managed landscapes. Laboratory work involves site evaluation, installation techniques, postplant care, and maintenance of established landscape plants.

Hort 351. Turfgrass Establishment and Management. (Cross-listed with Agron). (3-0) Cr. 3. F. *Prereq: 221 or Agron 114 or Biol 211.* Principles and practices of turfgrass propagation, establishment, and management. Specialized practices relative to professional lawn care, golf courses, athletic fields, highway roadsides, and seed and sod production. The biology and control of turfgrass pests. Nonmajor graduate credit.

Hort 351L. Turfgrass Establishment and Management Laboratory. (Cross-listed with Agron). (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 351.* Those enrolled in the Horticulture curriculum are required to take 351L in conjunction with 351 except by permission of the instructor. Nonmajor graduate credit.

Hort 354. Soils and Plant Growth. (Cross-listed with Agron). (3-0) Cr. 3. F.S. *Prereq: Biol 101 or 211.* Killorn or Loynachan. Effects of chemical, physical, and biological properties of soils on plant growth, with emphasis on nutritive elements, pH, organic matter maintenance, and rooting development. Nonmajor graduate credit.

Hort 354L. Soils and Plant Growth Laboratory. (Cross-listed with Agron). (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 354.* Henning. Laboratory exercises in soil testing that assess a soil's ability to support nutritive requirements for plant growth.

Hort 380. Principles of Garden Composition. (2-0) Cr. 2. S. *Prereq: 240.* Not available as credit for L A majors. Functional and aesthetic aspects of landscape planning as a basis for design decisions; emphasis on plant selection. Includes site analysis, development process, and design principles.

Hort 381. Beginning Garden Composition Studio. (0-4) Cr. 2. S. *Prereq: 240, 330.* To be taken concurrently with 380. Not available as credit for L A majors. Development of landscape graphic techniques. Studio-based projects implementing principles of landscape design.

Hort 391. Horticultural Management Experience. Cr. 1. Repeatable. F.S.SS. *Prereq: 221, permission of instructor.* A structured work experience for the student to gain insight into management operations associated with production and management of Horticultural crops. A report of 10 or more pages describing the student's experience is required. One credit is given for each term the student is enrolled in the course. A maximum of two credits may be used toward the Horticultural sciences course requirements, and two additional credits may be used toward the 128 credits required for graduation.

Hort 398. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of department resource and career center coordinator.* Students must register for this course before commencing each work period.

Hort 421. Introduction to Plant Breeding. (Cross-listed with Agron). (3-0) Cr. 3. F. *Prereq: Gen 320 or Biol 313.* Breeding methods used in the genetic improvement of self-pollinated, cross-pollinated, and asexually reproduced Agronomic and Horticultural crops. Applications of biotechnology techniques in the development of improved cultivars. Nonmajor graduate credit.

Hort 422. Postharvest Technology. (3-3) Cr. 4. Alt. F., offered 2009. *Prereq: 221, junior or senior classification.* Principles, methods, and techniques related to postharvest maintenance of quality of Horticultural commodities. Emphasis on the effects of handling, storage facilities and techniques, and quality evaluation. Field trips outside scheduled class time required. Weekend/overnight field trips may be required. Nonmajor graduate credit.

Hort 423. Plant Tissue, Cell, and Protoplast Culture. (Dual-listed with 523). (2-0) Cr. 2. Alt. F., offered 2009. *Prereq: Biol 313 and Hort 321 or Biol 330.* Theory and techniques of plant tissue culture, including organogenesis, somatic embryogenesis, micropropagation, anther and embryo culture, protoplast isolation and culture, and transformation. Applications to agriculture.

Hort 424. Sustainable and Environmental Horticulture Systems. (Dual-listed with 524). (Cross-listed with Env S). (2-0) Cr. 2. F. Inquiry into ethical issues and environmental consequences of Horticultural cropping systems and production practices. Emphasis on production systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

Hort 434. Greenhouse Crop Production I. (3-3) Cr. 4. Alt. F., offered 2009. *Prereq: 330 and 332.* Principles and practices of greenhouse floricultural crop production. Emphasis is placed on production of common bulbous, cut flower, foliage, and containerized flowering species produced in greenhouses and other controlled environments. Field trips outside scheduled class time required. Weekend/overnight field trips may be required. Nonmajor graduate credit.

Hort 435. Greenhouse Crop Production II. (2-3) Cr. 3. Alt. S., offered 2010. *Prereq: 330 and 332.* Principles and practices of greenhouse floricultural crop production. Emphasis is placed on production of flowering annual and perennial crops, vegetative annuals, and species in hanging baskets. Field trips outside scheduled class time required. Weekend/overnight field trips may be required. Nonmajor graduate credit.

Hort 442. Nursery Production and Management. (2-0) Cr. 2. Alt. F., offered 2009. *Prereq: 221.* Theory, nursery layout and design, and cultural practices important for growing and shipping field and container-grown nursery crops. Overview of garden center design and retailing and marketing strategies. Field trip(s) outside scheduled class time may be required. Nonmajor graduate credit.

Hort 444. Landscape Construction. (2-3) Cr. 3. F. *Prereq: 240, junior or senior classification.* Principles and practices of residential landscape construction. Encompasses process from initial client contact, materials procurement, job sequencing, and installation of plant material and hardscapes. Laboratory work involves site evaluation and measurement and landscape installation using various landscape materials and techniques.

Hort 445. Horticulture Management and Administration. (2-0) Cr. 2. F. *Prereq: 221, junior or senior classification.* In-depth presentation and discussion of skills and strategies needed to manage a Horticultural enterprise. Topics include motivating employees, managing meetings, conducting performance appraisals, dealing with conflict, and managing an increasingly diverse work force.

Hort 446. Landscape Contracting and Estimating. (2-0) Cr. 2. F. *Prereq: 240 and credit or enrollment in 342; junior or senior classification.* Overview and implementation of landscape estimating and contracting. Includes estimating procedures (material, labor, equipment) and landscape business issues (contracts, insurance, personnel).

Hort 451. Professional Turfgrass Management. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 351.* Turfgrass science including the study of (1) specific information on soil chemistry and soil modification as they relate to the development and maintenance of turfgrass areas, (2) specialized management practices used in athletic field care, professional lawn care, and golf course industries, and (3) construction methods for golf courses and sports fields. Nonmajor graduate credit.

Hort 452. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 552). (Cross-listed with Pl P, Ent). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Hort 453. Sports Turf Management. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 351.* Management techniques for today's specialized athletic fields. The Horticultural and budgetary aspects of football, soccer, baseball, and softball fields will be presented. Field trips and laboratory exercises will develop a practical understanding of actual principles in field development, construction, and management. Nonmajor graduate credit.

Hort 454. Turf & Landscape Irrigation. (3-0) Cr. 3. Alt. F., offered 2009. Irrigation systems and principles for turf and landscape environments. Topics include design, installation, equipment, management, and trouble shooting of irrigation systems for golf, athletic fields, residential lawns and landscapes. Participation in practical exercises and local field trips to irrigation sites are required.

Hort 461. Fruit and Nut Crop Production and Management. (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 221.* Principles and practices of small fruit, tree fruit, and nut culture and production. Morphology, physiology of growth and development, plant establishment, pest management, pruning, training, harvesting, storage, and marketing. Emphasis on sustainable practices. Participation in practical exercises and local field trips is required. Nonmajor graduate credit.

Hort 471. Vegetable Production and Management. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 221 or Agron 114 and Agron 154 or 155.* Principles of vegetable production with emphasis on sustainable practices, market outlets, business aspects, and risk management. Organic techniques will be discussed. Major crop climatic conditions, physiological growth and development, harvesting, storage, and marketing. Nonmajor graduate credit.

Hort 471L. Vegetable Production and Management Laboratory. (0-2) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in Hort 471 is required, except by permission of the instructor.* Sequence planting techniques, seed and seedling identification, seed germination quality and requirements, earliness techniques, irrigation management, fertilizer and compost application, postharvest handling, high tunnel production, and pesticide application will be covered. Field trip required. Some laboratory projects will require time outside the regular scheduled class period. Nonmajor graduate credit.

Hort 475. Urban Forestry. (Cross-listed with For). (2-3) Cr. 3. F. *Prereq: Junior or senior classification, 3 credits in biology.* Discussion of establishment and management of woody perennials in community-owned urban greenspaces, consideration of urban Site and soil characteristics, plant physiology, plant culture, urban forest valuation, inventory methods, species selection, and urban forest maintenance (health care and pest management). Nonmajor graduate credit.

Hort 480. Contemporary Issues in the Green Industry. (3-0) Cr. 3. S. *Prereq: junior or senior classification.* Analysis and evaluation of contemporary issues facing the green industry including environmental regulations, labor, market share, landscape contracting business management and professionalism. Discussion format and interaction with green industry professionals.

Hort 481. Advanced Garden Composition. (0-5) Cr. 3. F. *Prereq: 240, 330, 380, 381.* Limited to Planting Design/Installation option students. Development of residential landscapes using design principles and the design process. Projects encompass site analysis, concept development, preliminary design, final design, and graphic presentation techniques. Techniques will include hand and computer rendering.

Hort 484. Organic Agricultural Theory and Practice. (Dual-listed with 584). (Cross-listed with Agron). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 9 cr in biological or physical sciences.* Delate & DeWitt. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and Socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

Hort 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or Senior classification in Horticulture, permission of instructor.* Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.
A. Greenhouse Crops
B. Nursery Crops
C. Turfgrass
D. Fruit Crops
E. Vegetable Crops
F. Cross-Commodity
G. Landscape Horticulture
H. Honors
I. International Study
J. Entrepreneurship
Z. Service Learning

Hort 491. Seed Science Internship Experience. (Cross-listed with Agron, TSM). Cr. arr. Repeatable. F.S.SS. *Prereq: Agron 338, advanced approval and participation of employer and instructor.* A professional work experience and creative project for seed science secondary majors. The project requires prior approval and participation of the employer and instructor. The student must submit a written report.

Hort 493. Workshop in Horticulture. Cr. arr. Repeatable. Off campus. Offered as demand warrants. Workshops in Horticulture. Nonmajor graduate credit.

Hort 495. Horticulture Travel Course Preparation. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Limited enrollment. Students enrolled in this course also intend to register for Hort 496 the following term. Topics include preparation for safe international travel, the Horticultural/agricultural industries, climate, crops, economics, geography, history, marketing, soils, culture, traditions, and Horticultural/agricultural development of the country to be visited. Students enroll in this course the term immediately before travel to the foreign country.

Hort 496. Horticulture Travel Course. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Limited enrollment. Study and tour of production methods in major Horticultural regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, cultures, and history of Horticultural crops. Location and duration of tours will vary. Tour expenses paid by students.

Hort 497. Professional Development Seminar. (1-0) Cr. 1. S. *Prereq: Junior or senior classification.* Weekly series of lectures and workshops will help students better prepare for their professional career in Horticulture by developing the professional skills necessary to be successful in today's competitive workplace.

Courses primarily for graduate students, open to qualified undergraduate students

Hort 511. Integrated Management of Tropical Crops. (Cross-listed with Pl P, Ent). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Pl P 408 or 416 or Ent 370 or 376 or Hort 221.* Gleason, Lewis, Nonnecke. Applications of Integrated Crop Management principles (including plant pathology, entomology, and Horticulture) to tropical cropping systems. Familiarization with a variety of tropical agroecosystems and Costa Rican culture is followed by 10-day tour of Costa Rican agriculture during spring break, then writeup of individual projects. Tour expenses paid by students.

Hort 523. Plant Tissue, Cell, and Protoplast Culture. (Dual-listed with 423). (2-0) Cr. 2. Alt. F., offered 2009. *Prereq: Biol 313 and Hort 321 or Biol 330.* Theory and techniques of plant tissue culture, including organogenesis, somatic embryogenesis, micropropagation, anther and embryo culture, protoplast isolation and culture, and transformation. Applications to agriculture.

Hort 524. Sustainable and Environmental Horticulture Systems. (Dual-listed with 424). (2-0) Cr. 2. F. Inquiry into ethical issues and environmental consequences of Horticultural cropping systems and production practices. Emphasis on production systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

Hort 529. Publishing in Biological Sciences Journals. (Cross-listed with Agron, NREM). (2-0) Cr. 2. S. *Prereq: Permission of instructor; evidence of a publishable unit of the student's research data.* Process of preparing a manuscript for submission to a refereed journal in the biological sciences. Emphasis on publishing self-generated data from thesis or dissertation research.

Hort 530. Research Orientation. (1-3) Cr. 2. F. Instruction in scientific methods and communication skills.

Hort 537. Plant Stress Biology. (Cross-listed with Agron, EEOB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 330A or equivalent and BBMB 404-405.* Physiology and molecular biology of plant responses to environmental stress. Emphasis on the role of hormones and hormone interactions in governing stress responses. Lectures are prepared from journal papers that elucidate key mechanisms controlling responses to drought, flooding, salt, nutrient deficiencies, freezing, pathogens and herbivores. Plants studied include genetic model systems and crops of Horticultural and Agronomic value.

Hort 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BCB, FS HN, NutrS, VDPAM, BBMB, B M S, EEOB, NREM, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

Hort 543. Seed Physiology. (Cross-listed with STB). (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Brief introduction to plant physiology. Physiological aspects of seed development, maturation, longevity, dormancy and germination. Links between physiology and seed quality.

Hort 546. Organizational Strategies for Diversified Farming Systems. (Cross-listed with Agron, Soc, SusAg). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: SusAg 509.* Examination of the organization and operation of complex, diversified farming systems using tools and perspectives drawn from ecology, Agronomy, and Sociology. The course contains a significant field component focused on an Iowa farm.

Hort 551. Growth and Development of Perennial Grasses. (Cross-listed with Agron). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Junior or senior or graduate classification or permission of instructor.* The grass plant. Selected topics on anatomy, morphology, and physiology relative to growth and development of perennial grasses. Emphasis on growth and development characteristics peculiar to grasses and variations of such characteristics under natural and managed conditions.

Hort 552. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 452). (Cross-listed with Ent, Pl P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Hort 565. Professional Practice in the Life Sciences. (Cross-listed with Pl P, An S, V MPM, Agron, BCB, Micro). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.

A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.

B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

Hort 584. Organic Agricultural Theory and Practice. (Dual-listed with 484). (Cross-listed with Agron, SusAg). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 9 cr in biological or physical sciences.* Delate & DeWitt. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and Socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

Hort 590. Special Topics. Cr. arr. Repeatable. *Prereq: a major or minor in Horticulture.*

Hort 593. Workshop in Horticulture. Cr. arr. Repeatable. Workshops in Horticulture, with emphasis on off-campus instruction.
A. Greenhouse Crops
B. Nursery Crops
C. Turfgrass
D. Fruit Crops
E. Vegetable Crops
F. Cross-Commodity
G. Landscape Horticulture

Hort 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

Hort 610. Graduate Seminar. Cr. 1. Repeatable. F.S. Satisfactory-fail only.

Hort 690. Advanced Topics. Cr. arr. Repeatable.

Hort 696. Research Seminar. (Cross-listed with GDCB, Agron, BBMB, PlBio, for). Cr. 1. Repeatable. Research seminars by faculty and graduate students. Satisfactory-fail only.

Hort 698. Horticulture Teaching Practicum. (1-0) Cr. 1. S. *Prereq: Graduate student classification.* Discussions are intended to foster the development of graduate students as teaching assistants and future Horticulture/plant science teachers. Topics include establishing a classroom presence, improving lectures, motivating students, dealing with difficult or disruptive students, and developing a teaching Philosophy. Satisfactory-fail only.

Hort 699. Thesis and Dissertation Research. Cr. arr. Repeatable.
A. Greenhouse Crops
B. Nursery Crops
C. Turfgrass
D. Fruit Crops
E. Vegetable Crops
F. Cross-Commodity
G. Landscape Horticulture
I. Biotechnology

Hotel, Restaurant, and Institution Management

(Administered by the Department of Apparel, Educational Studies, and Hospitality Management)

Robert Bosselman, Chair of Department

Distinguished Professors (Emeritus): Fanslow, Moyer, Winakor

University Professors (Emeritus): Farrell-Beck

Professors: Bosselman, Damhorst, Fiore, Kadolph

Professors (Emeritus): Anderson, Beavers, Brun, Burnet, Cowan, Crabtree, Gilmore, Smith, Stone, Williams

Associate Professors: Baltzer, Hausafus, Jeong, Niehm, Oh, Parsons

Associate Professors (Emeritus): Amos, Brackelsberg, Brown, Ebert, Huss, Kundel, Kunz, Walsh

Associate Professor (Adjunct): Strohbehn

Assistant Professors: Barker, Hurst, Karpova, Keino, Y. Lee, Marcketti, Rajagopal, Wohlsdorf-Arendt, Zheng

Assistant Professor (Adjunct): Glock

Instructor (Adjunct): Fratzke

Lecturers: Ackerman, Burger, Christensen, Fiihr, Fitzpatrick, Kramer, M. Lee, Sanger, Trost, Wirth, Wise

The Hotel, Restaurant, and Institution Management (HRIM) program aspires to excellence in professional and leadership development, economic development, and food safety for the hospitality industry through education, research, and outreach with a mission of developing leaders in practice, education, and research for the hospitality industry. Educational experiences are planned to contribute to the graduate's effectiveness as a career professional and as a person, family member, and citizen. Research and extension efforts are conducted with the purpose of improving management effectiveness and quality of services within hospitality organizations. Finally, the program is committed to serving the respective missions of Iowa State University and the College of Human Sciences and to serving the needs of the citizens of Iowa.

Undergraduate Study

The program offers work for the degree bachelor of science in hospitality management. Coursework is planned to provide students with a general education plus professional preparation for supervisory and executive positions in hospitality organizations. Principles of business management are presented, as well as fundamentals of hospitality operations.

Graduates demonstrate leadership characteristics and make decisions based on integrating knowledge of financial, human resources, marketing, and operational principles for managing hospitality operations. They demonstrate best practices in meeting customer expectations and use of technology to achieve operational efficiency.

Learning experiences are provided in the quantity food production and service facility of the HRIM program and other approved establishments. Students are required to have a total of at least 600 hours of relevant work experience prior to graduation. Of the 600 hours, 200 hours are required prior to completing one year in the program.

The HRIM program offers a minor that may be earned by successfully completing at least 15 credits of AESHM/HRIM courses in consultation with the advisor. The program also participates in food safety and entrepreneurship interdisciplinary minors.

Communication Proficiency Requirement: Grade of C or better in either Engl 150 and 250 or equivalent transfer courses

Graduate Study

The HRIM program offers work for the master of science and doctor of philosophy degrees in hospitality management. Graduates of the program are able to interpret trends and adapt operating practices of hospitality organizations to changing economic, social, political, technological, and environmental conditions. They can manage a hospitality enterprise successfully to achieve objectives of the operation or, at the doctoral level, successfully carry out responsibilities of a hospitality educator. Graduates will make positive contributions to the growth and improvement of the hospitality industry using current research in the decision-making process.

A degree in hotel, restaurant, and institution management is the usual background for graduate study; however, applicants with preparation in dietetics, business, or closely related fields are encouraged to apply. Ph.D. applicants must have two (2) years of professional work experience in the field.

The master of science degree requires either a thesis or non-thesis (creative component) project. Students also are required to take one course in three of four core areas (human resources, financial management, marketing, and strategic management).

The program participates in the Master of Family and Consumer Sciences degree by offering a specialization in Hospitality management. The program also participates in the Master of Family and Consumer Sciences degree with specialization in Dietetics, offered in cooperation with the Department of Food Science and Human Nutrition.The Ph.D. program requires 80 credits, up to 30 of which may be applied from the Master's degree. All Ph.D. students take a minimum of 15 research/dissertation credits.

Courses primarily for undergraduate students

HRI 101. Introduction to the Hospitality Industry. (3-0) Cr. 3. F. Introduction to the foodservice, lodging, and tourism components of the hospitality industry. Background information, current issues, and future challenges in various segments of the industry.

HRI 189. Introduction to University Dining Services Management. (1-0) Cr. 1. S. Overview of management concepts and distinct features of university dining services.

HRI 193. Hospitality Work Experience I. Cr. R. F.S.SS. Approved work experience in foodservice, lodging, or related operations. A minimum of 200 hours required prior to completing one year in the program. Satisfactory-fail only.

HRI 233. Hospitality Sanitation and Safety. (3-0) Cr. 3. F.S. Sanitation and safety principles in foodservice and lodging operations. Issues impacting consumers and operators. Application of HACCP. Preparation for national foodservice sanitation certification examination. Characteristics of food, supplies, and equipment as related to quality, sanitation and safety.

HRI 260. Global Tourism Management. (3-0) Cr. 3. S. Overview of the global tourism industry: hospitality and related services, destination/ attractions, and transportation. Introduction to travel behavior, tourism planning and research, and economic and social impacts of tourism development.

HRI 289. Private Club Operations. (2-0) Cr. 2. F.S. *Prereq: 101.* Organization and management of private clubs including city, country, and other recreational and social clubs. Field trip required.

HRI 315. Hospitality Law. (3-0) Cr. 3. S. *Prereq: 101.* Laws relating to ownership and operation of hospitality organizations. The duties and rights of both hospitality business operators and customers. Legal implications of various managerial decisions. Nonmajor graduate credit.

HRI 333. Hospitality Operations Cost Controls. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 380, 380L; Math 104 or 150; Com S 103.* Introduction to revenue and cost systems in foodservice and lodging operations. Application of principles related to procurement, production, and inventory controls.

HRI 352. Lodging Operations Management I. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 101.* Introduction to functional department activities and current issues of lodging organizations with emphasis on front office and housekeeping. Reservation activities and night audit exercises. Case studies.

HRI 380. Quantity Food Production Management. (3-0) Cr. 3. F.S. *Prereq: 233 or 2 cr Micro; FS HN 111 or 214; at least junior classification; enrollment in 380L.* Principles of and procedures used in quantity food production management including quality control, food costing, work methods, menu planning, food production systems, and service.

HRI 380L. Quantity Food Production and Service Management Experience. (0-6) Cr. 2. F.S. *Prereq: 233 or 2 cr Micro; FS HN 111 or 214; at least junior classification; enrollment in 380; reservation with program required.* Application of quantity food production and service management principles and procedures in the program's foodservice operation.

HRI 381. International Study in Hospitality. Cr. arr. Repeatable. SS. *Prereq: Permission by application.* Limited enrollment. Supervised study abroad of tourism and its impact on hospitality operations. Experiences include hospitality-related tourist attractions and opportunities related to different cultures. Required pre-study sessions arranged. Expenses paid by student.

HRI 382. Field Study. Cr. arr. F.S.SS. *Prereq: Permission by application.* Supervised study opportunity for students to observe and apply classroom theory to actual hospitality operations across the US. Hospitality operations may include hotels, restaurants, resorts, wineries, theme parks, clubs, hospitals, and tourism operations. Required pre-study sessions may be arranged. Expenses paid by student.

HRI 383. Introduction to Wines, Beers, and Spirits. (2-0) Cr. 2. F.S. *Prereq: Must be at least 21 years old.* Introduction to history and methods of production for a variety of wines, beers, spirits, and other beverages. Product knowledge, sales, and service techniques related to the hospitality industry.

HRI 391. Foodservice Systems Management I. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 380, 380L.* Principles and techniques related to basic management, leadership, and human resource management of foodservices in health care and other institutional settings. Food safety and sanitation for institutions. Credit for either HRI 391 or 287 and 438 may count toward graduation. Not accepted for credit toward a major in HRIM.

HRI 392. Foodservice Systems Management II. (3-0) Cr. 3. S. *Prereq: 391.* Introduction to cost control in foodservice departments: procedures for controlling food, labor, and other variable costs. Application of principles related to food product selection, specification, purchase, and storage in health care and other institutions. Credit for either HRI 392 or 233 and 333 may count toward graduation. Not accepted for credit toward a major in HRIM.

HRI 393. Hospitality Work Experience II. Cr. 2. F.S.SS. *Prereq: 101, 193, 233, 287; adviser approval.* Approved 400-hour work experience in foodservice, lodging, or related operations for HRIM majors. Open to minors. Satisfactory-fail only.

HRI 433. Hospitality Financial Management. (3-0) Cr. 3. S. *Prereq: 333; Acct 284; Econ 101; credit or enrollment in Stat 101.* Use of common financial statements, accounting ratios, and financial techniques to impact management decisions.

HRI 437. Hospitality Information Technology. (3-0) Cr. 3. F. *Prereq: 352.* Introduction to hospitality information technology. Property management and point-of-sales system interfaces: customer relationship management, selecting and purchasing computer systems, electronic distribution systems, internet and its related application systems, managing internal and external communication networks. Case studies. Nonmajor graduate credit.

HRI 439. Advanced Hospitality Human Resource Management. (3-0) Cr. 3. F. *Prereq: 438.* Emphasis on development of management personnel in hospitality organizations. Case studies.

HRI 452. Lodging Operations Management II. (3-0) Cr. 3. S. *Prereq: 352; Com S 103.* Development of business plan and evaluation of business performance in a simulated environment. Operational decision making practices by applying concepts of management, operations, marketing, and finance for a computer-mediated environment. Nonmajor graduate credit.

HRI 455. Introduction to Strategic Management in Foodservice and Lodging. (3-0) Cr. 3. S. *Prereq: 340; credit or enrollment in 433; 438.* Introduction to strategic management principles and practices with an application of human resources, operations, marketing, and financial management concepts. Case studies.

HRI 487. Fine Dining Management. (Dual-listed with 587). (2-3) Cr. 3. F. *Prereq: 380, 380L; credit or enrollment in 333.* Creative experiences with U.S. regional and international foods appropriate for fine dining. Application of management principles in food preparation and service in fine dining operations. Exploration of the historical and cultural development of the world food table.

HRI 489. Issues in Food Safety. (Cross-listed with An S, FS HN, VDPAM). (1-0) Cr. 1. S. *Prereq: Credit or enrollment in FS HN 101 or 272 or HRI 233; FS HN 419 or 420; FS HN 403.* Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

HRI 490. Independent Study. Cr. arr. *Prereq: Sections B-E: Program approval; Section H: Full membership in Honors Program.*
B. Hospitality Management
D. Lodging Operations
E. Foodservice Operations
H. Honors

HRI 491. Internship. Cr. 2. Repeatable. F.S.SS. *Prereq: 193, 287, 352 or 380, 380L; adviser approval.* Approved 400-hour experience in hospitality operations and supervisory responsibilities. Satisfactory-fail only.
A. Foodservice Operations
B. Lodging Operations
C. Hospitality Management

HRI 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of undergraduate coordinator.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

HRI 504. Seminar. (0-1) Cr. 1. F. (A), S.(B). 504B may be taken more than once for credit.
A. Hospitality Research
B. Current Issues

HRI 511. Research Methods in Foodservice & Lodging Management. (3-0) Cr. 3. *Prereq: Graduate standing in the Department.* Overview of research methods. Methods for collecting and analyzing quantitative and qualitative data. Development of research plan.

HRI 533. Financial Decision Making in Foodservice and Lodging Organizations. (3-0) Cr. 3. S. *Prereq: 433.* Concepts of financial management applied to strategic decision making.

HRI 538. Human Resources Development in Foodservice and Lodging Organizations. (3-0) Cr. 3. *Prereq: 438.* Theories of human resources management. Practices and principles related to development of management personnel.

HRI 540. Marketing Strategy. (3-0) Cr. 3. S. *Prereq: 340.* Application of marketing principles in developing effective marketing strategies for hospitality, apparel, and retail organizations. Development of marketing plan.

HRI 555. Strategic Management in Foodservice and Lodging Organizations. (3-0) Cr. 3. *Prereq: Courses in Mkt. and Fin. Management.* Strategic management process as a planning and decision-making framework; integration of human resources, operations, marketing, and financial management concepts.

HRI 575. Professional Experience in Foodservice and Lodging Organizations. Cr. 2. F.S.SS. *Prereq: Accepted in HRIM graduate program.* Analysis and interpretation of professional functions or data, or design and implementation of a management project.

HRI 587. Fine Dining Management. (Dual-listed with 487). (2-3) Cr. 3. F. *Prereq: 380, 380L.* Creative experiences with U.S. regional and international foods. Application of management principles in food preparation and service. Exploration of the historical and cultural development of the world food table. Individual special problems.

HRI 590. Special Topics. Cr. arr. Repeatable. *Prereq: 9 credits in HRI at 400 level or above; permission of instructor.*
B. Hospitality Management
D. Lodging Operations
E. Foodservice Operations
F. Child Nutrition Program Management

HRI 599. Creative Component. Cr. arr.

Courses primarily for graduate students

HRI 604. Professional Writing. (2-0) Cr. 2. Development of professional written communication with emphasis on abstracts, proposals, manuscripts, and technical reports.

HRI 608. Administrative Problems. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Advanced administrative problems; case studies in foodservice and lodging organizations.

HRI 633. Advanced Hospitality Financial Management. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 533.* Theories and research in financial management with emphasis on financial performance and financing decisions.

HRI 638. Advanced Human Resources Management in Foodservice and Lodging Organizations. (3-0) Cr. 3. F. *Prereq: 538.* Research in human resources management with an emphasis on organization or unit administration.

HRI 640. Seminar on Marketing Thoughts. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 540; Stat 401.* Conceptual and theoretical development of marketing strategies. Analytical and critical review of marketing research and industry practices.

HRI 652. Advanced Lodging Operations. (3-0) Cr. 3. *Prereq: Enrollment in PhD program.* Analysis and applications of concepts and theories of operations research for lodging operations.

HRI 675. HRIM Teaching Experience. Cr. 1. F.S.SS. *Prereq: Accepted in PhD program.* Development of objectives, teaching methods and materials, and test items for selected topics. Implementation in an HRIM course.

HRI 680. Analysis of Research in Foodservice Operations. (3-0) Cr. 3. *Prereq: Enrollment in PhD program.* Analysis and application of theories, research, and research methods in foodservice.

HRI 690. Advanced Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in doctoral program.* Advanced study of current topics in foodservice and lodging management.
A. Leadership in Hospitality
B. Hospitality Management
C. Entrepreneurship
D. Lodging Operations
E. Foodservice Operations
F. Child Nutrition in Program Management

HRI 699. Research. Cr. arr. Repeatable.

Human Computer Interaction

www.hci.iastate.edu

(Interdepartmental Graduate Program)

Supervisory Committee: James Oliver, Chair; Chui Shui Chan; Julie Dickerson, Steven Hernstadt, Doug Gentile, Stephen Gilbert, Brian Mennecke

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in Human Computer Interaction (HCI). A Graduate Certificate in Human Computer Interaction is also offered, targeted especially for the benefit of students working in business and industry wanting education in this field. The graduate program in Human Computer Interaction (HCI) welcomes applicants from a diverse collection of technical and creative fields whose unifying characteristic is the desire to develop new ways to bridge the gap between human and machine. The students must demonstrate skill in software development and proficiency in high-level, object-oriented programming. To accommodate students who lack exposure to programming, the HCI interdepartmental graduate major will offer an introductory course to provide a base of technical skills.

At the Masters level, entrance requirements will include an undergraduate degree and demonstrable software skills. The degree calls for 30 credits of course work including appropriate credit for the master's thesis. MS students must take one core course of their choice from each of the categories of Implementation, Design, Evaluation and Phenomena. MS Students must also take two semesters of HCI 591 Seminar in HCI.

All programs of study for the Ph.D. must include 1) one core course of their choice from each of the categories of Implementation, Design, Evaluation and Phenomena, if not completed as part of the student's masters program; 2) two more courses of their choice from a list of recommended electives; and 3) four semesters of HCI 591 Seminar in HCI.

Information on applications procedures and specific requirements of the major can be obtained from the following Internet address: www.hci.iastate.edu.

Courses for graduate students

HCI 407. Principles of 3D Character Animation. (Dual-listed with 507). (Cross-listed with ArtIS). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 308.* Animation techniques using the computer and available software. Principles of character animation. Prior knowledge of modeling, lighting, texturing and rendering with available software is assumed. Nonmajor graduate credit.

HCI 409. Computer/Video Game Design and Development. (Dual-listed with 509). (Cross-listed with ArtIS). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Permission of instructor. Programming emphasis: Com S 227, 228, 229 or equivalent in Engineering; art or graphics emphasis: Art 230 and ArtIS 308; writing emphasis: an English course in creative writing or writing screen plays; business or marketing students: junior classification.* Independent project based creation and development of "frivolous and non-frivolous" computer games in a cross disciplinary team. Projects require cross-disciplinary teams. Aspects of Indie development and computer/video game history will be discussed. Nonmajor graduate credit.

HCI 504. Managing and Evaluating Instructional Technology Interventions. (Cross-listed with C I). (3-0) Cr. 3. S. *Prereq: CI 501.* Principles and procedures for analysis, review, and assessment of instructional technology interventions in education and corporate settings. Methods for planning, organizing, and conducting evaluative studies are applied.

HCI 509. Computer/Video Game Design and Development. (Dual-listed with 409). (Cross-listed with ArtIS). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Permission of instructor. Programming emphasis: Com S 227, 228, 229 or equivalent in Engineering; art or graphics emphasis: Art 230 and ArtIS 308; writing emphasis: an English course in creative writing or writing screen plays; business or marketing students: junior classification.* Independent project based creation and development of "frivolous and non-frivolous" computer games in a cross-disciplinary team. Projects require cross-disciplinary teams. Aspects of Indie development and computer/video game history will be discussed.

HCI 515. Statistical Natural Language Processing. (Cross-listed with Engl, Ling). (3-0) Cr. 3. F. *Prereq: Stat 330 or equivalent, recommended Ling 219 or Ling 511.* Introduction to computational techniques involving human language and speech in applications such as information retrieval and extraction, automatic text categorization, word prediction, intelligent Web searching, spelling and grammar checking, speech recognition and synthesis, statistical machine translation, n-grams, POS-tagging, word-sense disambiguation, on-line lexicons and thesauri, markup languages, corpus analysis, and Python programming language.

HCI 520. Computational Analysis of English. (Cross-listed with Engl, Ling). (3-0) Cr. 3. F. *Prereq: Engl 510 or 511.* Concepts and practices for analysis of English by computer with emphasis on the applications of computational analysis to problems in applied linguistics such as corpus analysis and recognition of learner language in computer-assisted learning and language assessment.

HCI 521. Cognitive Psychology of Human Computer Interaction. (Cross-listed with Psych). (3-0) Cr. 3. *Prereq: Graduate classification or instructor approval.* Biological, behavioral, perceptual, cognitive and social issues relevant to human computer interactions.

HCI 522. Scientific Methods in Human Computer Interaction. (Cross-listed with Psych). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Psych 521 and Stat 101 or equivalent.* Basics of hypothesis testing, experimental design, analysis and interpretation of data, and the ethical principles of human research as they apply to research in human computer interaction.

HCI 525. Optimization Methods for Complex Designs. (Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: Engr 160, Math 265.* Optimization techniques including unconstrained and constrained minimization, linear programming, and particle swarm optimization. Both the theory and methods and the application to complex designs will be presented.

HCI 558. Introduction to the 3D Visualization of Scientific Data. (Cross-listed with Geol, Com S). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate-student standing in the Mathematical or natural sciences.* Introduction to visualizing scientific information with 3D computer graphics and their foundation in human perception. Overview of different visualization techniques and examples of 3D visualization projects from different disciplines (natural sciences, medicine, engineering). Class project in interactive 3D visualization using the OpenDX, VTK or a similar system.

HCI 575. Computational Perception. (Cross-listed with Com S, Cpr E). (3-0) Cr. 3. S. *Prereq: Graduate standing or permission of instructor.* This class covers Statistical and algorithmic methods for sensing, recognizing, and interpreting the activities of people by a computer. This semester we will focus on machine perception techniques that facilitate and augment human-computer interaction. The main goal of the class is to introduce computational perception on both theoretical and practical levels. You will work in small groups to design, implement, and evaluate a prototype of a human-computer interaction system that uses one or more of the techniques covered in the lectures.

HCI 590. Special Topics. Cr. arr. Repeatable. Investigation of problems of special interest in human computer interaction.

HCI 591. Seminar in Human Computer Interaction. Cr. arr. Repeatable.

HCI 592. Entrepreneurship Workshop. (1-0) Cr. 1. F. Students will be taken step-by-step through activities that must be undertaken when attempting to commercialize a technology or start their own company. Speakers will be brought in to introduce relevant topics, provide resources, answer questions, and provide working examples.

HCI 603. Advanced Learning Environments Design. (Cross-listed with C I). (3-0) Cr. 3. S. *Prereq: CI 503.* Exploration of advanced aspects of the instructional design process. Application of analysis, design, development and production, evaluation, implementation, and project management principles. Focus on the production and use of instructional technology with an emphasis on the instructional design consulting process. Theory and research in instructional technology provides the foundation for design decisions.

HCI 655. Organizational and Social Implications of Human Computer Interaction. (Cross-listed with MIS). (3-0) Cr. 3. *Prereq: Graduate Classification.* Examine opportunities and implications of information technologies and human computer interaction on social and organizational systems. Explore ethical and social issues appurtenant to human computer interaction, both from a proscriptive and prescriptive perspective. Develop informed perspective on human computer interaction. Implications on research and development programs.

HCI 697. HCI Internship. Cr. R. Repeatable. *Prereq: Permission of Director of Graduate Education, graduate classification.*

HCI 699. Research. Cr. arr. Repeatable.

Human Development and Family Studies

Corlice Brooke, Interim Chair of Department

Distinguished Professors (Emeritus): Bivens, Meixner

Professors: Brooke, Brotherson, Crase, Draper, Fletcher, Garasky, Hira, Lempers, Macdonald, Martin, Peterson, Russell, Wickrama, Yearns

Professors (Emeritus): Coulson, Deacon, Engel, Joanning, Mercier, Pickett, Winter

Associate Professors: Cook, Greder, Hegland, Luze, Maude, Murphy, Torrie

Associate Professors (Emeritus): Crull, Dail, Herwig, K. Miller, N. Miller, Strong, Volker

Associate Professor (Adjunct): Melby

Assistant Professors: Hughes, Lohman, Margrett

Assistant Professors (Emeritus): Glass, Graham

Assistant Professors (Adjunct): Colbert, Hockaday, Oesterreich, Swanson

Senior Lecturer: Krogh

Lecturers: Borkowski, Enloe, Hensley, Kostelecky, Mahan, Mcclain, Popillion, Schrag, Shedd, Trudeau, Vanmeter, Walsh, Wetzler

Undergraduate Study

For undergraduate curricula in Human Development and Family Studies, leading to the degree bachelor of science, see *Human Sciences, Curricula.*

The Department of Human Development and Family Studies offers courses that focus on the interactions among individuals, families, their resources, and their environments throughout the life span. The department offers work for the Bachelor of Science degree in three curricula: Child, Adult, and Family Services; Early Childhood Education; and Family Finance, Housing and Policy.

The Child, Adult and Family Services curriculum leads to work in the helping professions with employment opportunities in public and private agencies, including Head Start. Opportunities exist to observe and work with infants, preschoolers, school-age children, adolescents, adults, and families. Graduates of the program are prepared for employment in agencies and organizations serving children, youth, families, and adults as program development specialists, coordinators, directors, teachers, direct care staff, and administrators. This flexible program provides a broad emphasis in theory, research, and application in child, adult and family services including attention to community issues and public policy.

Students in the Child, Adult and Family Services curriculum are eligible to participate in *Camp Adventure ™ Youth Services.* Administered by the University of Northern Iowa, Camp Adventure ™ offers students an opportunity to plan and implement school-age service and youth development, develop leadership and management skills, enhance one's global awareness and promote cultural sensitivity. Comprehensive school age and youth service programs directed primarily toward U.S. military installations, U.S. embassies, and corporate clubs and associations are offered. Students will earn 12 credits from the University of Northern Iowa, which can be transferred and applied to CAFS requirements. Students in the child program and youth program options may use Camp Adventure as HD FS 491 Internship if prerequisites are met before beginning the internship. See departmental advising coordinator for information and eligibility.

Students graduating in the Child, Adult, and Family Services major will 1) demonstrate competency in human development and family studies and their chosen field of emphasis; 2) demonstrate proficiency in interpersonal communication and in working with diverse groups to solve multidisciplinary problems; 3) effectively practice preparation and delivery of information to human Service and child care professionals as well as to the general public; 4) critically evaluate information and accurately interpret and use research, and 5) understand the complexity of issues facing professionals in the field, including ethical, cultural and environmental elements.

The Family Finance, Housing, and Policy curriculum prepares students for careers as financial counselors and planners, insurance agents, loan officers, mortgage originators, government housing authority administrators, housing advocates, housing planners, real estate agents, non-profit agency administrators, policy analysts and lobbyists, property managers, and consumer credit and financial aid counselors. The program focuses on financial resource management, housing services and administration, and family policy issues pertinent to children, adults and families. In addition, the program is designed to provide students with skills and background necessary to address the financial and housing related needs of vulnerable households including populations who experience discrimination due to poverty, minority Status, age, and/or disability Status. Laboratory and practicum opportunities exist in the ISU Financial Counseling Clinic, a HUD-approved financial and housing counseling service. Laboratory opportunities also exist in the Universal Design Learning Laboratory where students can complete class projects and investigations to better understand requirements of life span design and accessibility issues. A variety of service learning opportunities are available to familiarize students with public and not-for-profit community services and agencies. Well qualified juniors and seniors in Family Finance, Housing and Policy who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both a B.S. in FFHP and an M.S. in HDFS or a B.S. in FFHP and a Graduate Certificate in Family Financial Planning. Under concurrent enrollment, students simultaneously take undergraduate and graduate courses and may be eligible for assistantships. See *Graduate Study* for more information.

Students graduating in the Family Finance, Housing, and Policy major will 1) demonstrate competency in consumer science and policy and their chosen field of emphasis, 2) demonstrate proficiency in interpersonal communication and in working with diverse groups to solve multidisciplinary problems, 3) effectively practice preparation and delivery of information to family finance, housing, and policy professionals as well as to the general public, 4) critically evaluate information and accurately interpret and use research, and 5) understand the complexity of issues facing professionals in the field, including ethical, cultural and environmental elements.

The curriculum in Early Childhood Education is planned for students preparing to teach young children and work with their families. This program leads to careers in working with young children who are typically developing and those with special needs from birth through age eight. Graduates in this curriculum may teach in early childhood (preschool and primary) classrooms or home based programs, with emphasis on inclusive services; graduates may be employed by either public or private agencies or schools. This curriculum has been approved by the Iowa Department of Education and meets requirements for the early childhood education unified teacher license, which permits individuals to teach general and special education for children from birth through age eight. The program is an interdepartmental major administered by the Department of Curriculum and Instruction and the Department of Human Development and Family Studies within the College of Human Sciences.

Students who enroll in Early Childhood Education must make application to and be accepted into the teacher education program prior to enrolling in advanced courses. All early childhood education students, including those seeking a double major, must meet general education requirements for teacher licensure. Iowa State University is in compliance with the Iowa Department of Education's mandate for a performance based system of teacher training. Following this same type of system, the State of Iowa has developed and implemented a competency system to evaluate the performance of all teachers. A detailed list of the eleven Iowa State University Teacher Education Standards and the eight State of Iowa Teaching Standards, along with other information about the University Teacher Education Program, can be found at www.teacher.hs.iastate.edu/, the teacher education website. Information is also available from the student's academic adviser.

Students in early childhood education must meet the performance outcome standards for teacher licensure. Standards are assessed in coursework through designated performance indicators such as assignments, projects, or practicum participation. These standards assessments are based on the early childhood content standards for endorsement 100 in the State of Iowa. These include competencies in (1) child growth, development, and learning; (2) developmentally appropriate learning environment and curriculum implementation; (3) health, safety, and nutrition; (4) family and community collaboration; and (5) professionalism. Pre-student teaching field experiences and student teaching experience in a least two different settings are required. Students will receive both formative and summative evaluations of their progress toward meeting these outcomes throughout their program at ISU.

The department offers minors in Child, Adult, and Family Services, and Family Finance, Housing, and Policy.

The Child, Adult, and Family Services minor may be earned by completing 102; selecting 3 credits from 220, 221, 226, 227, or 377; and selecting 9 credits from 270, 344, 349, 360, 367, 373, 380, 395, 449, 463 or 479.

The Family Finance, Housing, and Policy minor may be earned by completing HD FS 239; 283; 395; and selecting 6 credits from HD FS 341, 360, 378, 463, 483, 488 or 489.

Communication Proficiency requirement: A student must achieve a grade of C or higher in English 150 and 250. A student achieving a grade of C– or lower in 150 and/or 250 must either repeat the course(s), earning a minimum grade of C, or, in consultation with the adviser and the coordinator of freshman English, complete another appropriate English writing course with a minimum grade of C.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with the major in Human Development and Family Studies, and minor work for students taking major work in other departments. Graduates of M.S. and Ph.D. programs in the department will understand and apply relevant theories to educational, research, and/or intervention programs. It is intended that they will produce and disseminate research results and provide leadership in human development and family studies professions.

Within the major of Human Development and Family Studies, both M.S. and Ph.D candidates may choose to work primarily in one of three signature areas: early childhood, care and education; life-span development; or family policy and practice. The Department of Human Development and Family Studies offers coursework and experiences leading to National Council of Family Relations certification as a family life educator

Prerequisite to work in the major is the completion of a related undergraduate program with basic courses in one or more of the following areas: architecture, child/human development, community and regional planning, economics, education, family studies, interior design, psychology, or Sociology. Additional coursework or prerequisites may be required depending on the undergraduate program and program of study.

Core guidelines for graduate programs of study in Human Development and Family Studies have been developed, and the student's program of study committee has the major responsibility for determining additional requirements for an individual program.

The department also participates in the Master of Family and Consumer Sciences degree programs. Students selecting this option may choose Human Development and Family Studies as the focus of their studies. A 42-credit Master of Family and Consumer Sciences-Family Financial Planning program (MFCS-FFP), along with the 18-credit Graduate Certificate Program is designed to prepare individuals to work in the financial planning field. The courses for this program are completely Web-based. Completion of course work in the Master's degree and Graduate Certificate meets the educational requirements to sit for the Certified Financial Planner (CFP) Board of Standards Certification Examination.

The department offers well qualified students in Family Finance, Housing, and Policy concurrent degree programs that allow them to obtain a B.S. in FFHP and an M.S. in HD FS or a B.S. in FFHP and a Graduate Certificate in Family Financial Planning in 5 years. Application for admission to the Graduate College should be made near the end of the junior year. Under concurrent enrollment, students simultaneously take undergraduate and graduate courses and may be eligible for assistantships. Students interested in these programs should contact the department for details.

The department cooperates in the interdepartmental Gerontology program; students may declare a minor in Gerontology. The Master of Family and Consumer Sciences - Gerontology program (MFCS-Geron) and the Graduate Gerontology Certificate program are designed to prepare professionals who work directly with older people or are involved in education and research related to the elderly. Professionals offering direct services often are involved in health promotion programs, directing intergenerational activities, managing senior centers or retirement communities, counseling older people and their families, and helping people plan for retirement. Professionals involved in education and research may evaluate community-based services, teach others about the aging process, develop policies and programs to serve the needs of the elderly, and work with business and industry on issues related to an aging work force.

Courses primarily for undergraduate students

HD FS 102. Individual and Family Life Development. (3-0) Cr. 3. F.S.SS. Development of individuals, families, and their reciprocal relationships as affected by external factors; examined within a framework of life-span developmental tasks.

HD FS 110. Freshman Learning Community Orientation. (2-0) Cr. 2. F. *Prereq: Membership in HD FS Learning Community.* Introduction to the Department of Human Development and Family Studies including academic requirements and opportunities, strategies for transitioning to college, learning and study strategies, reading and reflection, and career awareness.

HD FS 111. Orientation. (1-0) Cr. 1. Orientation to HD FS curricula. Development of a long-term curriculum plan. Satisfactory-fail only.

HD FS 208. Early Childhood Education Orientation. (Cross-listed with C I). Cr. 1. F.S. Overview of early childhood education (birth-grade 3) teacher licensure requirements. Program planning and university procedures. Required of all students majoring in early childhood education. Satisfactory-fail only.

HD FS 218. Professional Orientation and Service Learning. Cr. 2. F.S. *Prereq: 102.* Restricted to CH FS majors. Ethics, professional development, and career exploration in child, adult and family services. Visits to and service learning with programs that serve children, adults and families with diverse needs. Participation in service learning project required. Satisfactory-fail only.

HD FS 220. Development and Guidance: Ages Birth through 2 Years. (2-2) Cr. 3. F.S. Alt. SS., offered 2011. *Prereq: 102.* Typical and atypical development from birth through two years of age. Development and guidance within the contexts of family, program, and Society. Guided observation of physical, motor, cognitive, communication, social, and emotional development; practicum.

HD FS 221. Development and Guidance: Ages 3 through 8 Years. (3-1) Cr. 3. F.S. Alt. SS., offered 2010. *Prereq: 102.* Typical and atypical development from 3 through 8 years of age. Development and guidance within the contexts of family, program, and Society. Guided observation of physical, motor, cognitive, communication, social, and emotional development; practicum

HD FS 223. Development and guidance Ages Birth though 8 Years. (3-0) Cr. 3. S. Typical and atypical development from birth through eight years of age. Development and guidance within the contexts of the family, program, and Society. Guided observation of physical, motor, cognitive, communication, social, and emotional development.

HD FS 226. Development and Guidance in Middle Childhood. (2-2) Cr. 3. F.S. *Prereq: 102 or Psych 230.* Typical and atypical development from 5 to 12 years of age. Development in the contexts of family, school, and Society. Guidance of children in family and group settings; practicum.

HD FS 227. Adolescent Development. (3-0) Cr. 3. F. *Prereq: 102 or Psych 101 or 230.* Physical, cognitive, and socioemotional development of adolescents and young adults in the context of family, relationships, and culture.

HD FS 239. Housing and Consumer Issues. (3-0) Cr. 3. F.S. Introduction to factors affecting housing consumption of individuals and families, including current housing consumer issues related to housing choices, housing context of neighborhoods and communities, housing structure types, and credit and housing finance. Issues such as homelessness, housing discrimination, indoor air quality, accessible design.

HD FS 240. Literature for Children. (3-0) Cr. 3. F.S. *Prereq: 102 or Psych 230.* Evaluation of literature for children. Roles of literature in the total development of children. Literature selection and use.

HD FS 269. Research in Human Development and Family Studies. (3-0) Cr. 3. F.S. *Prereq: 102 or Psych 230.* Understanding and evaluating research. Use of primary and secondary data to identify and study problems related to human development and family issues, including finance and housing. An introduction to Statistical concepts and computer analysis. Research participation.

HD FS 270. Family Relationships. (3-0) Cr. 3. F.S.Alt. SS., offered 2011. *Prereq: 102 or Psych 230.* Introduction to and application of family theories. Family communication and its functions to develop, maintain, enrich and limit family relationships.

HD FS 276. Human Sexuality. (3-0) Cr. 3. F.S.SS. Behavioral, biological, and psychological aspects of human sexuality within the social context of family, culture, and society. Role of sexuality in human development. Critical analysis of media and research. Communication and decision-making skills relating to sexuality issues and relationships.

HD FS 283. Personal and Family Finance. (3-0) Cr. 3. F.S.SS. Introduction to basic principles of personal and family finance. Budgeting, record keeping, checking and savings accounts, consumer credit, insurance, investments, and taxes.

HD FS 317. Field Experiences. Cr. arr. Repeatable. F.S.SS. Consult department office for procedure. Permission of instructor. Supervised field experience in human development and family studies programs. Satisfactory-fail only.
A. Early Childhood Education Programs. Prereq: 343.
B. Family Services Programs. Prereq: 9 credits in HD FS.

C. Early Childhood Special Education Programs. Prereq: 220, 221.
D. School-Age Child Care Programs. Prereq: 226.
E. Infant/Toddler Programs. Prereq: 340.
F. Research. Prereq: 269.
G. Family Finance Programs.
K. Housing Programs.
L. Policy Programs.

HD FS 340. Assessment and Curricula: Ages Birth through 2 Years. (3-3) Cr. 4. F.S. *Prereq: 220.* Assessment strategies for infants and toddlers, including those with special needs. Curricula, learning environments, teaching strategies, health and nutritional practices, and schedules that are developmentally, individually, and culturally appropriate. Using assessment to plan, implement, and evaluate activities to promote physical, motor, cognitive, communication, and social emotional development; practicum.

HD FS 341. Housing Finance and Policy. (3-0) Cr. 3. F. *Prereq: 6 credits in social sciences.* The social, economic, and governmental contexts of housing and financial decision-making at the household level. Financial considerations for residential property management.

HD FS 343. Assessment and Programming: Ages 3 through 6 Years. (3-3) Cr. 4. F.S. *Prereq: 221; 240; 269 or Psych 332 or 333.* Assessment strategies for preschool and kindergarten children, including those with special needs. Learning environments, schedules, activities, nutritional practices, and teaching strategies that are developmentally, individually, and culturally appropriate. Using assessment to plan, implement, and evaluate activities to promote physical motor, cognitive, communication, and social emotional development; practicum.

HD FS 344. Programming for Children in Early Care and Education. (3-3) Cr. 4. F.S. *Prereq: 220 or 221.* Programming in inclusive child care centers and family child care homes, including those with special needs, aged birth through 8 years. Developing, implementing, and evaluating learning environments; activities and materials; behavioral guidance and classroom management practices; health and nutritional practices; and schedules to ensure developmental, individual, and cultural appropriateness. Monitoring children s development and behavior to promote physical, motor, cognitive, communication, and social emotional development. Collaborating effectively with parents and staff.

HD FS 345. Adapting Programming in Inclusive Settings. (3-1) Cr. 3. F.S. *Prereq: Credit or concurrent enrollment in 340 or 343; Sp Ed 250.* Adapting instruction, materials, and equipment to meet developmental needs of young children birth through age 8 with diverse learning needs and multiple disabilities in inclusive settings. Addressing individualized education programs; special health care needs, challenging behavior, and positioning and handling techniques; practicum.

HD FS 349. Parenting and Family Diversity Issues. (3-0) Cr. 3. F.S.Alt. SS., offered 2010. *Prereq: 102 or Psych 230; 270.* Diversity issues as they affect families. Parenting practices and family relationships among diverse human populations. Understanding the family system and the relationship of that system to Societal systems.

HD FS 360. Housing and Services for Families and Children. (3-0) Cr. 3. F. *Prereq: 6 credits in social sciences.* Approaches to and assessment of housing and services that assist those with special needs including those with disabilities, low-income, children at risk, single-parents, and the homeless. Emphasis on community settings; e.g., residential facilities, group housing, shelters and transitional housing.

HD FS 367. Abuse and Illness in Families. (3-0) Cr. 3. F.S.Alt. SS., offered 2010. *Prereq: 102 or Psych 230; 270.* Causes and consequences of family stressors including physical, sexual, and emotional abuse; substance abuse; and mental and physical illness across the life span. Interplay between victims, offenders, and the treatment system.

HD FS 373. Death as a Part of Living. (Cross-listed with Geron). (3-0) Cr. 3. F.S.Alt. SS., offered 2010. *Prereq: 102.* Consideration of death in the life span of the individual and the family with opportunity for exploration of personal and Societal attitudes.

HD FS 377. Aging and the Family. (Cross-listed with Geron). (3-0) Cr. 3. F.Alt. SS., offered 2011. *Prereq: 102.* Interchanges of the aged and their families. Emphasis on role changes, social interaction, and independence as influenced by health, finances, life styles, and community development.

HD FS 378. Economics of Aging. (Cross-listed with Econ, Geron). (3-0) Cr. 3. S. *Prereq: 3 credits in principles of economics and 3 credits in human development and family studies.* Economic Status of the aging, retirement planning and the retirement decision, role of Social Security, public transfer programs for the elderly, intrafamily transfers to/from the elderly, private pensions, financing medical care and housing for the elderly, prospects and issues for the future.

HD FS 380. Family Law. (3-0) Cr. 3. S. *Prereq: Junior classification.* Family relationships, rights, and duties as prescribed by law. Investigation of sources and interpretations of law.

HD FS 395. Children, Families, and Public Policy. (3-0) Cr. 3. F.S.Alt. SS., offered 2011. *Prereq: 6 credits in social sciences.* Public policy and politics as they affect children and families. Examination of how individuals and groups influence policy. Investigation of current issues and programs influencing the well-being and welfare of children and families.

HD FS 416. Human Development and Family Studies Seminar. Cr. arr. Repeatable. F.S.SS. *Prereq: 8 credits in human development and family studies.* Intensive study of a selected topic in human development and family studies.

HD FS 417. Supervised Student Teaching. Cr. 8. Repeatable. Reservation required.
A. Kindergarten Programs. F. S. Prereq: GPA 2.5, full admission to teacher education program, 455. Teaching experience with young children in kindergarten settings.
B. Preschool Programs. F. S. Prereq: GPA 2.5, full admission to teacher education program, 455; 456. Teaching experience with young children from birth to 5 in group settings.

C. Early Childhood Special Education Programs. F. S. Prereq: GPA 2.5, full admission to teacher education program, 455; 456. Teaching experience with preschool children with disabilities.

HD FS 445. Administration of Programs for Children. (3-0) Cr. 3. S. *Prereq: 344.* Management principles and techniques, including an introduction to financial management involved in programs for children with diverse needs and their families. Staff development, supervision, and evaluation in programs for children and families. Government regulations concerning child and family programs; community relations; and advocacy for children and families.

HD FS 449. Linking Families and Communities. (3-0) Cr. 3. F.S. *Prereq: 269 or Psych 332 or 333, senior classification.* Assessing family needs and community resources across the lifespan. Characteristics of successful community-based family intervention and support programs. Strategies and skills needed by community-based professionals, including grant writing skills. Linking families to community resources. Nonmajor graduate credit.

HD FS 455. Curricula for Ages 3 through 6 Years. (3-3) Cr. 4. F.S. *Prereq: 343, 345; Sp Ed 355 and 455.* Program models and methods leading to development and organization of appropriate curricula in preschool and kindergarten programs for young children with diverse learning needs. Government regulations and professional standards for child programming. Teaming with parents, colleagues, and paraprofessionals to plan, implement, and evaluate developmentally and culturally appropriate individualized education plans in inclusive settings; practicum. Nonmajor graduate credit.

HD FS 456. Family-Centered Supports for Young Children and their Families. (3-1) Cr. 3. F.S. *Prereq: 340, 345.* Family systems and the application of family centered principles in early intervention and home-based services. Impact of disability on families with young children and strategies for delivering family-centered interventions and service coordination. Understanding and measuring family outcomes of early intervention. Understanding foundations of theory and policy, establishing effective partnerships, and building family capacity through effective supports and services. Experiences with families. Nonmajor graduate credit.

HD FS 463. Environments for the Aging. (Dual-listed with 563). (Cross-listed with ArtID, Geron). (3-0) Cr. 3. S. *Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies.* Emphasis on independent living within residential settings including specialized shelter, supportive services, and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities.

HD FS 479. Family Interaction Dynamics. (3-0) Cr. 3. F. *Prereq: 102 or equivalent; 269 or equivalent; 9 hours in social sciences and junior or senior Status.* Analysis of research related to family interaction processes across the family life span. Emphasis on relationship dynamics and cultural differences. Nonmajor graduate credit.

HD FS 483. Advanced Personal and Family Finance. (3-0) Cr. 3. S. *Prereq: 283.* Managerial approaches to achievement of short- or long-term financial goals for households. Investigation of different forms of investments and investment risks management in financing current and future consumption. Analyses of tax, estate, and retirement planning needs of the family. Nonmajor graduate credit.

HD FS 486. Administration of Human Service Programs. (3-0) Cr. 3. F. *Prereq: Junior classification; 6 credits in HD FS at 300 level and above.* An examination of purposes, staffing, operation, and clientele of organizations and agencies serving families. Analysis of issues in coordination and delivery of services.

HD FS 488. Families in the Economy. (3-0) Cr. 3. S. *Prereq: Econ 101.* Analysis of the family as an economic unit in Society. Structure and composition of the family. Patterns of resource use and activities pursued by the family. Family economic transitions such as marriage, divorce, and childbirth. Nonmajor graduate credit.

HD FS 489. Financial Counseling. (Dual-listed with 589). (3-0) Cr. 3. F. *Prereq: 283.* Personal, social/psychological, and legal climates affecting family financial decisions. A life-cycle approach to financial decision-making. Development of financial counseling and planning skills to assist families and individuals to become self-sufficient in family financial management. Nonmajor graduate credit.

HD FS 489L. Financial Counseling Laboratory. (Dual-listed with 589L).(0-2) Cr. arr. Repeatable. F.S. *Prereq: Instructor permission.* Practical experience in remedial, preventative, and productive approaches to both financial and housing counseling in one-on-one and/or group settings.

HD FS 490. Independent Study. Cr. arr. *Prereq: 6 credits in human development and family studies.* Consult department office for procedure.
A. Child and Family Studies
B. Housing
C. Family Finance
F. Early Childhood Education
G. Early Childhood Special Education
H. Honors
I. Human Development and Family Studies
L. Policy Programs.

HD FS 491. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: 449; permission of instructor, senior classification.* Reservation required one semester before placement; minimum 2.0 GPA. Supervised work experience related to the student's curriculum. Satisfactory-fail only.

HD FS 493. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: Senior classification.* (Dual-listed with 593).

HD FS 499. Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Consult department office for procedures..* Supervised research experience.

Courses primarily for graduate students, open to qualified undergraduate students

HD FS 501. Graduate Study Orientation. (1-0) Cr. R. F. Orientation to graduate study and current research in the department.

HD FS 503. Quantitative Research Methodology. (3-0) Cr. 3. S. *Prereq: Stat 401 or ResEv 553, concurrent enrollment in HD FS 505.* Concepts, methods, and strategies for research in human development and family studies. Topics include the nature of scientific research, measurement, types of research in human development and family studies, validity of research designs, methods of data gathering, and strategies for and issues in the study of change.

HD FS 504. Qualitative Research Methods I. (3-0) Cr. 3. F. *Prereq: 9 credits of social sciences.* Introduction to qualitative research methodology. Application of fieldwork methods, analysis, interpretation, and writing through individual qualitative research projects.

HD FS 505. Application of Quantitative Research Methodology. (1-2) Cr. 2. S. *Prereq: Stat 401 or ResEv 553.* Coding, entry and manipulation of research data. Practical applications with interactive Statistical software.

HD FS 510. Theories of Human Development. (3-0) Cr. 3. F.SS. *Prereq: 9 credits of social sciences.* Theoretical approaches and current research in child, adolescent, and adult development. Individual life span perspectives. Policy implications.

HD FS 511. Family Theory. (3-0) Cr. 3. F. *Prereq: 9 credits in social sciences.* Theoretical approaches and current research in family development. Review the nature and value of theory to the study of the family and evaluate the use of theory in empirical research. Policy implications.

HD FS 521. Community Context of Individual and Family Well-being. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification; 511 or 6 credits in social sciences.* Impact of community contextual influences on human development and families. Analysis of conceptual frameworks, methodological approaches, and current research. Socio-psychological and economic impact of housing and community on children and families.

HD FS 525. Theories and Research in Early Childhood Education. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 510 or 6 credits in social sciences.* Analysis of contemporary and historical models, including early intervention programs. Examination of relationships among physical environment, programming, teacher effectiveness, and child outcomes.

HD FS 530. Perspectives in Gerontology. (Cross-listed with Geron). (3-0) Cr. 3. F. WWW only. Overview of current aging issues including theory and research, critical social and political issues in aging, the interdisciplinary focus of gerontology, career opportunities, and aging in the future.

HD FS 534. Adult Development. (Cross-listed with Geron). (3-0) Cr. 3. F: on campus. S: WWW only. Exploration of the biological, psychological and social factors associated with aging. Although the focus is on the later years, information is presented from a life-span developmental framework. Empirical studies are reviewed and their strengths, limitations and implications for normative and optimal functioning are discussed.

HD FS 538. Developmental Disabilities in Children. (Cross-listed with Psych). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 9 credits in human development and family studies or psychology.* Theories, research, and current issues regarding development in children with disabilities. Investigation of interventions with children and families.

HD FS 541. Housing and Real Estate in Family Financial Planning. (Cross-listed with FFP). (3-0) Cr. 3. Alt. SS., offered 2010. WWW only. The role of housing and real estate in the family financial planning process, including taxation, mortgages, financial calculations, legal concerns, and ethical issues related to home ownership and real estate investments. Emphasis on emerging issues in the context of housing and real estate.

HD FS 545. Economics, Public Policy, and Aging. (Cross-listed with Geron). (3-0) Cr. 3. Alt. F., offered 2010. WWW only. Policy development in the context of the economic Status of the older adult population. Retirement planning and the retirement decisions, social security and public transfer programs, intra-family transfers to/from the aged, private pensions; financing medical care, prospects and issues for the future.

HD FS 547. Parent-Child Relations. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 510 or 511 or 6 credits in social sciences.* Analysis of theories and research related to parent-child interactions; examination of parenting as a developmental process. Current issues in child rearing.

HD FS 548. Parent Education. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 510 or 511 or 6 credits in social sciences.* Needs assessments, models, delivery systems, and evaluation procedures used in parent education programs for families with diverse needs, including single parents, adolescent parents, and parents of children with developmental disabilities. Developmental aspects of parenting. Effects of values, family structures, family goals, and parenting styles on parent education.

HD FS 555. Current Issues in ECSE. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 9 credits in social sciences.* Examination of research and current issues in early childhood special education with special emphasis on inclusion, activity-based intervention, and developmentally appropriate programming. Emphasis on continuum of strategies to embed learning opportunities that promote physical, language, cognitive, and social development.

HD FS 556. Families and Disability. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 9 credits in social sciences.* Review of research, policy, and practice regarding families of children with a disability. Educational, environmental, economic, and social issues faced by families. Communication and consultation skills to work collaboratively with interdisciplinary professionals and families to implement individualized family and educational programs.

HD FS 563. Environments for the Aging. (Dual-listed with 463). (Cross-listed with Geron). (3-0) Cr. 3. S. *Prereq: 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies.* Emphasis on independent living within residential settings including specialized shelter, supportive services and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities.

HD FS 566. Impact of Public Policy on the Family. (3-0) Cr. 3. S. *Prereq: 9 credits in social sciences.* The effect of public policies on families and children, especially those at risk. Examines poverty in the U.S.; the consequences of poverty; the programs used to alleviate the consequences of poverty; evaluation of the efficacy of these programs.

HD FS 567. Family Stress, Abuse, and Illness. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 9 credits in social sciences.* Contemporary theory and research on the causes and consequences of family stressors including physical, sexual, and emotional abuse; substance abuse; and mental and physical illness across the life span. Interplay between victims, offenders, and the treatment system. Identification of barriers to services and supports and exploration of approaches to assist families in overcoming these barriers.

HD FS 568. Developmental Assessment. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 510.* Techniques assessing cognitive, language, motor, emotional, and social skills of children in school, home and community settings using criterion-referenced, norm-referenced, and curriculum-based tests and screening tools. Techniques for interviewing families and including them in assessment. Opportunities to practice using different assessments.

HD FS 571. Marital Therapy and Assessment. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 9 credits in social sciences.* Theories and techniques of couple therapy across the life cycle.

HD FS 573. Ethics and Professional Studies in Marriage and Family Therapy. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 credits in graduate level social sciences.* Professional ethics and legal responsibilities relevant to family therapy. Professional socialization and the role of professional organizations and state licensure/certification.

HD FS 575. Cross-cultural Perspectives on Families and Children. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 credits in social sciences.* Review of methods and findings on cultural influences on the development of children and youth and on family life. Comparison of child rearing practices, family roles, values, and traditions in different cultures.

HD FS 576. Marriage Across the Life Course. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 511.* A developmental approach to exploring predictors of the formation, maintenance, and dissolution of intimate relationships across the life course. Understanding how intimate relationships develop and change over time, beginning with the development of early adolescent relationships and continuing through later life.

HD FS 577. Aging in the Family Setting. (Cross-listed with Geron). (3-0) Cr. 3. *Prereq: 9 credits in social sciences.* Alt. S., offered 2008: on campus. Alt. S. offered 2009: WWW only. Theories and research related to personal and family adjustments in later life affecting older persons and their intergenerational relationships. Related issues including demographics also are examined through the use of current literature.

HD FS 578. Models of Marriage and Family Therapy. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 9 credits in social sciences.* Major models of marriage, couple, and family therapy. Includes clinical assessment, intervention, and evaluation.

HD FS 579. Family Interaction Dynamics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 9 credits in social sciences.* Current research and theory in family interaction, with emphasis on family dynamics and family change across the life course.

HD FS 581. International Study in Human Development and Family Studies. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission by application.* Limited enrollment. Supervised international study experiences in Human Development and Family Studies. Countries vary.
A. Practicum
B. Exchange
C. Group Study

HD FS 582. Contemporary Issues in Marriage and Family Therapy. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: 9 credits in social sciences.* Focus on assessment, intervention, and treatment of issues marriage and family therapists routinely face, including suicidal/depressed clients, eating disorders, alcoholism and substance abuse, self-harm behaviors, and grief issues. Issues examined from a systemic, socio-cultural perspective.

HD FS 583. Investing for the Family's Future. (Cross-listed with FFP). (3-0) Cr. 3. F. *Prereq: 483.* Evaluation of investment markets for the household. Analysis of how families choose where to put their

savings. Emphasis is on using the family's overall financial and economic goals to help inform investment choices.

HD FS 584. Program Evaluation and Research Methods in Gerontology. (Cross-listed with Geron). (3-0) Cr. 3. Alt. SS., offered 2010. WWW only. Overview of program evaluation, research methods, and grant writing in gerontology. Includes application of quantitative and qualitative methods in professional settings.

HD FS 585. Family Policy Analysis and Evaluation. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in graduate level social sciences.* Theoretical and practical issues related to family policy analysis and program evaluation. Assessment of programs' success in meeting goals. Examination of concepts related to family policy development in the United States. Examination of how individuals and groups can influence family policy and evaluation.

HD FS 586. Sex Therapy. (3-0) Cr. 3. Alt. SS., offered 2010. *Prereq: 571 or 578.* Review of gender orientation and sexual functioning as well as assessment and treatment of sexual problems. Research regarding effectiveness of treatment is reviewed.

HD FS 587. Diversity Issues in Marriage and Family Therapy. (Cross-listed with W S). (3-0) Cr. 3. Alt. F., offered 2009. Review treatment implications associated with topics such as gender and power, race/ethnicity, family structure, and Socioeconomic Status. Discuss treatment implications of social oppression and discrimination on families.

HD FS 588. Family Economics and Public Policy. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in Sociology or economics.* Analysis of family income, wealth, and economic well-being. Emphasis on effects of family behavior and public policies on the adequacy and security of income across the family life cycle. Implications of resource allocation within the family for adult and child well-being.

HD FS 589. Financial Counseling. (Dual-listed with 489). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Personal, social/psychological and legal climates affecting family financial decisions. A life cycle approach to financial decision making. Development of financial counseling and planning skills to assist families and individuals to become self-sufficient in family financial management.

HD FS 589L. Financial Counseling Laboratory. (Dual-listed with 489L).(0-2) Cr. arr. Repeatable. F.S. *Prereq: Instructor permission.* Practical experience in remedial, preventive, and productive approaches to both financial and housing counseling in one-on-one and/or group settings.

HD FS 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Consult department office on procedure for filing a written plan of study.
A. Family Studies
B. Housing
C. Family Finance
D. Human Development
E. Child Development
F. Early Childhood Education
G. Early Childhood Special Education
I. Human Development and Family Studies
M. Marriage and Family Therapy
N. Family Policy

HD FS 591. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: 10 graduate credits.* Supervised experience in an area of human development and family studies.
A. Family Studies
B. Housing
C. Family Finance
D. Human Development
E. Child Development
F. Early Childhood Education
G. Early Childhood Special Education
I. Human Development and Family Studies
M. Marriage and Family Therapy
N. Family Policy

HD FS 593. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: Senior classification.* (Dual-listed with 493.)

HD FS 594. Professional Seminar in Gerontology. (Cross-listed with Geron). (3-0) Cr. 3. Alt. SS., offered 2011. WWW only. An integrative experience for gerontology students designed to be taken near the end of degree program. By applying knowledge gained in earlier coursework, students will strengthen skills in ethical decision-making behavior, applying these skills in gerontology-related areas such as advocacy, professionalism, and family and workplace issues. Students from a variety of professions will bring their unique perspectives to bear on topics of common interest.

Courses for graduate students

HD FS 603. Advanced Quantitative Methods. (3-0) Cr. 3. S. *Prereq: 503; Stat 402 or 404.* Methodological and analytical issues in research in human development and family studies. Advanced research design and measurement, selection of Statistical techniques, and issues in the interpretation of findings.

HD FS 604. Advanced Qualitative Research. (3-0) Cr. 3. F. *Prereq: 503. Qualitative methods and related theory in human development and family studies.* Research procedures, including phenomenology, grounded theory, ethnography, and case studies. Methods of data collection and analysis.

HD FS 605. Multi-level Modeling for social and Behavioral Sciences. (Cross-listed with Psych). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 404.* Rationale for and interpretation of random coefficient models. Strategies for the analysis of multi-level and panel data including models for random intercepts, random slopes, and growth curves. Applications including HLM, SAS, PROCMIX, and MPLUS.

HD FS 616. Seminar. Cr. arr. May be repeated. F.S.SS.

HD FS 631. Learning and Cognitive Development in Children. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 510.* Theory and research emphasizing constructivist, Vygotskian, and information processing approaches to cognitive development. Concept, memory, and problem-solving development. Sources of individual differences in cognitive functioning of children and adolescents.

HD FS 632. Language and Literacy Development in Children. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 510.* Theory and research related to language and literacy development of children from birth to age 8. Exploration of the relationship between language and literacy development during the early childhood years. Discussion of current issues.

HD FS 633. Social and Emotional Development in Children. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 510.* Theory and research related to social and emotional development of infants, children, and adolescents. Dynamic socialization processes involving children, adolescents, parents, peers, and Society.

HD FS 634. Adolescent Development. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 510 or 511.* Theory and research on physical-motor, intellectual-cognitive, and social-personality development from early to late adolescence. Sources of developmental and individual differences in identity formation and attainment.

HD FS 650. Advanced Family Policy Theory. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 588.* Analysis of theories, research, and current issues related to family and household economics and policy. Emphasis on theory development and empirical analyses of macro and micro family economic problems. Future policy, economic and social trends, and their meaning for the family as an economic institution.

HD FS 690. Advanced Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor and enrollment in Ph.D. program.*
A. Family Studies
B. Housing
C. Family Finance
D. Human Development
E. Child Development
F. Early Childhood Education
G. Early Childhood Special Education
I. Human Development and Family Studies
M. Marriage and Family Therapy
N. Family Policy

HD FS 691. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Supervised practice and experience in the following specified areas: Satisfactory-fail only.
A. College Teaching
B. Research
C. Marriage and Family Therapy
D. Professional Experience

HD FS 699. Research. Cr. arr. Repeatable. Satisfactory-fail only.
A. Family Studies
B. Housing
C. Family Finance
D. Human Development
E. Child Development
F. Early Childhood Education
G. Early Childhood Special Education
I. Human Development and Family Studies
M. Marriage and Family Therapy
N. Family Policy

Human Sciences

David Whaley, Program Coordinator

Human Sciences courses provide integrative study and enriching experiences in areas that cut across the diverse curricula of the College of Human Sciences. These may include such areas as leadership, global understanding, social justice/responsibility, and ethics. Students in any college may take these courses.

Courses primarily for undergraduate students

H Sci 150. Dialogues on Diversity. (1-0) Cr. 1. F.S. An exploration of diversity within the context of the Iowa State University community through understanding human relations issues. Satisfactory-fail only.

H Sci 482. The Dean's International Leadership Seminar. (Dual-listed with 582). (3-0) Cr. 3. S.SS. *Prereq: Permission of the seminar leader.* Leadership strategies and effective use of leadership skills in an international setting. Compare leadership theories and practices in the U.S. and foreign countries. Construct individual leadership strategies to deal with complex issues in a global environment. Use discussion, personal assessment inventories, and simulated experiences to evaluate leadership strategies. Develop and improve skills in meeting the challenges of teamwork. Learn about the culture of a foreign country.

H Sci 490. Independent Study. Cr. arr.
E. Entrepreneurship

H Sci 582. The Dean's International Leadership Seminar. (Dual-listed with 482). (3-0) Cr. 3. S.SS. *Prereq: Permission of the seminar leader.* Leadership strategies and effective use of leadership skills in an international setting. Compare leadership theories and practices in the U.S. and foreign countries. Construct individual leadership strategies to deal with complex issues in a global environment. Use discussion, personal assessment inventories, and simulated experiences to evaluate leadership strategies. Develop and improve skills in meeting the challenges of teamwork. Learn about the culture of a foreign country.

Immunobiology

www.immunobiology.iastate.edu

(Interdepartmental Graduate Program)

Supervisory Committee: Marian Kohut, Chair; Mike Wannemuehler, Louisa Tabatabai, Jesse Hostetter, Bryan Bellaire

The Graduate Faculty: Marian Kohut, Chair; Ackermann, Mark, Andreasen; Claire, Andreotti, Amy; Bartholomay, Lyric; Bellaire, Bryan; Cunnick, Joan; Griffith, Ronald; Harris,DL; Hostetter, Jesse; Jarvinen, Julie; Jones, Doug; Kanthasamy, Anumantha; Lamont, Susan; Lippolis, John; Minion, F. Chris; Nilsen-Hamilton, Marit; Nonnecke, Brian; Nystrom, Evelyn; Opriessnig, Tanja; Palic, Dusan; Petersen, Christine; Platt, Ken; Reynolds, Don; Rosenbusch, Ricardo; Roth, James; Rothschild, Max; Sacco, Randy; Stabel, Judy; Tabatabai, Louisa; Thoen, Charles; Wannemuehler, Mike; Waters Ray; Zhang, Qijing

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in Immunobiology. Faculty are drawn from eight departments: Animal Science; Biochemistry, Biophysics, and Molecular Biology; Biomedical Sciences; Entomology; Kinesiology; Veterinary Diagnostic & Production Animal Medicine; Veterinary Microbiology & Preventative Medicine; and Veterinary Pathology. The diversity of faculty expertise ensures a broad education, while offering flexibility in choice of specialization. Ongoing research projects include areas such as: antibody and cell-mediated immunity, immunochemistry, immunogenetics, immunomodulation, mucosal immunity and nutritional immunology.

Students may enter the Immunobiology major in one of two ways; they may apply to and be directly accepted into the major, or they may be admitted to a participating department followed by formal admission to the major. Students directly admitted into the Interdepartmental Immunobiology Major will take Imbio 697 (graduate research rotation) in their first two semesters, and by the end of the second semester, enter a department by choosing a major professor from the participating faculty. Students first admitted to a department will choose a major professor from the participating faculty in that department.

Students should have a strong background in the biological sciences, including work in immunology, genetics and biochemistry. Prior research experience is highly encouraged. Submission of scores of the GRE General Test is required.

Immunobiology students should include in their program of study a core of courses which will provide a broad coverage of the basic program in immunobiology. Formal courses should include immunology, biochemistry, and Statistics. Additional coursework may be selected to satisfy individual interests or departmental requirements. The foreign language and teaching requirements are determined by the student's department. All students will take a minimum of one seminar course per year.

Graduates have a broad understanding of the interdisciplinary field of immunobiology, and can effectively integrate the principles of immunology with related disciplines. They are able to effectively communicate with scientific colleagues and the general public in both formal and informal settings. Graduates are able to integrate theory and research to address complex problems facing scientific professionals studying animal and human health, taking into account related ethical, social, legal and environmental issues. They are skilled at carrying out research, communicating research results, and writing persuasive grant proposals.

Courses for graduate students

Imbio 602. Current Topics Workshop in Immunology. (1-0) Cr. 1. Repeatable. Lectures provided by off-campus experts. Students are required to participate in discussion sessions with lecturers.

Imbio 604. Seminar in Immunobiology. (1-0) Cr. 1. Repeatable. Student and faculty presentation.

Imbio 690. Special Topics. Cr. arr. Repeatable. Advanced study of specific topics in specialized field of immunobiology.

Imbio 697. Graduate Research Rotation. Cr. arr. Repeatable. Graduate research projects performed under the supervision of selected faculty members in the Interdepartmental Immunobiology major.

Imbio 699. Research. Cr. arr. Repeatable.

Industrial Engineering

(Administered by the Department of Industrial and Manufacturing Systems Engineering)

Gary Mirka, Chair of Department

Distinguished Professors (Emeritus): Cowles

University Professor: Vardeman

University Professor (Emeritus): David

Professors: Heising, Mirka, Morris, Ryan

Professors (Emeritus): Barta, Berger, Even, Mohr, Montag, Moore, Patterson, C. Smith, G. Smith, Tamashunas, Vaughn

Associate Professors: Gemmill, Jackman, Meeks, Min, Olafsson, Peters

Associate Professor (Emeritus): Love

Assistant Professors: Frank, Stone, Wang

Assistant Professor (Collaborator): Guerra-De-Castillo

Senior Lecturer: Potter

Lecturers: Sly

Undergraduate Study

For the undergraduate curriculum in industrial engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission ABET.

Industrial engineers are employed to design, analyze, and improve systems and processes found in manufacturing, consulting, and service industries. Professional responsibilities are typically in design, management, analysis, optimization, and modeling of industrial systems. An industrial engineer is focused on human factors, operations research, engineering management, manufacturing engineering, and quality. Industrial engineers are typically found in organizations responsible for operations management, process engineering, automation, logistics, supply chain management, scheduling, plant engineering, quality control, and technical sales. The overall goal of the industrial engineering undergraduate curriculum is to produce technically qualified industrial engineers who are capable of successful professional practice in the field. To meet this goal, the curriculum includes in-depth instruction to accomplish the integration of systems using appropriate analytical, computational, and engineering practices. The curriculum also provides graduates with the necessary educational foundation to pursue advanced studies in industrial engineering or related fields.

The industrial engineering curriculum has the following objectives. The industrial engineering curriculum is preparing its graduates during their professional careers to:

1. Make decisions on system design or analysis with broad-based analytical tools and information technology.
2. Formulate and analyze problems in specific application areas including manufacturing, production, logistics, ergonomics, service industries, public policies, or information systems.
3. Develop and implement project solutions concerning designs, processes, operations, or systems.
4. Prepare and deliver professional communications in written and oral formats.
5. Achieve team goals in a multidisciplinary team environment and provide leadership in some capacity, based on an understanding of team dynamics and project management.
6. Acquire new skills and training for lifelong learning.

Details on industrial engineering program outcomes that foster the attainment of these objectives are available at appropriate sections of: www.imse.iastate.edu

The industrial engineering undergraduate curriculum provides students with fundamental knowledge in mathematics and science, engineering science, social science, and humanities as well as professional industrial engineering course work. Management electives provide students with an opportunity to become familiar with modern business practices that they will encounter in their career. A senior capstone design course provides students with an opportunity to solve open-ended industrial problems with an industrial partner. The cooperative education program provides students with real world experience in the profession and a good perspective on career choices. Students are encouraged to participate in international experiences through exchange programs and industrial internships. Qualified juniors and seniors interested in graduate studies may apply to the Graduate College to concurrently pursue both B.S. and M.S. degrees in Industrial Engineering or B.S. and M.B.A. degrees.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with a major in industrial engineering. A formal minor is available to graduate students having a major in another department. Graduate study is designed to improve the student's capability to conduct research as well as improve professional expertise in industrial engineering.

The prerequisite to major graduate work is the completion of a curriculum similar to that required of undergraduate students in engineering at this institution.

With the help of a program of study committee, a graduate student develops an educational program in areas within industrial engineering. Typical areas of concentration include ergonomics, engineering management, human computer interfaces, manufacturing systems, operations research and optimization, and information engineering.

Courses primarily for undergraduate students

I E 101. Industrial Engineering Profession. Cr. R. F.S. (1-0) Introduce students to the industrial engineering profession, its scope, industrial engineering tools, and future trends.

I E 148. Information Engineering. (2-2) Cr. 3. F.S. *Prereq: Credit or enrollment in Math 142.* Development of information solutions for engineering problems. Fundamentals of the software development process. Engineering computations and the human/computer interface. Data models and database development. Program connectivity and network applications.

I E 248. Engineering System Design, Manufacturing Processes and Specifications. (2-2) Cr. 3. F. *Prereq: Credit or enrollment in 101 and Mat E 272.* Introduction to metrology, engineering drawings and specifications. Engineering methods for designing and improving systems. Theory, applications, and quality issues related to machining processes.

I E 271. Applied Ergonomics and Work Design. (3-0) Cr. 3. S. *Prereq: Phys 221.* Basic concepts of ergonomics and work design. Their impact on worker and work place productivity, and cost. Investigations of work physiology, biomechanics, anthropometry, work methods, and their measurement as they relate to the design of human-machine systems.

I E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

I E 305. Engineering Economic Analysis. (3-0) Cr. 3. F.S.SS. *Prereq: Math 166.* Economic analysis of engineering decisions under uncertainty. Financial engineering basics including time value of money, cash flow estimation, and asset evaluation. Make versus buy decisions. Comparison of project alternatives accounting for taxation, depreciation, inflation, and risk. Nonmajor graduate credit. Nonmajor graduate credit.

I E 312. Optimization. (3-0) Cr. 3. F. *Prereq: Math 267.* Concepts, optimization and analysis techniques, and applications of operations research. Formulation of Mathematical models for systems, concepts, and methods of improving search, linear programming and sensitivity analysis, network models, and integer programming. Nonmajor graduate credit.

I E 341. Production Systems. (3-0) Cr. 3. F. *Prereq: Stat 231; credit or enrollment in I E 312.* Introduction of key concepts in the design and analysis of production systems. Topics include inventory control, forecasting, material requirement planning, project planning and scheduling, operations scheduling, and other production systems such as Just-In-Time (JIT), warehousing, and global supply chains. Nonmajor graduate credit.

I E 348. Solidification Processes. (2-2) Cr. 3. S. *Prereq: 248.* Theory and applications related to metal casting, welding, polymer processing, powder metallurgy, electronic assembly, and semi-conductor manufacturing. Nonmajor graduate credit.

I E 361. Statistical Quality Assurance. (Cross-listed with Stat). (2-2) Cr. 3. F.S. *Prereq: Stat 231 or 401.* Statistical methods for process improvement. Simple quality assurance principles and tools. Measurement system precision and accuracy assessment. Control charts. Process capability assessment. Experimental design and analysis for process improvement. Significant external project in process improvement. Nonmajor graduate credit.

I E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period.

I E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* Professional work period for a maximum of one semester per academic year. Satisfactory-fail only.

I E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

I E 403. Introduction to Sustainable Production Systems. (Dual-listed with 503). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Credit or enrollment in 341.* Quantitative introduction of sustainability concepts in production planning and inventory control. Review of material recovery (recycling) and product/component recovery (remanufacturing) from productivity perspectives. Sustainability rubrics ranging from design and process to systems. Application to multi-echelon networks subject to forward/backward flow of material and information. Closed-loop supply chains. Comparative study of sustainable vs traditional models for local and global production systems.

I E 408. Interdisciplinary Problem Solving. (Cross-listed with E E, TSM). (3-0) Cr. 3. F.S. *Prereq: Junior or senior classification.* Use of the Theory of Constraints as a way of approaching problem solving, win-win negotiation, project planning and effective delegation in the context of engineering/business systems. Team projects aimed at improving design outcomes. Nonmajor graduate credit.

I E 409. Interdisciplinary Systems Effectiveness. (Cross-listed with E E, TSM). (3-0) Cr. 3. F.SS. *Prereq: Junior or senior classification.* Focus on functions that determine the effectiveness of an entire organization. Generic Theory of Constraints solutions to production, distribution, and project management are compared to traditional solutions. Strategy for improvements discovered using simulations. Nonmajor graduate credit.

I E 413. Stochastic Modeling, Analysis and Simulation. (4-0) Cr. 4. F. *Prereq: Math 267, Stat 231.* Development and analysis of simulation models using a simulation language. Application to various areas of manufacturing and service systems such as assembly, material handling, and customer queues. Utilizing model output to make important business decisions. Fitting of data to Statistical distributions. Introduction to Markov processes and other queuing models. Nonmajor graduate credit.

I E 419. Manufacturing Systems Modeling. (3-0) Cr. 3. S. *Prereq: Stat 231.* Modeling material handling systems, inventory systems, and production systems for performance analysis. Introduction to analysis, simulation, and physical models of manufacturing systems. Simulation languages such as ARENA, AweSim, and ProModel. Not available for degrees in industrial engineering. Nonmajor graduate credit.

I E 441. Industrial Engineering Design. (1-6) Cr. 3. F.S. *Prereq: 248, 271, 361; credit or enrollment in 341, 413, and 448.* A large, open-ended design project related to an enterprise. Application of engineering design principles including problem definition, analysis, synthesis, and evaluation. Nonmajor graduate credit.

I E 446. Geometric Variability in Manufacturing. (Dual-listed with 546). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: I E 348, or Mat E 341, or M E 324.* Assessment, accommodation, and control of geometric variability of manufacturing processes. Use of CMMs, vision and scanning systems, and prolifometers. Techniques to successfully accommodate variation through design of product, tooling or process plan including plastic injection molding, metalcasting, welding, machining, powder metallurgy. Methodologies to control geometric variability. Nonmajor graduate credit.

I E 448. Manufacturing Systems Engineering. (3-0) Cr. 3. S. *Prereq: 248 or similar manufacturing experience, 305.* Fixturing and tooling requirements for manufacturing process planning, geometric dimensioning and tolerancing, computer aided inspection, cellular and flexible manufacturing, and facility layout. The role of these topics in supporting lean manufacturing will be integrated throughout the course. Nonmajor graduate credit. Nonmajor graduate credit.

I E 449. Computer Aided Design and Manufacturing. (Dual-listed with 549). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 248, some experience with theory of matrices.* Representation and interpretation of curves, surfaces and solids. Parametric curves and surfaces and solid modeling. Use of CAD software and CAD/CAM integration. Computer numerical control, CNC programming languages, and process planning.

I E 466. Multidisciplinary Engineering Design. (Cross-listed with A. E, Aer E, Cpr E, E E, Engr, Mat E, M E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing, and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

I E 481. e-Commerce Systems Engineering. (Dual-listed with 581). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 148.* Design, analysis, and implementation of e-commerce systems. Information infrastructure, enterprise models, enterprise processes, enterprise views. Data structures and algorithms used in e-commerce systems, SQL, exchange protocols, client/server model, web-based views.

I E 483. Knowledge Discovery and Data Mining. (Dual-listed with 583). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 148, 312, and Stat 231.* Introduction to data warehouses and knowledge discovery. Techniques for data mining, including probabilistic and Statistical methods, genetic algorithms and neural networks, visualization techniques, and Mathematical programming. Advanced topics include web-mining and mining of multimedia data. Case studies from both manufacturing and service industries. A computing project is required. Nonmajor graduate credit.

I E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Senior classification, permission of instructor.* Independent study and work in the areas of industrial engineering design, practice, or research.
A. Manufacturing
B. Human Factors
C. Operations Research
D. Enterprise Computing and Information Management
E. Engineering Management
H. Honors

I E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

I E 501. M.S. Research Basics and Communications. Cr. R. Repeatable. Principles and practices for research tasks at the M.S. level including proposal writing, presentations, paper preparation, and project management.

I E 503. Introduction to Sustainable Production Systems. (Dual-listed with 403). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Credit or enrollment in 341.* Quantitative introduction of sustainability concepts in production planning and inventory control. Review of material recovery (recycling) and product/component recovery (remanufacturing) from productivity perspectives. Sustainability rubrics ranging from design and process to systems. Application to multi-echelon networks subject to forward/backward flow of material and information. Closed-loop supply chains. Comparative study of sustainable vs. traditional models for local and global production systems. A course project is required for graduate credit.

I E 508. Design and Analysis of Allocation Mechanisms. (3-0) Cr. 3. *Prereq: 312 or Math 307.* Market-based allocation mechanisms from quantitative economic systems perspective. Pricing and costing models designed and analyzed with respect to decentralized decision processes, information requirements, and coordination. Case studies and examples from industries such as regulated utilities, semiconductor manufacturers, and financial engineering services.

I E 510. Network Analysis. (3-0) Cr. 3. *Prereq: 312. Form*ulation and solution of deterministic network flow problems including shortest path, minimum cost flow, and maximum flow. Network and graph formulations of combinatorial problems including assignment, matching, and spanning trees. Introduction to deterministic and stochastic dynamic programming.

I E 513. Analysis of Stochastic Systems. (3-0) Cr. 3. *Prereq: Stat 231.* Introduction to modeling and analysis of manufacturing and service systems subject to uncertainty. Topics include the Poisson process, renewal processes, Markov chains, and Brownian motion. Applications to inventory systems, production system design, production scheduling, reliability, and capacity planning.

I E 514. Production Scheduling. (3-0) Cr. 3. *Prereq: 312, 341.* Introduction to the theory of machine shop systems. Complexity results for various systems such as job, flow and open shops. Applications of linear programming, integer programming, network analysis. Enumerative methods for machine sequencing. Introduction to stochastic scheduling.

I E 519. Simulation Modeling and Analysis. (3-0) Cr. 3. *Prereq: Com S 311, Stat 401.* Event scheduling, process interaction, and continuous modeling techniques. Probability and Statistics related to simulation parameters including run length, inference, design of experiments, variance reduction, and stopping rules. Aspects of simulation languages.

I E 531. Quality Control and Engineering Statistics. (Cross-listed with Stat). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Stat 401; Stat 342 or 447.* Wu. Statistical methods and theory applicable to problems of industrial process monitoring and improvement. Statistical issues in industrial measurement; Shewhart, CUSUM, and other control charts; feedback control; process characterization studies; estimation of product and process characteristics; acceptance sampling, continuous sampling and sequential sampling; economic and decision theoretic arguments in industrial Statistics.

I E 533. Reliability. (Cross-listed with Stat). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Stat 342 or 432 or 447.* Meeker. Probabilistic modeling and inference in reliability; analysis of systems; Bayesian aspects; product limit estimator, probability plotting, maximum likelihood estimation for censored data, accelerated failure time and proportional hazards regression models with applications to accelerated life testing; repairable system data; planning studies to obtain reliability data.

I E 534. Linear Programming. (3-0) Cr. 3. *Prereq: 312.* Develop linear models. Theory and computational aspects of the simplex method. Duality theory and sensitivity analysis. Introduction to interior point methods and column generation. Multiobjective linear programs.

I E 537. Reliability and Safety Engineering. (3-0) Cr. 3. *Prereq: Stat 231 or Stat 401.* Mathematical basics for dealing with reliability data, theory, and analysis. Bayesian reliability analysis. Engineering ethics in safety evaluations. Case studies of accidents in large technological systems. Fault and event tree analysis.

I E 541. Inventory Control and Production Planning. (3-0) Cr. 3. *Prereq: 341.* Economic Order Quantity, dynamic lot sizing, newsboy, base stock, and (Q,r) models. Material Requirements Planning, Just-In-Time (JIT), variability in production systems, push and pull production systems, aggregate and workforce planning, and capacity management.

I E 545. Rapid Prototyping and Manufacturing. (3-0) Cr. 3. *Prereq: 248 or similar manufacturing experience.* Introduction to rapid prototyping processes and other rapid manufacturing methodologies. Operating principles and characteristics of current and developing rapid prototyping processes. Use of rapid prototypes in product design, development, and service. Selection of rapid prototyping systems based on rapid methodologies used in manufacturing processes and rapid tooling approaches.

I E 546. Geometric Variability in Manufacturing. (Dual-listed with 446). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: I E 348, or Mat E 341, or M E 324.* Assessment, accommodation, and control of geometric variability of manufacturing processes. Use of CMMs, vision and scanning systems, and prolifometers. Techniques to successfully accommodate variation through design of product, tooling or process plan including plastic injection molding, metalcasting, welding, machining, powder metallurgy. Methodologies to control geometric variability.

I E 549. Computer Aided Design and Manufacturing. (Dual-listed with 449). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 248, some experience with theory of matrices.* Representation and interpretation of curves, surfaces and solids. Parametric curves and surfaces and solid modeling. Use of CAD software and CAD/CAM integration. Computer numerical control, CNC programming languages, and process planning.

I E 561. Continuous Quality Improvement of Process. (3-0) Cr. 3. *Prereq: 361.* Methods for continuous quality improvement in process analysis. The systems analysis for process improvement model based on W. Edwards Deming. Quality function deployment methods. Case studies of applications to manufacturing and other heavy industries. Use of process analysis computerized programs and tools for design analysis.

I E 565. Systems Engineering and Analysis. (Cross-listed with Aer E, E E). (3-0) Cr. 3. *Prereq: Coursework in basic Statistics.* Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated systems. Life cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test and evaluation, and systems engineering planning and organization. Not available for degrees in industrial engineering.

I E 566. Applied Systems Engineering. (3-0) Cr. 3. *Prereq: 565.* Design for reliability, maintainability, usability, supportability, producibility, disposability, and life cycle costs in the context of the systems engineering process. Students will be required to apply the principles of systems engineering to a project including proposal, program plan, systems engineering management plan, and test and evaluation plan. Not available for degrees in industrial engineering.

I E 570. Systems Engineering and Project Management. (3-0) Cr. 3. *Prereq: Coursework in basic Statistics.* Systems view of projects and the processes by which they are implemented. Focuses on qualitative and quantitative tools and techniques of project management. Specific systems concepts, methodologies, and tools for effective management of both simple and complex projects. Introduction of important performance parameters for planning, cost control, scheduling, and productivity, including discussions of traditional and state of the art tools and systems.

I E 571. Occupational Biomechanics. (3-0) Cr. 3. *Prereq: EM 274, Stat 231.* Anatomical, physiological, and biomechanical bases of physical ergonomics. Anthropometry, body mechanics, strength of biomaterials, human motor control. Use of bioinstrumentation, passive industrial surveillance techniques and active risk assessment techniques. Acute injury and cumulative trauma disorders. Static and dynamic biomechanical modeling. Emphasis on low back, shoulder and hand/wrist biomechanics.

I E 572. Design and Evaluation of Human-Computer Interaction. (3-0) Cr. 3. *Prereq: 577.* Human factors methods applied to interface design, prototyping, and evaluation. Concepts related to understanding user characteristics, usability analysis, methods and techniques for design and evaluation of the interface. The evaluation and design of the information presentation characteristics of a wide variety of interfaces: web sites (e-commerce), computer games, information presentation systems (cockpits, instrumentation, etc.), and desktop virtual reality.

I E 576. Human Factors in Product Design. (3-0) Cr. 3. *Prereq: 577.* Investigation of the human interface to consumer and industrial systems and products, providing a basis for their design and evaluation. Discussions of human factors in the product design process: modeling the human during product use; usability; human factors methods in product design evaluation; user-device interface; safety, warnings, and instructions for products; considerations for human factors in the design of products for international use.

I E 577. Human Factors. (3-0) Cr. 3. *Prereq: 271, Stat 231 or 401.* Physical and psychological factors affecting human performance in systems. Signal detection theory, human reliability modeling, information theory, and performance shaping applied to safety, reliability, productivity, stress reduction, training, and human/equipment interface design. Laboratory assignments related to system design and operation.

I E 581. e-Commerce Systems Engineering. (Dual-listed with 481). (3-0) Cr. 3. *Prereq: 148.* Design, analysis, and implementation of e-commerce systems. Information infrastructure, enterprise models, enterprise processes, enterprise views. Data structures and algorithms used in e-commerce systems. SQL, exchange protocols, client/server model, web-based views.

I E 582. Enterprise Modeling and Integration. (3-0) Cr. 3. *Prereq: 3 credits in information technology or information systems.* The design and analysis of enterprise models to support information engineering of enterprise-wide systems. Representation of system behavior and structure including process modeling, information modeling, and conceptual modeling. Applications in enterprise application integration, enterprise resource planning systems, product data management systems, and manufacturing execution systems.

I E 583. Knowledge Discovery and Data Mining. (Dual-listed with 483). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 148, 312, and Stat 231.* Introduction to data warehouses and knowledge discovery. Techniques for data mining, including probabilistic and Statistical methods, genetic algorithms and neural networks, visualization techniques, and Mathematical programming. Advanced topics include web-mining and mining of multimedia data. Case studies from both manufacturing and service industries. A computing project and an additional project with more theoretical content are required.

I E 585. Requirements Engineering. (3-0) Cr. 3. *Prereq: 3 credits in information technology or information systems.* Principles and practices for requirements engineering as part of the product development process with emphasis on software systems engineering. Problem definition, problem analysis, requirements analysis, requirements elicitation, validation, specifications. Case studies using requirements engineering methods and techniques.

I E 588. Information Systems for Manufacturing. (3-0) Cr. 3. *Prereq: 148, 448.* Design and implementation of systems for the collection, maintenance, and usage of information needed for manufacturing operations, such as process control, quality, process definition, production definitions, inventory, and plant maintenance. Topics include interfacing with multiple data sources, methods to utilize the information to improve the process, system architectures, and maintaining adequate and accurate data for entities internal and external to the enterprise to achieve best manufacturing practices.

I E 590. Special Topics. Cr. arr. Repeatable. Advanced study of a research topic in the field of industrial engineering.

I E 599. Creative Component. Cr. arr. Repeatable.

A. Industrial Engineering
C. Operations Research

Courses for graduate students

I E 601. Ph.D. Research Basics and Communications. Cr. R. Repeatable. Principles and practices for conducting research at the Ph.D. level, including problem definition, proposal writing, presentations, conference proceedings, paper preparation, and project management.

I E 613. Stochastic Production Systems. (3-0) Cr. 3. *Prereq: 513.* Modeling techniques to evaluate performance and address issues in design, control,

and operation of systems. Markov models of single-stage make-to-order and make-to-stock systems. Approximations for non-Markovian systems. Impact of variability on flow lines. Open and closed queuing networks.

I E 631. Nonlinear Programming. (3-0) Cr. 3. *Prereq: 534.* Develop nonlinear models, convex sets and functions, optimality conditions, Lagrangian duality, unconstrained minimization techniques. Constrained minimization techniques covering penalty and barrier functions, sequential quadratic programming, the reduced gradient method.

I E 632. Integer Programming. (3-0) Cr. 3. *Prereq: 534.* Integer programming including cutting planes, branch and bound, and Lagrangian relaxation. Introduction to complexity issues and search-based heuristics.

I E 642. Simultaneous Engineering in Manufacturing Systems. (3-0) Cr. 3. *Prereq: 549 or M E 415.* Current engineering methods for the product life cycle process. Feature-based design, computer-aided process planning, and data-driven product engineering.

I E 690. Advanced Topics. Cr. arr. Repeatable. *Prereq: Permission of the instructor.* Advanced topics related to Ph.D. research in industrial engineering under the direction of the instructor.

I E 697. Engineering Internship. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of department.* Professional work period for a maximum of one semester per academic year. Satisfactory-fail only.

I E 699. Research. Cr. arr. Repeatable.
A. Industrial Engineering
C. Operations Research

Information Assurance

www.iac.iastate.edu

(Interdepartmental Graduate Major)

Supervisoy Committee: D. Jacobson (Chair), C. Bergman, J. McCormick, J. Wong.

Work is offered for the degree Master of Science with a major in information assurance under a cooperative arrangement with various departments including Electrical and Computer Engineering, Computer Science, Political Science, Logistics, Operations, and Management Information Systems, Mathematics, Industrial and Manufacturing Systems Engineering. Students graduating from the major will help to fill the need for well-educated system security specialists in the government, private sector, and academia. The program objectives identified as being critical to the accomplishment of this mission are: (1) Impart and enhance knowledge about information infrastructure security; (2) Expand and develop ability to engineer complex systems; (3) Instill and nurture social awareness, and the ability to function in a team; (4) Instill and nurture a sense of ethics; and (5) Develop an understanding of strategic and policy issues.

Students interested in the interdepartmental major apply and are admitted to both a home department (the department that is most closely aligned with the student's research interest and background) and to the program. The home department sets the admission standards, course requirements, and thesis standards.

The program is broadly based and uses courses in the various departments. The program will consist of 24 course credits with 6 credits of research work for a Master of Science with thesis. A non-thesis Master of Science will consist of 27 credits of courses and 3 credits of creative component. The courses are divided into three categories: core, electives, and thesis research.

A student's Program of Study Committee, in consultation with the student, determines the elective courses to be taken and the acceptability of transfer credits. The major professor will be selected from the discipline where the student is admitted (home department).

The basic prerequisite for admission to this program is a baccalaureate degree in engineering, mathematics, computer science, management information systems, political science, or closely related field. The GRE or GMAT examination may be required based on the standards of the home department. If the GRE or GMAT is not required it will be considered in admissions decisions if offered. Potential students with baccalaureate degrees in the physical sciences, statistics, or other related fields will be considered on an individual basis, possibly with provisional admission. The degree awarded is a master of science in information assurance.

A graduate certificate in Information Assurance is offered, which consists of four courses (12 credits) (InfAs 530, 531, 532, (533 or 535)).

For additional information students should contact the chair of the Supervisory Committee, 2215 Coover Hall, ISU, Ames, Iowa 50011, or www.iac.iastate.edu.

Courses for graduate students

InfAs 530. Advanced Protocols and Network Security. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Cpr E 381.* Detailed examination of networking standards, protocols, and their implementation. TCP/IP protocol suite, network application protocols, IP routing, network security issues. Emphasis on laboratory experiments.

InfAs 531. Information System Security. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Cpr E 489 or 530 or Com S 586 or MIS 535.* Computer and network security: basic cryptography, security policies, multilevel security models, attack and protection mechanisms, legal and ethical issues.

InfAs 532. Information Warfare. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Cpr E 531.* Computer system and network security: implementation, configuration, testing of security software and hardware, network monitoring. Authentication, firewalls, vulnerabilities, exploits, countermeasures. Ethics in information assurance. Emphasis on laboratory experiments.

InfAs 533. Cryptography. (Cross-listed with Math, Cpr E). (3-0) Cr. 3. S. *Prereq: Math 301 or Cpr E 310 or Com S 330.* Basic concepts of secure communication, DES and AES, public-key cryptosystems, elliptic curves, hash algorithms, digital signatures, applications. Relevant material on number theory and finite fields.

InfAs 534. Legal and Ethical Issues in Information Assurance. (Cross-listed with Cpr E, Pol S). (3-0) Cr. 3. S. *Prereq: Graduate classification, Cpr E or InfAs 531.* Legal and ethical issues in computer security. State and local codes and regulations. Privacy issues.

InfAs 535. Steganography and Watermarking. (Cross-listed with Math, Cpr E). (3-0) Cr. 3. S. *Prereq: Cpr E 531 or E E 524 or Math 533/Cpr E 533/InfAs 533.* Basic principles of steganography and watermarking. Algorithms based on spatial domain approaches, transformations of data, statistical approaches. Techniques for images, video, and audio data. Communications models for data hiding. Analysis, detection and recovery of hidden data. Military, commercial and e-commerce applications. Known theoretical results. Software packages for data hiding. Social and legal issues, case studies, and digital rights management issues that affect technological development of steganography and watermarking. Current developments in the area.

InfAs 536. Computer and Network Forensics. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Cpr E 381 and Cpr E 489 or 530.* Fundamentals of computer and network forensics, forensic duplication and analysis, network surveillance, intrusion detection and response, incident response, anonymity and pseudonymity, privacy-protection techniques, cyber law, computer security policies and guidelines, court testimony and report writing, and case studies. Emphasis on hands-on experiments.

InfAs 592. Seminar in Information Assurance. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Projects or seminar in Information Assurance.

InfAs 632. Information Assurance Capstone Design. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: 531, 532, 534.* Capstone design course which integrates the security design process. Design of a security policy. Creation of a security plan. Implementation of the security plan. The students will attach each other's secure environments in an effort to defeat the security systems. Students evaluate the security plans and the performance of the plans. Social, political and ethics issues. Student self-evaluation, journaling, final written report, and an oral report.

InfAs 697. Information Assurance Summer Internship. Cr. R. *Prereq: Permission of department, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

Interdisciplinary Graduate Studies

www.grad-college.iastate.edu/igs/

(Interdepartmental Graduate Program)

Supervisory Committee: G. A. Jackson, Chair; J. Courteau (Arts and Humanities), J. Mayfield (Biological and Physical Sciences), G. A. Jackson (General), S. Freeman (International Development Studies), S. J. Crase, (Social Sciences), C. Flora (Community Development)

The degree of master of science or master of arts with major in interdisciplinary graduate studies is available to graduate students who wish to have a more diversified program of advanced study than that generally permitted students who specialize in a single subject. Areas of specialization in arts and humanities, biological sciences, international development studies, physical sciences, social sciences, community development (see below) and a general area are designed to broaden and supplement a student's program. Students must take courses in three different graduate subject matter areas, each subject contributing a minimum of nine credits toward the 35 graduate credits required for the degree. Courses which may be used for credit toward this degree program are selected from those listed in the Graduate College Catalog for graduate credit.

Both thesis and nonthesis options are available except in arts and humanities in which a thesis is required. If the thesis option is chosen, a minimum of three credits of IGS 699 (Research) is required and a maximum of five credits of IGS 699 may be counted in the total of 35 required credits. If the nonthesis option is elected, evidence of original creative effort must be presented. This may be in the form of a demonstration of independent creativity such as a written report of laboratory, field, or library research; a project in fine arts; or some other original contribution acceptable to the student's committee. In the nonthesis option a minimum of three credits of IGS 599 (Creative Component) is required and a maximum of five credits of IGS 599 may be counted toward the total of 35 graduate credits. The student, in consultation with the program of study committee, will decide on the option. The committee also aids the student in planning a program of study and in selecting appropriate courses. Graduates will have

experience in designing their own program centered around issues they have identified. Because of the interdisciplinary nature of IGS, students are expected to synthesize knowledge from three different areas of study.

Students who wish to apply for admission to interdisciplinary graduate studies should communicate with the chair of the program, the chair of the supervisory committee or one of its members (see above).

Students in IGS may select a 37-credit area of specialization in Community Development. The Community Development area of specialization, offered in collaboration with five other universities in the Great Plains Interactive Distance Education Alliance, is offered exclusively through courses on the Web.

Courses for graduate students

IGS 599. Creative Component. Cr. arr. Repeatable.

IGS 699. Thesis Research. Cr. arr. Repeatable.

Interdisciplinary Studies

www.las.iastate.edu/academics/interdisciplinarystudies.shtml

(Interdepartmental undergraduate major administered by the College of Liberal Arts and Sciences)

A major in interdisciplinary studies is offered in the College of Liberal Arts and Sciences for undergraduate students who have unique interdisciplinary educational goals. The student, a faculty review board, and an academic adviser design the major. Leading to either the bachelor of arts or the bachelor of science degree, the major includes 36 to 48 credits of coursework chosen to provide a coherent, carefully planned program in an area of interest that bridges two or more departments. This specialized area is identified on the diploma. Learning goals are individually crafted for each proposed major.

A degree in Interdisciplinary Studies may be particularly attractive to students who wish to develop an area of interest based upon one of the College's cross-disciplinary programs. Areas of interest in Interdisciplinary Studies have included Classical Studies, Criminology and Criminal Justice, International Relations, Ecology Studies, African American Cultural Studies, Asian Studies, and U.S. Latino/a Studies.

A student seeking admission to the program in interdisciplinary studies writes a letter of application that explains how the proposed major meets specific educational and learning goals. A faculty review board screens applications. Since students are expected to earn at least 30 credits after they are admitted into the program, the proposal is ordinarily submitted to the review board in the sophomore or junior year. The proposal will be considered if the area of interest properly falls within the College of Liberal Arts and Sciences and if the student's educational goals cannot be met by a more traditional combination of existing majors, minors, and electives.

The interdisciplinary studies major must satisfy the requirements of the liberal arts and sciences curriculum in the College of Liberal Arts and Sciences. A major emphasizing the humanities or communicative arts normally leads to a B.A.; a major emphasizing the natural or social sciences normally leads to a B.S. Different requirements for the B.A. and B.S. degrees are determined by the nature of the chosen field of study. Courses listed in the individualized major may come from any department of the university with the following restrictions:

1. The selection of courses needs to focus on a single theme and be consistent with the career and educational goals of the student.

2. At least one half of the courses in the major will come from departments within the College of Liberal Arts and Sciences.

3. The courses will be chosen from at least two disciplines.

All courses in the major must be at the 200-level or higher. At least 15 credits must be at the 300-level or higher with at least 6 credits at the 400-level or higher. An average grade of C or better must be earned in 15 credits at the 300-level or higher in the major. To meet the English and communication proficiency requirement, a grade of C or better must be earned in either an advanced English composition course or a course in the major with a significant writing component.

Further information may be obtained from the college office.

International Agriculture

www.ageds.iastate.edu/intrnlag/index.htm

(Interdepartmental Undergraduate Program)

Supervisory Committee: Robert A. Martin, Chair; Michael D. Kenealy, Ebby Luvaga

The international agriculture program provides opportunities to develop knowledge and skills related to the factors that interact to impact agricultural and environmental issues, production, processes, distribution and utilization worldwide. The program puts emphasis on international experience through structured internships and study abroad. The international agriculture program is appropriate for students seeking positions that require knowledge and experience related to global agricultural issues and their impact on local, regional, national and international policies and practices. Students preparing for careers in the following areas will benefit from the international agriculture program; governmental and non-governmental development agencies, agribusinesses, educational institutions, and non-profit assistance agencies. Outcomes from participation in this program include developing an awareness for the role of international agriculture in the career development process, analyzing international agricultural issues and policies, acquiring skills for solving problems in international development and agribusiness and experiencing real situations and gaining perspectives about agriculture in a global setting.

Secondary Major

International agriculture is an undergraduate secondary major that may be taken only in conjunction with a primary major in an agriculture and life sciences curriculum. Students choosing international agriculture will strengthen their career placement with a business or agency involved in international activities. Technical knowledge of a primary major discipline will be strengthened by a global awareness of agriculture and life sciences. A secondary major in international agriculture will give students practical insight into the role of agriculture in a world of increasing food and fiber needs. It is ideal for those who wish to broaden their international perspective or prepare for international work in agriculture. The secondary major includes an emphasis on international internship or study abroad and/or foreign languages, and selection of appropriate courses (from an approved list) to meet the needs and interests of the student.

Courses for the secondary major include Agron 342; six credits of study abroad, travel, or language courses or any combination thereof; and six credits in selected international agriculture courses in the College of Agriculture and Life Sciences. Fifteen credits of the secondary major cannot be used to meet requirements of the major or any other college or university requirement.

See *International Agriculture, Curriculum*, for the specific program. Students interested in earning a secondary major in international agriculture must contact a program adviser. The early indication of an interest in international agriculture allows for effective integration of the secondary major course requirements with those of the primary major.

Minor

A minor in international agriculture is available to interested students regardless of their major. Students selecting the minor should have at least minimal familiarity with agriculture and life sciences and agricultural systems.

Courses for the minor include Agron 342; 3 to 6 credits of study abroad and/or foreign language and 3 to 6 credits in selected international agriculture courses in the College of Agriculture and Life Sciences. Nine credits of the 15 credit total for the minor can not be used for meeting requirements for the major.

For more information about a secondary major or minor in international agriculture, see descriptions in the designated departments or the supervisory committee.

For more information about courses for either a secondary major or a minor in international agriculture, see descriptions in the designated departments.

International Business

Interdepartmental Undergraduate Secondary Major

Supervisory Committee: Dr. Ann Coppernoll-Farni (contact person) and others annually appointed by College.

The international business program is designed to provide students with information that will enable them to work for companies that are involved with international business. Students are expected to develop an understanding of international business issues applied to the different functional areas of business. They will also develop skills to prepare themselves for business positions with international responsibilities. The program is designed to prepare students for employment in multinational companies and for business assignments beyond the United States.

International business is an undergraduate secondary major that may be taken only in conjunction with a primary major in business. Technical knowledge of international business will strengthen the expertise acquired with the primary major. Business students pursuing this program should strengthen their placement opportunities with multinational corporations.

A student in the College of Business may earn a secondary major in International Business. The requirements for this major include 12 credits in international business courses, one year of the same university-level foreign language (minimum of 6 credits) and an approved international experience (minimum 3 months). Students who pursue this secondary major will be required to complete the requirements for a primary major in Business. Fifteen of the 18 credits required for the International Business major must not be used for the primary major.

International Studies

www.las.iastate.edu/international/major.shtml

(InterdepartmentalUndergraduate Major and Minor, Administered by the College of Liberal Arts and Sciences)

Director: Dawn Bratsch-Prince

Faculty Steering Committee: Charles Dobbs, Chad Gasta, Hsain Ilahaine, Olga Mesropova, Thomas Waldemer.

Undergraduates completing the International Studies major understand the interconnections between local and global issues and events. They can integrate their understanding of a selected global issue with knowledge of the major culture, values, and problems of a selected geographical area. They can communicate with persons of cultures other than their own and, in so doing, appreciate the impact of their own cultural and educational experience on their perception of the world. The international studies program provides opportunities for students to develop skills and understanding about international events and problems, and global issues. The program is designed for students who wish to prepare for work or advanced study in the international arena, such as in foreign service, journalism, advocacy organizations, scientific or research institutions, business, nongovernmental development organizations (NGOs), humanitarian agencies, environmental organizations, human rights organizations, think tanks, international agriculture, engineering, and other fields.

A secondary major and a minor in International Studies are available for undergraduates. The program requirements are structured around a combination of a designated Topical Module and a Geographic Regional Studies Component. Each student's program of study is designed to reflect programmatic opportunities at Iowa State University and the academic, intellectual, and professional interests of the student.

Secondary Major

A student seeking a secondary major in International Studies must successfully complete a minimum of 27 semester credits in courses approved for use in the International Studies program, including: IntSt 235, 430; 21 credits in courses approved for the International Studies program, with a minimum of 9 credits (at least 6 of which are numbered 300 or above) in a designated Topical Module and a minimum of 9 credits (at least 6 of which are numbered 300 or above) in a Geographic Regional Studies Component; Fulfillment of Language Proficiency (see below); study abroad.

The major must include a minimum of 12 credits not used to meet any other department, college, or university requirement.

Minor

A student seeking a minor in International Studies must successfully complete a minimum of 18 semester credits in courses approved for use in the International Studies program, including: IntSt 235, IntSt 430; 12 credits in courses approved for the International Studies program, with a minimum of 6 credits (at least 3 of which are numbered 300 or above) in a designated Topical Module and a minimum of 6 credits (at least 3 of which are numbered 300 or above) in a Geographic Regional Studies Component; Fulfillment of Language Proficiency (see below); study abroad.

The minor must include a minimum of 9 credits not used to meet any other department, college, or university requirement.

Language Proficiency

Students with a major or minor in International Studies fulfill the Language Proficiency requirement through one of the following options:

•Completion of two years of university-level language instruction in a single, appropriate foreign language, as demonstrated by a foreign language course numbered 202 or higher. Students whose first language is other than English fulfill Language Proficiency with Engl 250 at a grade of "C" or better.

•Passing an examination given by the Dept. of World Languages and Cultures or otherwise certifying proficiency equivalent to two years of college instruction. Students proficient in languages not offered at ISU may petition for special consideration.

•Intensive study abroad experience that includes in-the-field-use of a language other than English (individual prior approval of committee required for this option).

A. Topical Modules
•Global Environmental Issues
•Globalization and Economic Development
•International Issues in Science and Technology
•International Communication
•International Conflict
•Social and Cultural Change

B. Geographic Regional Studies Component
•Africa and Middle East
•Asia
•Latin America
•Western Europe
•Russia, East Europe and Central Asia

International Studies students are required to participate in study and/or work abroad programs. Students may petition to use up to 9 credits in the major (6 credits in the minor) earned in study abroad and/or international internship programs to substitute for courses within the Topical Module, Geographic Regional Studies Component, and/or Language Proficiency requirements.

Courses primarily for undergraduate students

IntSt 235. Introduction to International Studies. (3-0) Cr. 3. F.SS. Overview of international studies, emphasizing cultural, geographic, economic, and political characteristics of major world areas and nations.

IntSt 350. Topics in International Studies. Cr. arr.

IntSt 430. Seminar in International Studies. (3-0) Cr. 3. S. Capstone seminar in international studies focused on economic development, women's issues, war and ethnic conflict, population, the environment, globalization, human rights, international trade and business and other issues. Students develop a project on a subject linked to their area of professional interest or academic specialization.

IntSt 446. International Issues and Challenges in Sustainable Development. (Cross-listed with Agron, Globe). Cr. 4. S. *Prereq: 3-credit biology course, Sophomore or higher classification, permission of Instructor.* Mullen. Interdisciplinary study and analysis of agricultural, biophysical, environmental, sociological, economical, political, and historical factors affecting sustainable development of communities and countries from art and science perspectives. International field experience with foreign language training required. A program fee is charged to students for international study abroad.

IntSt 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of International Studies Advisory Committee Chair and faculty supervisor.* Designed to meet the needs of students who wish to study in areas other than those in which courses are offered or to integrate areas of study appropriate to special problems with international foci. No more than 3 credits of IntSt 490 may be used in the International Studies major or minor..

Iowa Lakeside Laboratory

www.lakesidelab.org

(Interinstitutional Program)

Participating Faculty: Neil P. Bernstein (Biology, Mount Mercy College), Bonnie S. Bowen (Ecology, Evolution and Organismal Biology, Iowa State University), C. Lee Burras (Agronomy, Iowa State University), C. Arthur Croyle (Art and Design, Iowa State University), John F. Doershuk (Anthropology, University of Iowa, and State Archaeologist), Mark B. Edlund (Science Museum of Minnesota, St. Croix Watershed Research Station), Jim Heynen (English, St. Olaf College), Laura L. Jackson (Biology, University of Northern Iowa), Stephen Juggins, (School of Geography, Politics & Sociology, University of Newcastle, UK), Kenneth L. Lang (Biological Sciences, Humboldt State University), Michael J. Lannoo (Muncie Center for Medical Education, Ball State University), William R. Norris (Natural Sciences, Western New Mexico University), Clay L. Pierce (Natural Resource Ecology and Management, Iowa State University), Thomas R. Rosburg (Biology, Drake University), Daryl D. Smith (Native Roadside Vegetation Center, University of Northern Iowa), Sarah A. Spaulding (Inst. of Arctic & Alpine Research, University of Colorado), Lois H. Tiffany (Ecology, Evolution and Organismal Biology, Iowa State University), Arnold van der Valk (Ecology, Evolution, and Organismal Biology), James L. Wee (Biological Sciences, Loyola University).

Iowa Lakeside Laboratory is run cooperatively by the Iowa Lakeside Laboratory Consortium whose members include Drake University, Iowa State University, the University of Northern Iowa, and the University of Iowa. Lakeside courses can be taken for credit through all Consortium members. Students should check with their advisers to determine whether Lakeside courses can be used to satisfy major or minor requirements or college or university general education requirements.

The Laboratory was established in 1909 for the conservation and study of the rich flora and fauna of northwest Iowa, especially those of the Iowa Great Lakes region with its numerous lakes, wetlands, and prairies. Its campus is located on approximately 140 acres of restored prairie, wetland, and gallery forest along the west shore of West Okoboji Lake. Lakeside's mission is to provide undergraduate and graduate students an opportunity to get hands-on experience working with a variety of natural and human environments through its field-oriented summer courses and to provide research facilities and support for graduate students and faculty working on research projects in northwestern Iowa. Each summer, Iowa Lakeside Laboratory offers students a unique educational experience: small, full-immersion, field-oriented courses in the natural sciences (archaeology, ecology, environmental science, hydrology, evolution, geology, soils, taxonomy). All courses meet all day from Monday through Friday. The majority of courses run for 4 weeks. Enrollments in most courses are limited to 8 to 10 students. Courses are taught at the undergraduate (sophomore and junior) and the senior/graduate level. Students obtain one credit for each week (40 hours) in class. One and two week courses are also available, including courses designed especially for teachers. Weather permitting, students normally spend at least part of each day doing field work, either as part of their class work or working on individual or group projects. Because some courses are offered intermittently, the current Iowa Lakeside Laboratory summer brochure or the Lakeside Lab Website (www.lakesidelab.org) should be consulted for the list of courses being offered in a given summer session. The Lakeside Lab Website

(www.lakesidelab.org) also contains additional information about the Laboratory and about each course being offered.

Research projects by undergraduates, graduate students and faculty can be done either on the campus or at many nearby natural areas. Undergraduate and graduate students are strongly encouraged to do independent projects at Lakeside and graduate students are welcome to use it as a base for their thesis and dissertation research. Laboratory space and other facilities are available for long-term or short-term research projects.

Teaching and research facilities include eight laboratory buildings, a library, and a lecture hall. Living accommodations include cottages, motel-style units, and a large mess hall. All students are encouraged to stay at Lakeside while they are taking courses to take full advantage of its educational, professional, and social life.

Financial Aid

Iowa Lakeside Laboratory Scholarships are available to both undergraduates and graduate students. All scholarships cover room and board. Information about how to apply for Iowa Lakeside Laboratory Scholarships is included on the Website (www.lakesidelab.org). Students should also consult the Student Financial Aid Office for other scholarship, work study, and loan programs for which they are eligible.

Registration

Students can only enroll in Iowa Lakeside Lab courses by submitting an Iowa Lakeside Lab Registration and Scholarship form and Housing form to the Iowa Lakeside Laboratory Administrative Office. These forms are found on the Iowa Lakeside Laboratory Website: (www.lakesidelab.org) where they can be submitted online or downloaded. For further information, contact

Iowa Lakeside Laboratory
1838 Highway 86
Milford, IA 51351
Phone: (712) 337-3669
FAX: (712) 337-0361
E-Mail: peter-vanderlinden@uiowa.edu

Early registration is advisable. Because enrollment in Lakeside courses is limited, students should register before May 1 for the following summer session. Housing is also limited and students must apply for housing or indicate that they plan to live off campus at the time of registration.

Courses primarily for undergraduate students

Ia LL 302. Plant-Animal Interactions. Cr. 4. Alt. SS., offered 2011. *Prereq: One course in the biological sciences.* Introduction to ecology and co-evolution of plants and animals; emphasis on dispersal, pollination, and plant-herbivore interactions; field and laboratory work, reading, discussion.

Ia LL 303I. Undergraduate Internships. (Cross-listed with NREM). Cr. arr. SS. *Prereq: Permission of instructor and sophomore standing.* Placement with county conservation boards, camps, parks, etc. for experience as interpreters, rangers, and technicians.

Ia LL 312I. Ecology. (Cross-listed with A Ecl, EnSci). Cr. 4. SS. An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

Ia LL 326I. Ornithology. (Cross-listed with A Ecl). Cr. 4. SS. The biology, ecology, and behavior of birds with emphasis on field studies of local avifauna. Group projects stress techniques of population analysis and methodology for population studies.

Ia LL 364. Biology of Aquatic Plants. Cr. 4. Alt. SS., offered 2010. A field-oriented introduction to the taxonomy and ecology of aquatic plants in lakes, wetlands and rivers. Individual or group projects.

Ia LL 367. Plant Taxonomy. Cr. 4. SS. Principles of classification and evolution of vascular plants; taxonomic tools and collection techniques; use of keys. Field and laboratory studies emphasizing identification of local flowering plants and recognition of major plant families.

Ia LL 371I. Introduction to Insect Ecology. (Cross-listed with Ent). (3-3) Cr. 4. Alt. SS., offered 2011. Field and laboratory study of insects, their diversity, life history; emphasis on ecology and behavior.

Ia LL 402I. Watershed Hydrology and Surficial Processes. (Cross-listed with Agron, EnSci. Cr. 4. SS. *Prereq: Four courses in physical or biological sciences or engineering.* Effects of geomorphology, soils, and land use on transport of water and materials (nutrients, contaminates) in watersheds. Fieldwork will emphasize investigations of the Iowa Great Lakes watershed. Nonmajor graduate credit.

Ia LL 403. Evolution. Cr. 4. SS. Mechanisms and patterns in microevolution and macroevolution. Field exercises will emphasize studies of natural selection, adaptation, genetic variation, and population genetics of local plant and animal populations. Nonmajor graduate credit.

Ia LL 404I. Behavioral Ecology. (Cross-listed with A Ecl). Cr. 4. Alt. SS., offered 2010. *Prereq: Two semesters of biology.* Animal coloniality, courtship, territoriality, predator defense, habitat selection, foraging, mating systems, and parental care will be examined in the field in order to evaluate various ecological and evolutionary theories of animal behavior.

Ia LL 415. Freshwater Invertebrates. Cr. 4. SS. *Prereq: One or more ecology courses.* Field-oriented introduction to the identification, life-history, and ecology of common, free-living freshwater invertebrates of north-temperate lakes, rivers, and wetlands. Emphasis on the role of invertebrates in aquatic food chains and litter processing. Nonmajor graduate credit.

Ia LL 419I. Vertebrate Ecology and Evolution. (Cross-listed with A Ecl). Cr. 4. SS. Field and laboratory study of representative vertebrates of northwestern Iowa. Observations and experimentation emphasize ecological histories by integrating concepts of functional morphology, behavioral ecology, and evolutionary biology. Nonmajor graduate credit.

Ia LL 420I. Amphibians and Reptiles. (Cross-listed with A Ecl). Cr. 4. Alt. SS., offered 2010. *Prereq: Two semesters of biology.* Ecology, behavior, and conservation biology of amphibians and reptiles with emphasis on their anatomy and morphology; temperature and water regulation; locomotion; life history; reproduction; population and community ecology; and conservation.

Ia LL 422I. Prairie Ecology. (Cross-listed with EnSci). Cr. 4. SS. *Prereq: Familiarity with basic principles in biological sciences and ecology.* Basic patterns and underlying physical and biotic causes of both regional and local distributions of plants and animals of North American prairies; field and laboratory analyses and projects. Nonmajor graduate credit.

Ia LL 425I. Aquatic Toxicology and Wetland Dynamics in Freshwater Systems. Cr. 4. SS. *Prereq: Introductory biology course and general chemistry course.* Fundamental knowledge and understanding of the scientific concepts related to the physio-chemical and biological environment. Problems and issues (global, national, regional, and local) associated with freshwater systems and how wetland restoration can be used to ameliorate problems. Discussion and application of basic tools used to assess aquatic toxicological problems. Nonmajor graduate credit.

Ia LL 427I. Archaeology. (Cross-listed with Anthr). Cr. 4. SS. Nature of cultural and environmental evidence in archaeology and how they are used to model past human behavior and land use; emphasis on Iowa prehistory; basic reconnaissance surveying and excavation techniques. Nonmajor graduate credit.

Ia LL 435I. Illustrating Nature I Sketching. (Cross-listed with BPM I). Cr. 2. SS. Sketching plants, animals and terrain. Visual communication, development of a personal style, and integration of typographic and visual elements on a page will be emphasized.

Ia LL 436I. Illustrating Nature II Photography. (Cross-listed with BPM I). Cr. 2. SS. Beginning to intermediate technical and compositional aspects of color photography of natural areas and their plants and animals.

Ia LL 461I. Introduction to GIS. (Cross-listed with EnSci, Env S, L A). Cr. 4. SS. Descriptive and predictive GIS modeling techniques, spatial Statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management. Nonmajor graduate credit.

Ia LL 463I. Soil formation and Landscape Relationships. (Dual-listed with 563I). (Cross-listed with Agron, EnSci). Cr. 4. Alt. SS., offered 2010. *Prereq: Agron 154 or 260.* Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Nonmajor graduate credit.

Ia LL 484. Plant Ecology. Cr. 4. SS. Principles of plant population, community, and ecosystem ecology illustrated through studies of native vegetation in local prairies, wetlands and forests. Group or individual projects. Nonmajor graduate credit.

Ia LL 490I. Undergraduate Independent Study. (Cross-listed with Anthr, NREM). Cr. arr. Repeatable. SS. *Prereq: Junior or senior classification and permission of instructor.*

Ia LL 493. Natural History Workshop. Cr. arr. SS. Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.
A. Amphibians and Reptiles
B. Birds and Birding
C. Nature Photography
D. Mushrooms and Other Fungi
E. Iowa's Trees and Forests
F. Fish Biology
G. Prairies
I. Common Insects
J. Aquatic Plants
K. Life in Rivers
L. Life in Lakes
M. Mosses and Liverworts
N. Natural History of Iowa Great Lakes Region
P. Field Archaeology
Q. Common Algae
S. Scuba Diving
T. Astronomy
U. Sketching Nature

Ia LL 494. Ecosystems of North America. Cr. arr. SS. *Prereq: A general ecology course and permission of the instructor.* An extended field trip to study a particular type of ecosystem (prairie, coastal wetland, forest, alpine, coral reefs, etc.) or the ecosystems of a specific region (Rocky Mountains, Gulf Coast, Appalachian Mountains, Deserts of the Southwest, Central America, etc.). Prior to the field trip, there will be an orientation period and after each field trip a review and synthesis period. A field trip fee will be assessed to cover travel expenses. Nonmajor graduate credit.

Ia LL 499. Undergraduate Research. Cr. arr. *Prereq: Junior or senior classification and permission of instructor.*

Courses primarily for graduate students, open to qualified undergraduate students

Ia LL 501I. Freshwater Algae. (Cross-listed with EEOB). Cr. 4. SS. Structure and taxonomy of freshwater algae based on field collected material; emphasis on genus-level identifications, habitats visited include lakes, fens, streams, and rivers; algal ecology.

Ia LL 503. Graduate Internships. Cr. arr. SS. *Prereq: Permission of instructor and graduate standing.* Placement with county conservation boards, camps, parks, schools, etc. For experience as interpreters, rangers, technicians, and teachers.

Ia LL 508I. Aquatic Ecology. (Cross-listed with EnSci, NREM). Cr. 4. SS. *Prereq: Courses in ecology, chemistry, and physics.* Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

Ia LL 523I. Fish Ecology. (Cross-listed with A Ecl). Cr. 4. Alt. SS., offered 2010. Basic principles of fish interaction with the biotic and abiotic environment. Field methods, taxonomy, and biology of fish with emphasis on the fish fauna of northwestern Iowa.

Ia LL 526I. Advanced Field Ornithology. (Cross-listed with A Ecl). Cr. 2. SS. *Prereq: Concurrent registration in Ia LL 326I.* Field study of birds of the upper Midwest; extended field trip to Minnesota and Wisconsin; individual or group project.

Ia LL 531I. Conservation Biology. (Cross-listed with EEOB, A Ecl). Cr. 4. Alt. SS., offered 2010. *Prereq: Ia LL 312I.* Population-and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

Ia LL 532. Analysis of Environmental Data. (2-0) Cr. 2. SS. *Prereq: An undergraduate course in statistics, understanding of basic concepts such as correlation and regression, and familiarity with PC-based software for data analysis.* Analysis of Environmental Data will provide students with training in the theory and application of a range of Statistical techniques useful for the analysis of ecological and paleoecological data. Topics will include data management, exploratory data analysis, regression analysis, direct and indirect ordination methods, classification techniques, transfer functions and the analysis of temporal data. Practical classes will provide hands-on training in the use of Statistical and graphical software including R, CANOCO, C2, and TWINSPAN. The course will be directed towards advanced undergraduate, graduate and working professionals in ecology and paleoecology.

Ia LL 535I. Restoration Ecology. (Cross-listed with A Ecl, EnSci, EEOB). Cr. 4. Alt. SS., offered 2010. *Prereq: A course in ecology.* Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

Ia LL 563I. Soil formation and Landscape Relationships. (Dual-listed with 463I).(Cross-listed with Agron, EnSci). Cr. 4. Alt. SS., offered 2010. *Prereq: Agron 154 or 260.* Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use.

Ia LL 564I. Wetland Ecology. (Cross-listed with EnSci, EEOB). Cr. 4. SS. *Prereq: Ia LL 312I.* Ecology, classification, creation, restoration, and management of wetlands. Field studies will examine the composition, structure and functions of local natural wetlands and restored prairie pothole wetlands. Individual or group projects.

Ia LL 573. Techniques for Biology Teaching. (Cross-listed with EEOB, A Ecl). Cr. arr. Repeatable. SS. The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A. Animal Biology (Same as A Ecl 573A)
B. Plant Biology
C. Fungi and Lichens
D. Aquatic Ecology
E. Prairie Ecology
F. Wetland Ecology
G. Limnology (Same as A Ecl 573G)
H. Animal Behavior (Same as A Ecl 573H)
I. Insect Ecology
J. Biology of Invertebrates
K. Non-invasive Use of Living Organisms
W. Project WET (Same as A Ecl 573W)

Ia LL 575I. Field Mycology. (Cross-listed with EEOB). Cr. 4. Alt. SS., offered 2010. Identification and classification of the common fungi; techniques for identification, preservation, and culture practiced with members of the various fungi groups.

Ia LL 580I. Ecology and Systematics of Diatoms. (Cross-listed with EEOB). Cr. 4. SS. Field and laboratory study of freshwater diatoms; techniques in collection, preparation, and identification of diatom samples; study of environmental factors affecting growth, distribution, taxonomic characters; project design and execution including construction of reference and voucher collections and data organization and analysis.

Ia LL 590I. Graduate Independent Study. (Cross-listed with A Ecl, Anthr, EEOB). Cr. arr. Repeatable. SS. *Prereq: Graduate classification and permission of instructor.*

Ia LL 593. Natural History Workshop. Cr. arr. *Prereq: Permission of instructor.* Graduate workshop on some aspect of the natural history of the Upper Midwest or on techniques for studying natural history.

Courses for graduate students

Ia LL 699I. Research. (Cross-listed with A Ecl, Anthr, EEOB, GDCB). Cr. arr. Repeatable.

Journalism and Communication, The Greenlee School of

www.jlmc.iastate.edu

Michael Bugeja, Director

Professors: Abbott, Beell, Bugeja, Peterson, Rodriguez, Smith

Professors (Emeritus): Disney, Emmerson, Friederich, Gillette, Kunerth, Shelley, Wechsler

Associate Professors: Geske, Mack, Prior-Miller

Associate Professors (Emeritus): Coon, Fowler, Haws

Assistant Professors: Blevins, Bulla, Chamberlin, Cozma, Dahlstrom, Dimitrova, Groshek, Han, Harms, Lee, Newell, Sar

Senior Lecturers: Wilgenbusch

Lecturers: D. Bugeja, Haag, Monahan, Rouse, Thomas

Clinicians: Ames, Gibson

The Greenlee School of Journalism and Communication offers work for the bachelor of arts in advertising, and the bachelor of science degree in journalism and mass communication. The unit, founded in 1905, has been continuously accredited every six years since 1948 by the Accrediting Council on Education in Journalism and Mass Communications and was last reaccredited in 2004. Accreditation is based on the principle that students need a broad-based, liberal arts education, as well as a solid core of courses within the discipline.

Undergraduate Study

Students who complete degrees in advertising or journalism and mass communication will develop competencies in 12 key areas:

History/role of professionals and institutions: Demonstrate an understanding of the history and role of professionals and institutions in shaping communications;

First Amendment/Law: Understand and apply the principles and laws of freedom of speech and press, including the right to dissent, to monitor and criticize power, and to assemble and petition for redress of grievances;

Theory: Understand concepts and apply theories in the use and presentation of images and information;

Research and evaluation: Conduct research and evaluate information by methods appropriate to the communications professions in which they work;

Diversity: Demonstrate an understanding of the diversity of groups in a global society in relationship to communications;

Ethics: Demonstrate an understanding of professional ethical principles and work ethically in pursuit of truth, accuracy, fairness and diversity;

Critical thinking: Think critically, creatively and independently;

Writing: Write correctly and clearly in forms and styles appropriate for the communications professions, audiences and purposes they serve;

Visual Communication: Conceptualize, prepare or select appropriate methods to convey information in visual form, whether as a complement or supplement to words;

Numeracy: Apply basic numerical and statistical concepts; ***Critical Evaluation/Editing:*** Critically evaluate their own work and that of others for accuracy and fairness, clarity, appropriate style and grammatical correctness;

Tools and technology: Apply tools and technologies appropriate for the communications professions in which they work.

To become an advertising or journalism and mass communication major, the student must 1) have either achieved a score of 26 or higher on the ACT English exam, 590 or higher on the SAT verbal exam, or passed the School's English Usage Test as outlined in the Greenlee School's policy for meeting the English Usage Standard; and 2) have completed the pre-major core requirements (See majors). Until these requirements are successfully completed, advertising and journalism and mass communication students are designated as pre-majors. A copy of the EUT policy, including additional details and requirements, is available from the Greenlee School.

Communication Proficiency Requirement
To meet the University's Communication Proficiency requirement, all majors in the School must earn a grade of C or better in English 150 and 250 (or 250H). These additional requirements apply:

Advrt majors must earn a C+ or better in JI MC 201 and one of Advrt 334 or 336.

JI MC majors must earn a C+ or better in JI MC 201 and 202 or 206 or 321.

The Advertising Major

The advertising major prepares students for careers in business and industry or for graduate education. Students majoring in advertising find career opportunities in professions requiring applied communication expertise. Graduates are qualified for positions in the creative and account sides of advertising within businesses, agencies and media.

To become an advertising major, a student must successfully complete JI MC 101, 110, and 201 (with a C+ or better) and Advrt 230. Until the EUT standard is met and these courses are successfully completed, advertising students are designated as pre-majors. To receive a bachelor of arts degree in advertising, a student must earn at least 120 credits. A minimum of 80 credits must come from courses other than Advrt or JI MC and must include Principles of Marketing, Mkt 340. At least 65 of these credits must come from the liberal arts and sciences, and must include Principles of Statistics, Stat 101, or other approved statistics course, and Fundamentals of Public Speaking, Sp Cm 212. Overall, at least 45 credits must be from 300-level courses or above.

The degree requirements allow for a minimum of 33 and a maximum of 40 credits to be taken in Advrt and JI MC. These include the pre-major core requirements of 9 credits: Mass Media and Society, JI MC 101, 3 credits; Orientation to Journalism and Communication, JI MC 110, required; Reporting and Writing for the Mass Media, JI MC 201, 3 credits; and Principles of Advertising, Advrt 230, 3 credits.

Advrt 301, Strategic Planning for Advertising and Public Relations, JI MC 460 Law of Mass Communication, and JI MC 499 Professional Media Internship, are required of all Advrt majors. Additional recommended courses and requirements for the advertising major are available from the Greenlee School.

Advrt majors need a broad-based academic background that the School seeks to ensure by requiring a Designated Area of Concentration (DAC) made up of 21 credits with at least 12 credits from the 300-level or above. The DAC is a secondary area of expertise made up of courses selected and designed by the student, with adviser approval, to complement the student's professional and academic interests. A second major outside of Advrt or JI MC may substitute for the DAC.

The Journalism and Mass Communication Major

The major in journalism and mass communication prepares students for careers that involve all aspects of news and information. The emphasis is on generating ideas, organizing, writing, editing and presenting information for various media platforms and audiences. Graduates most likely will work in journalism (magazines, newspapers, electronic media or on-line media) and public relations and public information as well as related disciplines that expect articulate and informed writing and presentation. Students work with advisers to develop programs of study designed to prepare them for work in a variety of communication-specific areas: electronic media, print media (magazine and/or newspaper), public relations/public information, science communication or visual communication.

To be a JI MC major, a student must successfully complete JI MC 101, 110 and 201 (with a C+ or better). Until the EUT standard is met and these courses are successfully completed, journalism and mass communication students are designated as pre-majors. To receive a bachelor of science degree in journalism and mass communication, a student must earn at least 120 credits. A minimum of 80 credits must come from courses other than Advrt or JI MC. At least 65 of these credits must come from the liberal arts and sciences and must include Principles of Statistics, Stat 101, or other approved statistics course. Overall, at least 45 credits must be from 300-level or above.

The degree requirements allow for a minimum of 33 and a maximum of 40 credits to be taken in Advrt and JI MC. These include the pre-major core requirements of 6 credits: Mass Media and Society, JI MC 101, 3 credits; Orientation to Journalism and Communication, JI MC 110, required; Reporting and Writing for the Mass Media, JI MC 201, 3 credits.

JI MC 460 Law of Mass Communication and JI MC 499 Professional Media Internship are required of all JI MC majors. Additional recommended courses and requirements for the journalism and mass communication major are available from the Greenlee School.

JI MC majors need a broad-based academic background that the School seeks to ensure by requiring a Designated Area of Concentration (DAC) made up of 21 credits. All courses for the DAC must be taken outside of Advrt and JI MC. At least 12 credits must be from the 300-level or above. The DAC is a secondary area of expertise made up of courses selected and designed by the student, with adviser approval, to complement the student's professional and academic interests. A second major may substitute for the DAC.

Minors

The Greenlee School offers a minor in Advertising and a minor in Journalism and Mass Communication.

For a minor in Advertising or Journalism and Mass Communication, students complete 15 credits, beginning with JI MC 101. The remaining 12 credits, at least 9 of which must be from Iowa State University, are selected from course offerings in the advertising and journalism and mass communication majors, as follows: 6 credits from the following 200- and 300-level courses, Advrt 230, 301, and 335; JI MC 220, 301, 305, 341, and 342; and 6 credits from the following 400-level courses; JI MC 401, 406, 453, 454, 461, 462, 464, 474, 476 and 477 and Advrt or JI MC 497.

JI MC majors may not minor in Advrt and Advrt majors may not minor in JI MC.

Graduate Study

The Greenlee School of Journalism and Communication offers work for a master of science degree in journalism and mass communication. Two tracks are available: one for students who desire specialized study in communication theory and research; the second for students who wish to strengthen professional strategic skills.

Majors plan programs of study in one of two tracks:

I. Communication as theory and research – The School offers advanced academic preparation in communication theory and research leading to the master of science degree. Graduate work prepares students to use and contribute to research and scholarship in the field of communication. The degree requires a thesis or creative component based on original research, which must be defended successfully before a committee at the end of the program.

Areas of research emphasis include: science and risk communication, media performance, media effects, advertising, public relations, political communication, communication technology, law and ethics, international communication and visual communication.

II. Professional and Strategic Communication – The School offers advanced professional study in journalism and mass communication leading to the master of science degree. Graduate work prepares students for professional careers in a variety of mass communication fields. Students with limited training or experience in journalism and mass communication may include skills courses in their programs for no credit. The degree requires either a creative component or thesis.

All students must complete four core courses: Introduction to Graduate Study in Journalism and Mass Communication (JI MC 592), Theories of Mass Communication (JI MC 501), Communication Research Methods (JI MC 502) and Seminars in Mass Communication (JI MC 598). Each student selects elective courses based on his/her area of emphasis and career goal, in consultation with the student's major professor and Program of Study Committee.

The Greenlee School graduate program offers minor work for students majoring in other departments. The M.S. minor requires JI MC 501 (Communication Theory), JI MC 510 (Communication Strategies), and one other course in journalism and mass communication for a total of 9 credits taken within the Greenlee School.

Advertising (Advrt)

Courses primarily for undergraduate students

Advrt 230. Advertising Principles. (3-0) Cr. 3. F.S. Historical, social, economic and legal aspects of advertising. Evaluations of advertising research, media, strategy, and appeals. Study of the creation of print and broadcast advertising.

Advrt 301. Strategic Planning for Advertising and Public Relations. (Cross-listed with JI MC). (3-0) Cr. 3. F.S. *Prereq: 230 or JI MC 220; Sophomore classification.* Prospect analysis, market segmentation, positioning, strategic planning, public opinion formation, communication strategy formation and development of critical thinking skills.

Advrt 334. Advertising Creativity. (2-2) Cr. 3. *Prereq: C+ or better in JI MC 201; Advrt/JI MC 301.* Development and execution of creative advertising materials. Copywriting, art direction and computer applications for print, broadcast and digital media. Creative strategy development, execution and evaluation.

Advrt 335. Advertising Media Planning. (3-0) Cr. 3. *Prereq: Advrt/JI MC 301.* Concepts of media planning and selection in the development, execution and evaluation of advertising campaigns. Characteristics and capabilities of the advertising media. Utilization of market segmentation, consumer buying and media audience databases.

Advrt 336. Advertising Account Management. (3-0) Cr. 3. *Prereq: C+ or better in JI MC 201; Advrt/JI MC 301.* Fundamentals of account management with emphasis on leadership, sales techniques, relationship building, presentation skills, and strategic thinking. Includes aspects of agency revenue growth, team building, client management, evaluating creative concepts and media plans, and developing strategic proposals and campaign recommendations.

Advrt 390. Professional Skills Development. (Cross-listed with JI MC). Cr. arr. Repeatable. *Prereq: C+ or better in 201, other vary by topic; instructor permission.* Credit not given for working on student or professional media. Check School for course availability.

Advrt 434. Advertising Campaigns. (3-0) Cr. 3. F.S. *Prereq: Advrt/JI MC 301; C+ or better in 334 or 336, and major Status.* Development of advertising campaigns for business and social institutions. Projects

involve budgeting, media selection, market analysis, campaign strategy, and creative execution.

Advrt 435. Advertising Competition. Cr. arr. Repeatable. S. *Prereq: Permission of instructor, Junior/senior standing strongly recommended.* Preparation of materials for regional and national competitions.

Advrt 436. Advertising Portfolio Practicum. (2-2) Cr. 3. *Prereq: C+ or better in 334, instructor permission.* Advanced advertising writing and design. Emphasis on creative strategy, problem solving and execution of creative materials in print, broadcast and on-line media for a variety of clients.

Advrt 497. Special Topics in Communication. (Cross-listed with Jl MC). Cr. arr. Repeatable. Seminars or one-time classes on topics of relevance to students in communication.

Journalism and Mass Communication (Jl MC)

Courses primarily for undergraduate students

Jl MC 101. Mass Media and Society. (3-0) Cr. 3. F.S. Communication models and their application to the mass media; the mass communication process; organization, characteristics and responsibilities of the mass media; media-related professional operations.

Jl MC 110. Orientation to Journalism and Communication. Cr. R. F.S. Orientation to career opportunities, emphasis areas and requirements in the Greenlee School. Satisfactory-fail only.

Jl MC 201. Reporting and Writing for the Mass Media. (1-4) Cr. 3. F.S. *Prereq: Engl 250 (or testout) and either a score of 26 or higher on the ACT-English exam, 590 or higher on the SAT verbal exam or a passing score on the School's English Usage Test.* Generating story ideas, exercising news judgment and gathering information via interviews, observation and documentary sources to produce news and informational material for the mass media. Emphasis on analyzing and organizing information, as well as accuracy and principles of good writing.

Jl MC 202. Intermediate Reporting and Writing for the Mass Media. (2-2) Cr. 3. F.S. *Prereq: C+ or better in 201.* Designed for students interested in writing for newspapers, magazines and online media. Enhancing and refining skills in developing sources and generating story ideas. information-gathering techniques, reporting and writing. Includes segments on local government and judiciary.

Jl MC 206. Reporting and Writing for the Electronic Media. (2-3) Cr. 3. F.S. *Prereq: C+ or better in 201.* Researching, organizing, and writing for radio, television and online media. Basic principles of news, information and entertainment programming. An emphasis on development, content and structure.

Jl MC 220. Principles of Public Relations. (3-0) Cr. 3. F.S. Introduction to public relations in business, government and non-profit organizations; functions, processes, and management; attitudes, public opinion and persuasion; overview of theory.

Jl MC 301. Strategic Planning for Advertising and Public Relations. (Cross-listed with Advrt). (3-0) Cr. 3. F.S. *Prereq: Advrt 230 or Jl MC 220; Sophomore classification.* Prospect analysis, market segmentation, positioning, strategic planning, public opinion formation, communication strategy formation and development of critical thinking skills.

Jl MC 305. Publicity Methods. (3-0) Cr. 3. *Prereq: Engl 250, Sophomore classification.* Communication and publicity fundamentals and the use of media for publicity purposes. Preparing releases for print and broadcast; basics of publication layout. Publicity campaigns. Not available to Jl MC and Advrt majors.

Jl MC 306. Electronic Media Production. (2-2) Cr. 3. F.S. *Prereq: C+ or better in Jl MC 201.* Introduction to studio production using professional equipment. Course focus on visual concepts, maintenance and practical operation of studio equipment.

Jl MC 308. Electronic News Gathering and Production. (2-3) Cr. 3. *Prereq: C+ or better in 202 or 206 or 321; 306.* Field techniques in single-camera video production used to shoot and edit visual stories. Introduction to electronic news gathering.

Jl MC 310. Fundamentals of Photojournalism. (1-3) Cr. 3. *Prereq: C+ or better in 201.* Basic photojournalism techniques. Includes camera operation, lighting, composition, and photo reproduction techniques for print or computer-mediated applications. Emphasis on using the camera as a reporting tool. Basic use of digital imaging and editing software. Ethical issues involving photojournalism.

Jl MC 315. Multimedia Production. (2-2) Cr. 3. *Prereq: 306 or 342L or 343L or equivalent computer design proficiency.* Concepts and principles for evaluating, constructing, and designing information for the Web and other computer-mediated communication systems. Explores the use of computer-generated animation and graphics, audio and video. Issues of ethics and ownership of work pertinent to the new media are discussed.

Jl MC 321. Public Relations Writing. (2-3) Cr. 3. *Prereq: C+ or better in 201; 220 or Advrt 230; 342 and 342L or computer design proficiency recommended. May be taken concurrently with 301.* Developing and writing public relations materials with an emphasis on media relations and news. Techniques addressed include media kits, brochures, newsletters and speeches.

Jl MC 341. Contemporary Magazine Publishing. (Dual-listed with 541). (3-0) Cr. 3. *Prereq: Junior classification.* Analysis of magazine industry and specific audiences served by print and online magazines. Editorial procedures and policies, advertising, circulation, and history of the industry. Individual study of magazines.

Jl MC 342. Visual Principles for Mass Communicators. (3-0) Cr. 3. *Prereq: Sophomore classification.* Understanding of the visual message. Visual perception, visual communication theory, design syntax, design elements and how they are applied in journalism and mass communication.

Jl MC 342L. Laboratory in Basic Visual Principles. (2-2) Cr. 3. *Prereq: Credit or enrollment in 342.* Introduction to desktop publishing, beginning techniques in layout. Application of visual principles to design simple print projects.

Jl MC 343L. Laboratory in Intermediate Visual Principles. (2-2) Cr. 3. *Prereq: 342L or equivalent computer design proficiency.* Application of more advanced features of desktop publishing and other document-enhancing software. Production of newsletters, multi-page brochures and other documents.

Jl MC 344. Depth Reporting and Writing. (2-2) Cr. 3. F. *Prereq: C+ or better in 202 or 206 or 321.* Developing and writing comprehensive news features and magazine articles. Majors may not apply both 344 and Engl 303 toward graduation.

Jl MC 346. Public Affairs Reporting. (2-2) Cr. 3. S. *Prereq: C+ or better in 202 or 206 or 321.* Reporting on government, business, and other institutions; identification of and access to public records; investigative reporting techniques; developing major stories on government and non-profit organizations, and issues for print and broadcast media.

Jl MC 347. Science Communication. (Dual-listed with 547). (2-2) Cr. 3. S. *Prereq: C+ or better in 202 or 206 or 321 for Jl MC majors; C+ or better in Jl MC 201 and Advrt 334 or 336 for Advrt majors. Nonmajors by permission of instructor.* Reporting and writing about science and technology topics for general audiences. Outlets for stories include print, broadcast and online media. Story topics include reporting about basic, applied sciences and social sciences, as well as ethical, political and policy issues related to science and technology.

Jl MC 349. Print Media Editing. (1-5) Cr. 3. *Prereq: C+ or better in 202 or 206 or 321.* Grammar, punctuation, usage, syntax and logic. Editing newspaper, magazine and online copy. Headline, title writing and visual presentation. Use of computer editing programs.

Jl MC 354. Advanced Electronic Media Production. (2-3) Cr. 3. *Prereq: 306 and 308.* Application of advanced television techniques: producing, directing and managing live and recorded information programs.

Jl MC 390. Professional Skills Development. (Cross-listed with Advrt). Cr. arr. Repeatable. *Prereq: C+ or better in 201, other vary by topic. Instructor permission.* Credit not given for working on student or professional media. Check School for course availability.

Jl MC 401. Mass Communication Theory. (3-0) Cr. 3. *Prereq: Junior classification.* Theory and research in mass communication processes and effects; the scientific process; methods of measuring, evaluating and reporting mass communication research.

Jl MC 406. Media Management. (Dual-listed with 506). (3-0) Cr. 3. *Prereq: Junior classification.* Decision-making functions of media. Basic media market analysis, media organization and management, circulation and audience development, technological developments affecting management decisions, and relationships with labor and regulatory agencies that affect media operations.

Jl MC 424. Public Relations Campaigns. (3-0) Cr. 3. *Prereq: 220, 301, and C+ or better in 321; junior classification. Section B: C+ or better in 202 or 206; instructor permission only.* Developing public relations and corporate communication campaigns for business and social institutions.

Jl MC 449. Advanced Print Media Editing. (3-0) Cr. 3. S. *Prereq: 342, 342L, 349 or concurrent enrollment; junior classification.* Developing higher-level editorial skills needed for issue-planning, editorial management and decision making. Designing, developing, and repositioning existing and new magazines, newspapers, and new media. Editing complex manuscripts, with continued emphasis on grammar, punctuation, usage, syntax and logic. Use of computer publishing programs. Nonmajor graduate credit.

Jl MC 453. Electronic Media Technology and Public Policy. (3-0) Cr. 3. *Prereq: Junior classification.* Issues and policies affecting historical, contemporary and future developments of electronic media and their technologies.

Jl MC 454. Critical Analysis and History of the Moving Image. (3-0) Cr. 3. *Prereq: Junior classification.* Evolution of motion picture and television content and other visual technologies. Theories and techniques for evaluating and critiquing film and video. Nonmajor graduate credit.

Jl MC 460. Law of Mass Communication. (3-0) Cr. 3. F.S. *Prereq: C+ or better in 201; junior classification.* First Amendment law, libel, privacy, obscenity, contempt, copyright, trademark, the Federal Communications Act; laws affecting advertising, legal publication, and other business activities of the media, including the Internet. Nonmajor graduate credit.

Jl MC 461. History of American Journalism. (3-0) Cr. 3. *Prereq: Junior classification.* Role of the mass media, including advertising and public relations, in shaping the social, economic and political history of America; impact of change in these areas on the development, traditions, and philosophies of the media. Nonmajor graduate credit.

Jl MC 462. Media Ethics, Freedom, Responsibility. (3-0) Cr. 3. *Prereq: Junior classification.* Media ethics and performance; functions of the media in relation to the executive, judicial and legislative branches of government; agencies of media criticism; right to know versus right to privacy.

Jl MC 464. Journalism and Literature. (3-0) Cr. 3. *Prereq: Junior classification.* A study of journalism's impact on literary writing and literature's impact on journalism, as seen through the works of such American author-journalists as Ernest Hemingway, Truman Capote, Joan Didion, John McPhee, Tom Wolfe, Hunter Thompson. Nonmajor graduate credit.

JI MC 474. Communication Technology and Social Change. (Cross-listed with T SC). (3-0) Cr. 3. *Prereq: Junior classification.* Examination of historical and current communication technologies, including how they shape and are shaped by the cultural and social practices into which they are introduced.

JI MC 476. World Communication Systems. (Dual-listed with 576). (3-0) Cr. 3. *Prereq: Junior classification.* World communication systems and social, political, and economic factors determining flow, character, and volume of news. Impact of media information and entertainment content on nations and societies. Comparative analysis of role and impact of traditional modes of communication, the mass media, and computer-mediated systems.

JI MC 477. Ethnicity, Gender, Class and the Media. (3-0) Cr. 3. *Prereq: Junior classification.* Portrayals of ethnic groups, genders, and classes in the media in news, information, and entertainment; the effects of mass media on social issues and population groups. Nonmajor graduate credit.

JI MC 490. Independent Study in Communication. Cr. arr. *Prereq: Junior classification and contract with supervising professor to register.* Independent studies are research-based. Students may study problems associated with a medium, a professional specialization, a philosophical or practical concern, a reportorial method or writing technique, or a special topic in their field. Credit is not given for working on student or professional media without an accompanying research component. See Greenlee School Student Services Office for more information. No more than 3 credits of JI MC 490 may be used toward a degree in journalism and mass communication or advertising.

JI MC 497. Special Topics in Communication. (Cross-listed with Advrt). Cr. arr. Repeatable. Seminars or one-time classes on topics of relevance to students interested in communication.

JI MC 499. Professional Media Internship. Cr. 3. *Prereq: JI MC majors, C+ or better in 202 or 206 or 321; Advrt majors, C+ or better in JI MC 201; Advrt 301; All students, junior classification, formal faculty adviser approval of written proposal.* Required of all JI MC and Advrt majors. A 400-hour internship in the student's journalism and mass communication or advertising specialization. Assessment based on employer evaluations, student reports and faculty reviews. Available only to JI MC and Advrt majors. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

JI MC 501. Theories of Mass Communication. (3-0) Cr. 3. F. *Prereq: 6 credits in social science or admission to the graduate program.* Examination of major areas of research activity and theoretical development related to organization, functions, and effects of mass communication.

JI MC 502. Communication Research Methods. (3-2) Cr. 4. S. *Prereq: 501 or equivalent communication theory course.* Research methods in journalism and mass communication, including problem selection, sampling, hypothesis formulation, research design, data collection and analysis. Designing a research strategy appropriate for a variety of communication-related questions and assessing the appropriateness, validity, and generalizability of research results.

JI MC 506. Media Management. (Dual-listed with 406). (3-0) Cr. 3. S. *Prereq: 6 credits in social science (economics highly recommended) or admission to the graduate program.* Decision-making functions of media. Basic media market analysis, media organization and management, circulation and audience development, technological developments affecting management decisions, and relationships with labor and regulatory agencies that affect media operations.

JI MC 510. Strategies of Communication. (3-0) Cr. 3. *Prereq: 501.* The process of developing professional communication and persuasion strategies, with emphasis on problem definition, behavioral objectives, situation analysis, strategy formulation, and justification through application of communication theories and research results.

JI MC 520. Persuasion Theory and Methods. (3-0) Cr. 3. *Prereq: 6 credits in social science.* Theories and research methods applied to the study and practice of public relations.

JI MC 521. Theories of Visual Communication. (2-2) Cr. 3. *Prereq: 6 credits in social science.* Introduction to the study of picture-based media (film, television, photography, advertising, etc.). Exploration of theoretical concepts of vision and perception, visual literacy, visual language, visual persuasion/manipulations, and the cultural implications of visual images.

JI MC 541. Contemporary Magazine Publishing. (Dual-listed with 341). (3-0) Cr. 3. *Prereq: 502 or Instructor permission.* Analysis of magazine industry and specific audiences served by print and online magazines. Editorial procedures and policies, advertising, circulation, and history of the industry. Roundtable on research literature.

JI MC 547. Science Communication. (Dual-listed with 347). (2-2) Cr. 3. S. *Prereq: 6 credits of social science or admission to the graduate program.* Reporting and writing about science and technology topics for general audiences. Outlets for stories include print, broadcast and online media. Story topics include reporting about basic, applied and social sciences, as well as ethical, political and policy issues related to science and technology. Nonmajors by permission of instructor.

JI MC 561. Media and Society: Interrelationships. (3-0) Cr. 3. F. *Prereq: 6 credits in social science.* Media functions in a democratic society; conflicts between the media and social institutions; ethical and social controls on the media.

JI MC 574. Communication Technologies and social Change. (Cross-listed with T SC). (3-0) Cr. 3. *Prereq: 6 credits in social science.* Personal, organizational, and social implications of the use of communication technologies. Includes theories and empirical research across the continuum of perspectives, from techno-utopianism through an anti-technology stance.

JI MC 576. World Communication Systems. (Dual-listed with 476). (3-0) Cr. 3. World communication systems and social, political, and economic factors determining flow, character, and volume of news. Impact of media information and entertainment content on nations and societies. Comparative analysis of role and impact of traditional modes of communication, the mass media and computer-mediated systems.

JI MC 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
A. Media Studies
B. Professional Specialization
C. Research Problems and Methods
D. Technique and Style
E. Specialized Communication

JI MC 591. Professional Internship. Cr. arr. F.S.SS. *Prereq: Permission of instructor.* Supervised internship experience. Satisfactory-fail only.

JI MC 592. Introduction to Graduate Study in Journalism and Mass Communication. Cr. R. F. *Prereq: Graduate classification.* Overview of advanced study in journalism and mass communication with special emphasis on requirements for obtaining the master of science degree.

JI MC 598. Seminars in Mass Communication. Cr. arr. Repeatable.
A. Audiences and Effects
B. Communication Technology
C. Professional Communication
D. Development Communication
E. Evaluation Methods
F. International Communication
G. Mass Communication History
H. Mass Communication Law
I. Media Management
J. Research Methods
K. Society and Mass Communication
L. Journalism and Mass Communication Education
M. Visual Communication
N. Broadcast Communication
O. Communication Theory
P. Computer Mediated Communication
Q. Science, Technology and Risk Communication.

JI MC 599. Creative Component. Cr. arr. *Prereq: Approved creative component proposal.*

Courses for graduate students

JI MC 699. Thesis Research. Cr. arr. Repeatable. *Prereq: Approved thesis proposal.*

Kinesiology

(www.edu.iastate.edu/hhp/homepage.htm)

Philip Martin, Chair of Department Distinguished Professors (Emeritus): Forker, Toman

Professors: Anderson, Bloedel, Franke, King, Martin, Sharp

Professors (Emeritus): Frye, Hutchison, Schneider, J. Thomas

Professor (Emeritus Adjunct): Beran

Associate Professors: Derrick, Ekkekakis, Engelhorn, Gillette, Kohut, Smiley-Oyen, K. Thomas, Welk

Associate Professor (Emeritus): Wood

Assistant Professors: Baker, Murdoch, Schabel, Selsby, Welch

Assistant Professor (Emeritus): McDonald

Assistant Professors (Collaborators): Buck, Senchina

Instructors (Adjunct): Coberley, Meier, O'Mara, Pak

Senior Lecturers: Atkinson, Denton, Lipsey, Power

Lecturers: Dukes, Franke, Gundlach, Miller, Nespor, Norris, Packheiser, Peel, Spry-Knutson, Wissink

Mission

We promote health and well-being by creating and disseminating knowledge about physical activity and active living. Through discovery, learning and engagement we improve the lives of citizens of Iowa, the United States and the world.

Goals

The department has identified the following goals to support this mission:

1. We seek to improve the lives of citizens of Iowa, the United States, and the world by the creation and dissemination of knowledge about physical activity and its relationship to health and well-being.

2. We prepare scholars and professionals in the study of physical activity at the undergraduate and graduate levels.

3. We educate the public and the University community in the scientific aspects of physical activity especially exercise, sport, and the role of movement throughout the lifespan.

Overview of Programs

The Department Kinesiology provides opportunities for matriculation leading to the degrees of Bachelor of Science, Master of Science, and Doctor of Philosophy. At both the undergraduate and graduate level, there are opportunities for study in the department's two specializations: the behavioral and biological bases of physical activity.

Undergraduate Study

Dance. Coursework in dance provides opportunities for students to develop an understanding and appreciation of dance as part of a liberal education. Those interested in teaching dance and Physical Education in the public schools may major in

health and human performance (teacher licensure option) and minor in dance.

An interdisciplinary Performing Arts major with a dance emphasis is available through the College of Liberal Arts and Sciences. For further information see *Index, Theatre and Performing Arts*.

The department offers a minor in dance that may be earned by completing the following: Dance 220, 222, 270, 320, 360, 384, 385 or 386, and three additional credits selected from dance courses numbered 200 or above. Participation in Orchesis I or II is recommended.

Kinesiology. Kinesiology. The undergraduate curriculum in Kinesiology is comprised of four components: general education, the Basic Core, the Advanced Core, and the option component. The intent of the general education component is to promote intellectual and personal growth and to prepare students for success in the basic, advanced and option components. The Basic Core enables students to understand, define and explore their own health and physical activity through the cognitive, affective and psychomotor domains. The Advanced Core extends this learning to include disciplinary concepts and tools of inquiry that comprise scientific literacy associated with health and physical activity. Finally, coursework within each specialization option builds upon this personal and scholarly learning by enabling students to master content and skills specific to career applications. The specialization Options comprise a focused area of study within Kinesiology. Options available are 1) Athletic Training, 2) Community and Public Health, 3) Exercise Science, 4) General Studies, and 5) Health/Fitness Management and 6) Physical Education/Licensure. Enrollment in the Athletic Training and Physical Education Licensure options is limited because of accreditation requirements and the provision of more individualized field experiences.

Academic options within the undergraduate program. Students in the CAATE accredited Athletic Training option are prepared for the National Athletic Training Association Board of Certification examination or for graduate work in athletic training. Graduates of this option will effectively use their expertise to plan Strategies aimed at the prevention, treatment and rehabilitation of athletic injuries.

Academic options within the undergraduate program. Students in the CAAHEP accredited Athletic Training option are prepared for the National Athletic Training Association Board of Certification examination or for graduate work in athletic training. Graduates of this option will effectively use their expertise to plan Strategies aimed at the prevention, treatment and rehabilitation of athletic injuries.

Students in the Community and Public Health option are prepared for professional employment at local, state or national health agencies, medical centers, and other public organizations that seek to promote health in the population. The curriculum prepares students to take the Certified Health Education Specialist certification examination upon graduation.

Students in the Exercise Science option utilize an interdisciplinary approach to the study of human movement. In so doing, they become prepared for graduate study in Kinesiology or advanced study leading to careers in medicine, physical therapy, or other allied health programs.

Students in the General Studies option combine kinesiology with a concentration in another area of study to support an individualized program, such as community sport and recreation, dance, and other sport, exercise, or health related fields. Programs of study must be approved by the undergraduate program coordinator.

Students in the Health/Fitness Management option are prepared for professional roles as health and fitness leaders or program managers. Employment opportunities include work in corporate fitness programs, health clubs, cardiac rehabilitation programs or personal training. Graduates are able to plan, implement and supervise exercise programs which will improve fitness and health. Graduates also have a basic understanding of economic and management issues related to business applications in the health and fitness field.

Students in the Physical Education Licensure option are prepared to teach Physical Education in grades K-12 and to meet the State of Iowa learning outcomes for teachers. Graduates can plan developmentally appropriate physical education, and individualize instruction and assessment for diverse audiences.

Learning outcomes for the undergraduate degree. Despite the diversity in specialization Options, the Learning Outcomes comprise a common framework for each student as they matriculate through Iowa State University.

The learning outcomes emphasized in academic coursework in the Department of Kinesiology are:

Content knowledge. The student has a broad conceptual view of physical activity and health, recognizes its scientific underpinnings (e.g. history, content, disciplinary concepts, and tools of inquiry) and appreciates the interdisciplinary nature of the study of physical activity and health. Literacy will be gained from the personal, scholarly and professional perspectives.

Discovery and critical thinking. The student can use accepted techniques of discovery and apply critical thinking within and outside of the discipline area. The student will be able to solve problems independently and evaluate opinions and outcomes at the personal scholarly and professional level.

Communication. The student uses knowledge of effective verbal, nonverbal and media communication techniques to foster inquiry, collaboration, and engagement in physical activity and health related settings.

Numeracy. The student understands and uses qualitative and quantitative analysis through formal and informal assessment strategies.

Technology. The student understands and uses a variety of technological applications to improve personal understanding and to enhance scholarly pursuits and professional practice in their chosen area of study.

Learning in the following domains occurs both in and outside the Iowa State University experience. The department will foster development in these domains through its courses and other activities.

Citizenship. The student uses value and ethics based decision making to demonstrate personal, professional and world citizenship through fostering relationships, embracing leadership, accepting social responsibility, seeking and completing opportunities to improve the quality of life for others.

Lifelong learning. The student is a reflective professional who actively seeks to further self-knowledge and seeks opportunities to grow professionally.

Diversity. The student understands how individuals differ in their approaches to initiating and maintaining a physically active, healthy lifestyle, and creates appropriate environments for diverse participants.

The department offers a minor in athletic coaching. The minor may be earned by completing the following: Kin 220, 258, 315, 355, 358, 365; Biol 155; and Psych 230.

The department offers a minor in sport and culture. The minor may be earned by completing the following: Kin 360 and 365; and completing 9 credits from the following: Kin 242, 315, 331, 442, and 445.

Endorsement to Coach Interscholastic Athletics. The State Department of Education has provided for the endorsement of licensed teachers for the coaching of athletic teams in schools. The endorsement does not lead to licensure to teach physical education. For requirements of the program, leading to the coaching endorsement, see *Teacher Education, Requirements for Areas of Specialization*.

Basic Activity Instruction Program. The department offers a wide selection of beginning, intermediate, and advanced courses in the areas of aquatics, dance, and sports. These courses are designed to serve general education purposes for all students.

B.S./M.S. degree in Diet and Exercise. A combined Bachelor of Science and Master of Science (B.S./M.S.) degree in diet and exercise is available. The program is jointly administered by the Department of Food Science and Human Nutrition (FS HN), within the Colleges of Agriculture and Human Sciences, and the Department of Kinesiology, within the College of Human Sciences. Students interested in this program must enroll as freshmen in the pre-diet and exercise program In the fall of the junior year students will apply for admission to the B.S./M.S. program. Students not accepted into the program will continue toward completion of a B.S. degree in dietetics or kinesiology. Coursework has been designed to facilitate a 4-year graduation date for those students not accepted into the program and electing to complete a single undergraduate degree. Students accepted into the program will progress toward completion of B.S./M.S. degrees in diet and exercise.

Graduate Study

The Department of Kinesiology graduate seeks to integrate discovery and learning by preparing graduate students to understand and create basic and applied knowledge in the study of physical activity, exercise and sport. For all graduate degrees the department offers specializations in behavioral basis of physical activity and biological basis of physical activity. The normal prerequisite to major graduate work is the satisfactory completion of a curriculum essentially equivalent to that required of undergraduate students in kinesiology at this university. However, it is possible for students to qualify for graduate study if undergraduate preparation has been in a related area.

Students in the M.S. and Ph.D. degrees are required to complete original research and write a thesis or dissertation. There is a nonthesis degree option for M.S. students requiring more coursework and an internship experience or other creative component. Specific information about the requirements for these degree options is available from the department office or from the department web site (www.kin.hs.iastate.edu/graduate).

The department participates in the interdepartmental minor in gerontology (see *Index*).

Courses primarily for undergraduate students

Kin 101. Swimming I. (0-3) Cr. 1. F.S. Basic course for nonswimmers. Emphasis on two fundamental strokes and personal water safety skills. Satisfactory-fail only.

Kin 102. Swimming II. (0-3) Cr. 1. F.S. *Prereq: 101 or equivalent skill.* Intermediate course. Emphasis on learning and improving five basic strokes and personal water safety skills. Satisfactory-fail only.

Kin 108. Aquatic Fitness. (0-3) Cr. 1. *Prereq: 102 or equivalent skill.* Water related exercises, activities, and swimming workouts to improve physical fitness. Satisfactory-fail only.

Kin 114. Lifeguard Training. (0-3) Cr. 1. F.S. *Prereq: Ability to swim 500 yards continuously of front crawl, sidestroke, and breaststroke; perform a standing and surface dive; swim under water; and tread water for one minute. Minimum age 16.* Specific training for Red Cross Lifeguard certification. First aid and CPR included. Satisfactory-fail only.

Kin 116. Water Safety Instructor Practicum. (0-3) Cr. 1. *Prereq: H S 105, CPR certification, and permission of instructor.* Supervised teaching experience in swimming, aquatic fitness, lifeguard training, and WSI courses. Satisfactory-fail only.

Kin 117. Lifeguard Training Instructor. (0-2) Cr. 1. F.S. *Prereq: Minimum age 17; able to swim 500 yards; current lifeguard, first aid, and CPR certifications.* The students will learn skills (rescue skills and CPR for the Professional Rescuer) necessary to certify prospective Lifeguards in the American Red Cross Lifeguard Training Program. Satisfactory-fail only.

Kin 118. Water Safety Instructor. (1-3) Cr. 2. S. *Prereq: Minimum age 17; able to swim 500 yards; current first aid and CPR certification.* The students will learn the skills necessary to teach and certify individuals in the following American Red Cross courses. Learn to Swim Program (Levels 1-6), Parent and Child Aquatics (Level A 6 months-2 years; Level B 18 months-5 years), Safety Training for Swim Team Coaches, Community Water Safety, Home Pool Safety, Aquatic Leader Program, and Basic Water Rescue. Satisfactory-fail only.

Kin 119. Archery. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 122. Badminton. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 126. Pocket Billiards. (0-2) Cr. 1. F.S. Introduction to the basic strokes (stop, draw, follow) and contemporary game forms associated with pocket billiards. Satisfactory-fail only.

Kin 129. Bowling. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 135. Golf. (0-2) Cr. 1. F.S. Beginning skills only. Satisfactory-fail only.

Kin 144. Racquetball. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 153. Ice Skating. (0-2) Cr. 1. Satisfactory-fail only.

Kin 158. Tennis. (0-2) Cr. 1. F.S.SS. Introduction to basic skills (forehand, backhand, service) and basic knowledge of game play. Satisfactory-fail only.

Kin 162. Triathlon Training. (0-3) Cr. 1. F.S. *Prereq: 102 or equivalent skill.* Introduction to the sport of triathlon integrating the discipline(s) of running, cycling, and swimming. Emphasis on cross-training systems and skill enhancement. Satisfactory-fail only.

Kin 163. Physical Fitness. (0-3) Cr. 1. Evaluation of fitness Status. Exercises, activities, and programs to improve physical fitness. Relationship between physical activity and weight control. Credit for only Ex Sp 163 or 258 may be applied toward graduation. Satisfactory-fail only.

Kin 164. Walking for Fitness. (0-3) Cr. 1. F.S. Fitness walking as an activity to improve health and fitness; values of this type of activity as a lifetime endeavor. Satisfactory-fail only.

Kin 166. Weight Training. (0-3) Cr. 1. F.S. Satisfactory-fail only.

Kin 170. Tae Kwon Do/Karate I. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 171. Tae Kwon Do/Karate II. (0-2) Cr. 1. Satisfactory-fail only.

Kin 173. Hap Ki Do/Martial Self-Defense. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 182. Volleyball. (0-2) Cr. 1. Satisfactory-fail only.

Kin 185. Soccer. (0-2) Cr. 1. Satisfactory-fail only.

Kin 220. Basic Athletic Training. (1-2) Cr. 2. *Prereq: Biol 155 or 255 and 256.* Introduction to methods of prevention and immediate care of athletic injuries. Basic information concerning health supervision of athletes, and some basic wrapping and strapping techniques for common injuries.

Kin 221. Pre-Athletic Training Clinical Practicum. (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 222 and permission of athletic training program director.* Athletic training clinical observation experiences to accompany 222. Utilize knowledge to evaluate, analyze and demonstrate appropriate taping, wrapping and basic skill techniques. Open to students interested in the athletic training option. Satisfactory-fail only.

Kin 222. Basic Athletic Training for Athletic Trainers. (2-2) Cr. 3. S. *Prereq: Biol 255, 255L.* Provides pre-athletic training students with the knowledge of the profession of a certified athletic trainer, factors associated with injury prevention, treatment, emergency care of athletic injuries, protective equipment, basic organization, administrative, and legal concepts in the athletic training setting. To be taken concurrently with 221.

Kin 223. Clinical Practicum in Athletic Training. (0-3) Cr. 1. F. *Prereq: Permission of Athletic Training Program Director.* Athletic training clinical experiences for athletic training students during pre-season intercollegiate football. Clinical experiences include: Professional Rescuer CPR, AED certification, emergency splinting and spineboarding, medical record keeping and HIPPA regulations, environmental conditions, prevention of injury screening strategies, athletic training room and education program policies and procedures, review of athletic taping techniques, acute injury management, mouthpiece formation, and anatomy review. Satisfactory-fail only.

Kin 224. Evaluation of Athletic Injuries I. (2-3) Cr. 3. F. *Prereq: Permission of athletic training program director.* Sport injury assessment procedures and evaluation techniques for lower body injuries. Includes an overview of mechanisms of injury, general musculoskeletal disorders, and dermatological conditions. Designed for students in the athletic training option or preprofessional health programs.

Kin 225. Athletic Injuries I Clinical Practicum. (0-3) Cr. 1. F. *Prereq: Permission of athletic training program director.* Athletic training clinical experience to accompany 224. Open to students in the athletic training option. Satisfactory-fail only.

Kin 226. Evaluation of Athletic Injuries II. (2-3) Cr. 3. S. *Prereq: Permission of athletic training program director.* Sport injury assessment procedures and evaluation techniques for upper body injuries. Includes an overview of common illnesses of athletes and sport specific injuries. Designed for students in the athletic training option or preprofessional health programs.

Kin 227. Athletic Injuries II Clinical Practicum. (0-3) Cr. 1. S. *Prereq: Permission of athletic training program director.* Athletic training clinical experience to accompany 226. Open to students in the athletic training option. Satisfactory-fail only.

Kin 230. Fundamentals of Aquatics. (0-3) Cr. 1. S. *Prereq: 101 or equivalent.* Eligibility for admission to Kin teacher education program. Basic water safety and emergency water safety. Skill enhancement, understanding, and progressions.

Kin 231. Fundamentals of Tumbling and Gymnastics. (0-3) Cr. 1. F. *Prereq: Eligibility for admission to Kin teacher education program.* Fundamentals of tumbling and gymnastics apparatus. Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 232. Fundamentals of Indoor Team Sports. (0-3) Cr. 1. S. *Prereq: Eligibility for admission to Kin teacher education program.* Fundamentals of indoor team sports, for example basketball, volleyball, team handball. Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 233. Fundamentals of Outdoor Team Sports. (0-3) Cr. 1. F. *Prereq: Eligibility for admission to Kin teacher education program.* Fundamentals of outdoor team sports, for example flag football, soccer, softball. Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 235. Fundamentals of Racquet Sports. (0-3) Cr. 1. S. *Prereq: Eligibility for admission to Kin teacher education program.* Fundamentals of racquet sports, for example tennis, badminton, racquetball. Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 236. Fundamentals of Individual Sports. (0-3) Cr. 1. F. *Prereq: Eligibility for admission to Kin teacher education program.* Fundamentals of individual sports, for example track and field, golf, archery and bowling. Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 237. Fundamentals of Self-Defense. (0-3) Cr. 1. S. *Prereq: Eligibility for admission to Kin teacher education program.* Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 238. Fundamentals of Outdoor and Adventure Activities. (0-3) Cr. 1. F. *Prereq: Eligibility for admission to Kin teacher education program.* Techniques of individual and group facilitation for initiatives involving outdoor adventure activity. Topics include ropes/challenge course events, activity presentation, and sequencing, safety techniques, preparation principles and new games Philosophy. Participation is required in one weekend of fieldwork.

Kin 240. Introduction to Taping, Equipment, and Bracing Techniques. (0-3) Cr. 1. S. *Prereq: Permission of athletic training program director.* Basic information and laboratory instruction regarding basic taping techniques, athletic equipment fitting procedures, and the use and proper fitting of prophylactic braces. Open to students in the athletic training option. Satisfactory-fail only.

Kin 242. Introduction to the Management of Community and Recreational Sport. (3-0) Cr. 3. F. Introduction to the study of the organization, structure, and management of community-based sport programs and facilities.

Kin 252. Disciplines and Professions in Kinesiology and Health. (2-0) Cr. 2. F.S. Overview of the various disciplines and professions that comprise the field of Kinesiology (the study of human movement) and help students determine the career option that best fits their interests.

Kin 253. Orientation in Kinesiology and Health. (1-0) Cr. 1. S. *Prereq: Concurrent enrollment or credit in 252.* Overview of ISU policies and procedures, academic advising operations, degree requirements, program of study planning, and campus resources. Satisfactory-fail only.

Kin 254. Learning Communities in Kinesiology/Health. (0.5-0) Cr. 0.5. F.S. *Prereq: Concurrent enrollment or credit in 253.* Semester long course for new students in the Kinesiology Learning Community to be taken concurrently with the general orientation class for Kinesiology majors. Students will take field trips and work with faculty, staff and mentors to explore careers in kinesiology and complete assignments related to identification & development of their skills and interests. Required for freshmen only. Satisfactory-fail only.

Kin 258. Physical Fitness and Conditioning. (1-3) Cr. 2. F.S. *Prereq: Kinesiology and health majors only.* Development of personal fitness using a variety of conditioning and exercise techniques such as aerobics, weight training, and aquatic fitness. Introduction to acute and chronic responses to exercise, and the role of exercise in health promotion and weight management. Credit for only one of the following courses may be applied toward graduation: Kin 163, 258.

Kin 259. Leadership Techniques for Fitness Programs. (1-3) Cr. 2. F.S. *Prereq: 258.* Development of exercise leadership skills for a variety of activities. Includes planning, promotion, and teaching techniques for developing fitness in others using a variety of exercise modalities including aerobics, weight training, and aquatic fitness.

Kin 266. Advanced Strength Training and Conditioning. (1-2) Cr. 2. F.S. *Prereq: 258, 259.* This course is designed to enhance the student's current level of knowledge and expertise to an advanced level in the area of strength training and conditioning. The course will prepare students interested in taking the National Strength and Conditioning Association Certified and Conditioning Specialist's exam. The course will focus on the assessment and implementation of training programs with strong emphasis on the areas of resistance training, metabolic training, flexibility, reaction time, speed, and agility.

Kin 280. Directed Field Experience in Elementary Physical Education. (0-3) Cr. arr. S. Observing, planning, and facilitating movement experiences of children in an elementary school setting. Satisfactory-fail only.

Kin 281. Directed Field Experience in Physical Education. (0-3) Cr. arr. *Prereq: Admission to University Teacher Education Program.* Observing, planning, and facilitating movement experiences of students in a public school setting. Satisfactory-fail only.

Kin 284. Elementary and Pre-school Movement Education. (2-3) Cr. 3. F.S.SS. *Prereq: 3 credits in human development and family studies.* Approaches to teaching movement skills to pre-school and elementary school age children. Emphasis on planning and conducting developmentally appropriate movement experiences for preschool and elementary aged children based upon motor development research. Practical experience provided. Credit in only one of the following courses may be applied toward graduation: Kin 284, 312.

Kin 285. Pre-Internship in Kinesiology. Cr. arr. F.S.SS. *Prereq: Kinesiology and Health major and permission of internship coordinator.* Pre-internship experience with a community sport and recreation or health fitness organization. Satisfactory-fail only.

Kin 312. Movement Education in Elementary School Physical Education. (2-3) Cr. 3. S. *Prereq: Concurrent enrollment in 280.* Planning for management and instruction of developmentally appropriate physical education for children pre-school through elementary grade 6. Laboratory experience required. Credit for only one in the following courses can be applied toward graduation: Kin 284, 312.

Kin 315. Coaching Theory and Administrative Issues. (3-0) Cr. 3. S. Study in the theory, ethics, strategy, and mechanics of coaching various interscholastic and/or intercollegiate sports. Emphasis on formulating a Philosophy, identifying goals and psychological aspects, teaching skills, and developing strategies.

Kin 323. Therapeutic Modalities for Athletic Trainers. (2-2) Cr. 3. F. *Prereq: Permission of athletic training program director.* Theory and technique of therapeutic modalities used in the management of injuries.

Kin 324. Therapeutic Modalities Clinical Practicum. (0-3) Cr. 1. F. *Prereq: Permission of athletic training program director.* Athletic training clinical experience to accompany 323. Open to students in athletic training option. Satisfactory-fail only.

Kin 326. Rehabilitation of Athletic Injuries. (2-2) Cr. 3. S. *Prereq: Permission of athletic training program director.* Theory and practical application of rehabilitation principles used in the management of athletic injuries.

Kin 327. Rehabilitation of Athletic Injuries Clinical Practicum. (0-3) Cr. 1. S. *Prereq: Permission of athletic training program director.* Athletic training clinical experience to accompany 326. Open to students in the athletic training option. Satisfactory-fail only.

Kin 331. Youth Sports. (Dual-listed with 531). (3-0) Cr. 3. S. The research findings from non-school related sport programs for children and adolescents and how these impact programs, parents and children including bio-physical, social, psycho-motor and cognitive factors.

Kin 345. Management of Health-Fitness Programs and Facilities. (3-0) Cr. 3. F.S. Application of management concepts to the fitness industry, e.g., understanding customers, marketing, program management, financial management, legal issues, and evaluation and planning.

Kin 355. Biomechanics. (2-2) Cr. 3. F.S. *Prereq: Phys 106 or 111.* Mechanical basis of human performance; application of mechanical principles to exercise, sport and other physical activities. Nonmajor graduate credit.

Kin 358. Physiology of Exercise. (2-2) Cr. 3. F.S. *Prereq: Biol 255, 255L, 256 and 256L.* Physiological basis of human performance; effects of physical activity on body functions. Nonmajor graduate credit.

Kin 360. Sociology of Sport and Exercise. (3-0) Cr. 3. F.S. *Prereq: Soc 134 and one of Stat 101, 104 or 226/326, or Kin 471.* Sport and exercise as social systems and as institutions related to other institutions such as the polity, the economy, mass media, and education.

Kin 365. Sport Psychology. (3-0) Cr. 3. F.S. *Prereq: Psych 101 or Psych 230.* Psychological factors that influence performance in sport settings. The influence of personality, anxiety, motivation, social factors, and psychological skills training.

Kin 366. Exercise Psychology. (3-0) Cr. 3. F.S. *Prereq: Psych 101 or Psych 230.* Psychological theories for understanding and predicting health-oriented exercise behavior. Psychological and psychobiological responses to exercise. Psychological interventions for increasing exercise participation and adherence rates.

Kin 372. Motor Control and Learning Across the Lifespan. (2-2) Cr. 3. F.S. *Prereq: Psych 101 or Psych 230, Biol 255, 256.* Introduction to major concepts of neuromotor control, behavioral motor control and motor learning in the child, adult and older adult, with emphasis on the adult system.

Kin 375. Teaching Physical Education. (2-3) Cr. 3. S. *Prereq: admission to University Teacher Education Program.* Current theory, practice and research on teaching focusing on management, instructional, and learning styles of students in secondary schools.

Kin 385. Search Strategies for Field Experiences and Employment. (Cross-listed with H S). Cr. R. F.S. *Prereq: Junior classification; to be taken minimum of two semesters prior to Kin 485.* Search techniques and preparation of materials utilized for acquisition of jobs and/or internships in kinesiology and health fields. Internship process and policies/procedures will be covered.

Kin 395. Adapted Physical Education. (Dual-listed with 595). (2-3) Cr. 3. F. *Prereq: 375.* Specific disabling conditions in terms of etiology, characteristics, needs, and potential for movement experiences. Techniques of assessment, prescription, adaptation of activities, methods, and program planning. Laboratory experience required. Kin 595 may not be taken by students who have previously earned credit in Kin 395.

Kin 417. Supervised Teaching in Physical Education in the Secondary School. Cr. 8. F.S. *Prereq: 355, 358, 375, 395, 471, 475. Students must be fully admitted to Teacher Education and must apply for approval to enroll at beginning of the semester prior to registering.* Supervised teaching in the secondary schools.

Kin 418. Supervised Teaching in Physical Education in the Elementary School. Cr. 8. F.S. *Prereq: 280, 312, 355, 358, 375, 395, 471, 475. Students must be fully admitted to Teacher Education and must apply for approval to enroll at the beginning of the semester prior to registering.* Supervised teaching in the elementary schools.

Kin 425. Organization and Administration of Athletic Training. (3-0) Cr. 3. F. *Prereq: Permission of athletic training program director, senior classification.* Current administrative, professional, and legal issues pertaining to athletic training. Job search techniques and strategies including preparation of materials for athletic training students.

Kin 442. Sport, Recreation, and Tourism. (3-0) Cr. 3. F. *Prereq: 242, 290; Soc 134.* The role of sport in developing fitness, recreational opportunities, and tourism, with special emphasis on issues related to youth sport, volunteerism, and the marketing of sport events and facilities.

Kin 445. Legal Aspects of Sport. (3-0) Cr. 3. S. Students will understand legal concepts and terminology relevant to sport/activity, identify strategies for limiting liability in sport/fitness programs, and identify solutions for elimination of discriminatory practices in sport and physical activity.

Kin 450. Medical Concerns for the Athletic Trainer. (3-0) Cr. 3. F. *Prereq: Permission of athletic training program director.* Current medical issues and concerns, including pathology of illness and injury, dermatological conditions, exposure to allied health care professionals, and pharmacological indications in relation to the profession of athletic training and in patient/athlete care.

Kin 458. Principles of Fitness Assessment and Exercise Prescription. (3-2) Cr. 4. F.S. *Prereq: 358.* Physiological principles of physical fitness; design and administration of fitness programs; testing, evaluation, and prescription; cardiac risk factor modification.

Kin 459. Internship in Exercise Leadership. (0-3) Cr. 1. *Prereq: C- or better in 259, CPR certification, concurrent enrollment in 458.* Observation and practice of exercise leadership techniques in an on-campus adult fitness program.

Kin 462. Medical Aspects of Exercise. (3-0) Cr. 3. F.S. *Prereq: 358.* The role of exercise in preventive medicine. Impact of exercise on various diseases, and the effect of various medical conditions on the ability to participate in vigorous exercise and competitive sports. Principles of exercise testing and prescription for individuals with these conditions. Environmental and nutritional aspects of exercise.

Kin 471. Measurement in Physical Education. (Dual-listed with 571). (3-0) Cr. 3. S. Study of grading, assessment and evaluation in physical education with a focus on measuring cognitive and psycho-motor achievement.

Kin 472. Neural Basis of Human Movement. (Dual-listed with 572). (3-0) Cr. 3. S. *Prereq: 372 or Psych 310.* Addresses the role of the central nervous system in the control of voluntary human movement, with the focus on the cerebral cortex, basal ganglia and cerebellum. Content organized around specific nervous system damage (such as stroke, apraxia, spasticity, or spinal cord damage) and functional movements (such as reaching and grasping, balance and gait). Converging evidence from human movement disorders, brain imaging, animal lesion and single cell studies provide the primary basis for the content. Nonmajor graduate credit.

Kin 475. Physical Education Curriculum Design and Program Organization. (Dual-listed with 575). (3-0) Cr. 3. F. *Prereq: Admission to University Teacher Education Program.* Current theory, practices and principles applied to curriculum development for programs in physical education, K-12. Organizing for teaching in a variety of school settings.

Kin 480. Functional Anatomy. (3-0) Cr. 3. S. *Prereq: 355; Biol 155 or 255 and 256.* The structure and function of human muscular, skeletal and nervous systems. The relationship of these systems to efficient and safe human motion. Nonmajor graduate credit.

Kin 485. Internship in Sport and Exercise Science. Cr. arr. *Prereq: Senior classification and advance registration.* Observation and practice in selected sport and exercise science agencies. Satisfactory-fail only.

A. Health/Fitness Management. Prereq: C- or better in 458 and 459, Kinesiology and Health majors only. Cumulative GPA 2.0.
B. Sport and Physical Activity. Prereq: Kinesiology and Health majors only. Cumulative GPA 2.0.

Kin 488. Research topics in Athletic Training. Cr. arr. Repeatable. F.S. *Prereq: Permission of athletic training program director.* Clinical experiences in application of athletic training techniques under supervision of certified athletic trainers. Participation in monthly research journal discussion. Satisfactory-fail only.

Kin 489. Review of Athletic Training Competencies and Clinical Proficiencies. Cr. R. F.S. *Prereq: Senior classification, permission of athletic training program director.* Preparation for professional endorsement and certification by review of required competencies and clinical proficiencies. Required for endorsement or approval to sit for Board of Certification Exam. Satisfactory-fail only.

Kin 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits from Kin advanced core and permission of coordinator.* Independent study of problems of areas of interest in exercise and sport science and related areas.
A. Exercise and Sport Science
B. Coaching
H. Honors

Kin 495. Seminar in Exercise and Sport Science. Cr. arr. *Prereq: Senior classification.* Satisfactory-fail only.

Kin 501. Research Methods in Physical Activity. (3-0) Cr. 3. Repeatable. *Prereq: Graduate classification in kinesiology and health.* Methods and techniques used in the design and interpretation of research involving physical activity. Emphasis on styles of writing, library use, and computer applications.

Kin 505. Research Laboratory Techniques in Exercise Physiology. (0-4) Cr. 2. *Prereq: Kin 358 or equivalent course with basic laboratory experience.* Application and use of laboratory research equipment in exercise physiology, including operation, calibration, and use in selected situations.

Kin 510. Advanced Medical Aspects of Exercise. (2-0) Cr. 2. *Prereq: Kin 358.* The role of exercise in preventive medicine. Impact of exercise on various diseases, and the effect of various medical conditions on the ability to participate in vigorous exercise and competitive sports. Principles of exercise testing and prescription for individuals with these conditions.

Kin 512. Methods in Physical Education. (3-0) Cr. 3. S. Study of learning and teaching in physical education for elementary and secondary schools.

Kin 516. Quantitative Analysis of Human Movement. (3-1) Cr. 3. *Prereq: Kin 355.* Application of the principles of mechanics to the analysis of human motion. Investigation of the effects of kinematics and kinetics on the human body with special emphasis on exercise and sport applications. Includes consideration of two-dimensional and three-dimensional imaging techniques and force measurements.

Kin 517. Musculoskeletal Modeling. (3-1) Cr. 3. F. *Prereq: 355 or permission from instructor.* Systematic problem-solving approaches and design of computer programs for biomechanical analyses. Estimation of anthropometric parameters and mechanical properties of muscles, bones, and joints. Integration of anthropometrics, kinematics, and muscle mechanics into simulations of human movement.

Kin 518. Student Teaching in Elementary Physical Education. (0-8) Cr. 8. F.S. *Prereq: 512, 570, 575.* Student teaching for 8 weeks in an elementary school.

Kin 519. Student Teaching in Secondary Physical Education. (0-8) Cr. 8. F.S. *Prereq: 512, 570, 575.* Student teaching for 8 weeks in a middle or high school.

Kin 520. The Social Analysis of Sport. (3-0) Cr. 3. *Prereq: 360; open to majors only or by permission of instructor.* Sociological analysis of sport with emphasis on Sociological theory, sports structure, and function in modern industrialized Society; the systems of sport in regard to their role structure; formal organization, and professionalization and its differentiation along social class, age, and sex.

Kin 521. Advanced Topics in Exercise and Sport Psychology. (3-0) Cr. 3. *Prereq: 365 or 366, 3 courses in psychology; open to majors only or by permission of instructor.* Aspects of psychology which form a basis for understanding and explaining behavior in the context of exercise and sport. Emphasis on evaluating published research, particularly theory and research methodology. Student presentations.

Kin 531. Youth Sports. (Dual-listed with 331). (3-0) Cr. 3. S. The research findings from non-school related sport programs for children and adolescents and how these impact programs, parents and children including bio-physical, social, psycho-motor and cognitive factors.

Kin 549. Advanced Vertebrate Physiology I. (Cross-listed with An S, B M S). (3-0) Cr. 3. F. *Prereq: Biol 335; credit or enrollment in BBMB 404 or 420.* Neurophysiology, sensory systems, muscle, neuroendocrinology, endocrinology.

Kin 550. Advanced Physiology of Exercise I. (2-3) Cr. 3. *Prereq: 505.* Concepts and methods of assessing neurological, muscular, cardiovascular, and respiratory adjustments to exercise.

Kin 551. Advanced Physiology of Exercise II. (2-3) Cr. 3. *Prereq: 505.* Analysis of factors affecting work capacity and performance. Human energy metabolism concepts and measurement.

Kin 552. Advanced Vertebrate Physiology II. (Cross-listed with An S, B M S, NutrS). (3-0) Cr. 3. *Prereq: Biol 335; credit or enrollment in BBMS 404 or 420.* Cardiovascular, renal, respiratory, and digestive physiology.

Kin 558. Physical Fitness - Principles, Programs and Evaluation. (2-3) Cr. 3. *Prereq: Kin 358.* Physiological principles of physical fitness, design and administration of fitness programs; testing, evaluation, and prescription; electrocardiogram interpretation.

Kin 560. Principles of Motor Control and Learning. (2-3) Cr. 3. *Prereq: Kin 372.* Theoretical perspectives of motor control and learning will be examined as well as factors that facilitate motor learning. Motor control and learning will also be addressed by studying functional tasks such as reach and grasp, posture and locomotor, handwriting, catching and/or speech.

Kin 561. Motor Development. (2-0) Cr. arr. *Prereq: Psych 230.* The physical development and characteristic reactions of children in relation to motor performance. Identification of special psychomotor needs of various age groups of children. All literature and theories applied to the physical education environment.

Kin 570. Physical Activity Assessment for Health Related Research. (2-2) Cr. 3. This course will cover the broad scope of research in physical activity and public health. Emphasis will be placed on the application of physical activity assessment techniques since accurate measures are needed to more accurately assess the health benefits from physical activity and to evaluate the effectiveness of behavioral interventions designed to promote physical activity.

Kin 571. Measurement in Physical Education. (Dual-listed with 471). (3-0) Cr. 3. S. Study of grading, assessment and evaluation in physical education with a focus on measuring cognitive and psycho-motor achievement.

Kin 572. Neural Basis of Human Movement. (Dual-listed with 472). (3-0) Cr. 3. *Prereq: Kin 372 or Psych 310.* Addresses the role of the central nervous system in the control of voluntary human movement, with the focus on the cerebral cortex, basal ganglia and cerebellum. Content organized around specific nervous system damage (such as stroke, apraxia, spasticity, or spinal cord damage) and functional movements (such as reaching and grasping, balance and gait). Converging evidence from human movement disorders, brain imaging, animal lesion and single cell studies provide the primary basis for the content.

Kin 575. Physical Education Curriculum Design and Program Organization. (Dual-listed with 475). (3-0) Cr. 3. F. Current theory, practices and principles applied to curriculum development for programs in physical education, K-12. Organizing for teaching in a variety of school settings.

Kin 590. Special Topics. Cr. arr. Repeatable.
A. Physical Education
B. Health and Exercise Promotion
D. Exercise Physiology
E. Sport Sociology
F. Sport/Exercise Psychology
G. Motor Behavior
H. Biomechanics
I. Human Growth and Puberty

Kin 591. Supervised Field Experience. Cr. arr. *Prereq: 10 graduate credits in health and human performance and/or related areas.* Supervised on-the-job field experience in special areas.
A. Physical Education
B. Health and Exercise Promotion
D. Exercise Physiology

Kin 595. Adapted Physical Education. (Dual-listed with 395). (2-3) Cr. 3. F. *Prereq: 375.* Specific disabling conditions in terms of etiology, characteristics, needs, and potential for movement experiences. Techniques of assessment, prescription, adaptation of activities, methods, and program planning. Laboratory experience required. Kin 595 may not be taken by students who have previously earned credit in Kin 395.

Kin 599. Creative Component. Cr. arr. Repeatable.

Kin 615. Seminar. Cr. arr. Repeatable.

Kin 620. Advance Research Methods in Physical Activity. (3-0) Cr. 3. S. *Prereq: 501, Stat 401 and 402. Doctoral students only.* Culminating seminar designed to synthesize Statistical and design courses with practical research issues using data from physical activity.

Kin 699. Research. Cr. arr. Repeatable.

Athletics (Ath)

Courses primarily for undergraduate students

Ath 101. Intercollegiate Athletics. Cr. 1. Repeatable. F.S. *Prereq: Permission of head coach.* Limited to 1 credit per year to a maximum of 4. Credit for a sport section of Ath 101 may not be applied toward graduation if credit is also received for Kin 166 or any skill technique course in the same sport. Satisfactory-fail only.
B. Basketball (men)
C. Basketball (women)
D. Cross Country (men)
E. Cross Country (women)
F. Football (men)
G. Golf (men)
J. Gymnastics (women)
K. Softball (women)
M. Swimming/Diving (women)
O. Tennis (women)
P. Track and Field (men)
Q. Track and Field (women)
R. Volleyball (women)
S. Wrestling (men)
T. Golf (women)
U. Soccer (women)

Dance (Dance)

Dance 120. Modern Dance I. (0-3) Cr. 1. F.S. Introduction and practice of basic dance concepts, including preparatory techniques and guided creativity problems. No previous modern dance experience required. Satisfactory-fail only.

Dance 130. Ballet I. (0-3) Cr. 1. F.S. Introduction to the basic skills, vocabulary, and tradition of ballet with concentration on control and proper alignment. No previous ballet experience required. Satisfactory-fail only.

Dance 140. Jazz I. (0-3) Cr. 1. F.S. Introduction to the modern jazz style with concentration on isolation and syncopation. No previous jazz experience required. Satisfactory-fail only.

Dance 150. Tap Dance I. (0-3) Cr. 1. F. Instruction and practice in basic tap technique and terminology. No previous tap experience required. Satisfactory-fail only.

Dance 160. Ballroom Dance I. (0-2) Cr. 1. F.S. Instruction and practice in foxtrot, waltz, swing, cha cha, rhumba, tango, and selected contemporary dances. Satisfactory-fail only.

Dance 199. Dance Continuum. Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Advance registration required. Continued instruction and practice in either modern dance, recreational dance, ballet, jazz and/or compositional skills. Satisfactory-fail only.

Dance 211. Fundamentals and Methods of social and World Dance. (1-3) Cr. 2. S. Skill enhancement, teaching, progressions with emphasis on world and social dance. Designed for kinesiology and health majors, open to others.

Dance 220. Modern Dance Composition. (1-3) Cr. 2. F. *Prereq: 120 or previous modern dance experience.* Theory and practice of the creative skills involved in solo and small group composition.

Dance 222. Modern Dance II. (0-3) Cr. 1. F. *Prereq: 120 or previous modern dance experience.* Dance techniques emphasizing strength, balance, endurance, rhythmic activity and extended combinations.

Dance 223. Modern Dance III. (0-3) Cr. 1. S. *Prereq: 222.* Continued experience in dance techniques and extended combinations. Emphasis on maturation of skill and artistry. Exposure to a variety of modern dance technical styles.

Dance 224. Concert and Theatre Dance. (Cross-listed with Thtre). (0-3) Cr. arr. Repeatable. F.S. *Prereq: By audition only.* Choreography, rehearsal, and performance in campus dance concerts and/or musical theatre productions. Satisfactory-fail only.

Dance 232. Ballet II. (0-3) Cr. 1. S. *Prereq: Previous ballet experience.* Technical skills in the classical movement vocabulary. Emphasis on alignment, techniques, sequence development, and performing quality.

Dance 233. Ballet III. (0-3) Cr. 1. F. *Prereq: 232.* Concentration on technical proficiency at the intermediate level. Pointe work and partnering opportunities available.

Dance 242. Jazz II. (0-3) Cr. 1. S. *Prereq: Previous jazz dance experience.* Dance concepts within the jazz idiom. Instruction in extended movement sequences and artistic interpretation.

Dance 270. Dance Appreciation. (3-0) Cr. 3. F.S.SS. Introduction to the many forms and functions of dance in world cultures. Develop abilities to distinguish and analyze various dance styles. No dance experience required.

Dance 320. Sound and Movement. (2-2) Cr. 3. S. *Prereq: 220.* Intermediate composition based on the relationship of movement to improvised sounds, rhythmic scores, and the musical works of composers from various periods.

Dance 360. History and Philosophy of Dance. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 270.* Study of the history of dance from early to modern times with emphasis on the theories and Philosophies of contemporary modern dance, dancers, and dance educators.

Dance 370. Advanced Studies in Dance. Cr. arr. Repeatable. F.S. *Prereq: 2 credits in dance.* Advance registration required. Designed to meet special interests and talents of students to include both group and independent study in various aspects of dance as a performing art including production, choreography, and performance.

Dance 384. Teaching Children's Dance. (1-3) Cr. 2. S. Content, experiences, and methods of a comprehensive dance program at the elementary school level. Theories and practice in guiding elementary school children in expressive movement experiences.

Dance 385. Methods of Teaching Dance. (1-3) Cr. 2. F. Methods and techniques of teaching social and world dance forms. Introduction to teaching educational modern dance.

Dance 386. Teaching Dance Technique and Composition. (1-3) Cr. 2. *Prereq: 320.* Teaching of dance as an expressive art form with emphasis on technique, rhythm, and the creative teaching process.

Dance 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in dance and permission of coordinator.* Independent study of problems or areas of interest in dance.

Health Studies (H S)

H S 105. First Aid and Emergency Care. (1-2) Cr. 2. F.S. Discussion and application of the basic techniques of administering first aid and cardiopulmonary resuscitation. ARC certification available.

H S 110. Personal and Consumer Health. (3-0) Cr. 3. F.S. Physical, mental, and social aspects of health as a basis for understanding and preventing health problems. False and misleading advertising and effects of cultists and faddists on consumer health. Study of legislation and agencies concerned with consumer protection and health insurance.

H S 215. Drug Education. (3-0) Cr. 3. *Prereq: Psych 101 or 230.* Use and abuse of mood modifying substances in contemporary Society. Includes study of tobacco, alcohol, and other drugs.

H S 275. Health Education in the Elementary School. (3-0) Cr. 3. *Prereq: HD FS 102 or 226.* An overview of school health services, healthful school living, and health instruction for teachers at the elementary level. Credit for both H S 275 and 375 may not be applied toward graduation.

H S 305. Instructor's First Aid and Cardio-pulmonary Resuscitation. (1-2) Cr. 2. S. *Prereq: 105, current Standard First Aid and Community CPR Certification.* Discussion and practice of skills needed to teach first aid and cardiopulmonary resuscitation. ARC certification available.

H S 310. Community and Public Health. (3-0) Cr. 3. *Prereq: 110.* Introduction to community health problems, programs of prevention, environmental health agencies, and health services. Study of local, state, and national community health agencies, their purposes and functions.

H S 350. Human Diseases. (3-0) Cr. 3. *Prereq: 110 and Biol 255, 256.* Discussion of disease process and ill-health in the twentieth century. Emphasis on epidemiology, prevention, treatment, and the understanding of the etiology of communicable and noncommunicable diseases.

H S 375. Teaching-Learning Process in Health Education. (3-0) Cr. 3. *Prereq: 105, 110, 215.* Principles, methods, materials, and resources involved in the teaching of health. Includes organization and development of the health education curriculum (K-12). Credit for both H S 275 and 375 may not be applied toward graduation.

H S 380. Worksite Health Promotion. (3-0) Cr. 3. *Prereq: KIN 258, 366, FS HN 167.* The design and implementation of worksite health promotion programs and the benefits these programs have for both employees and employers. Review of various health risk appraisals and planning theory-based incentive programs designed to promote positive lifestyles.

H S 385. Search Strategies for Field Experience and Employment. (Cross-listed with Kin). Cr. R. F.S. *Prereq: Junior classification, to be taken minimum of two semesters prior to KIN 485.* Search techniques and preparation of materials utilized for acquisition of jobs and/or internships in kinesiology and health fields. Internship process and policies/procedures will be covered. Satisfactory-fail only.

H S 390. Administration of the School Health Program. (3-0) Cr. 3. F. *Prereq: 310.* History and legal basis of school health programs. Procedures for developing, organizing, administering, and evaluating a modern program of health services, healthful school living, and health instruction. Includes administration, community and school relationships.

H S 417. Supervised Teaching in Health Education in the Secondary School. Cr. 12. F.S. *Prereq: 375.* Advance registration required.

H S 430. Community Health Program Development. (3-0) Cr. 3. F. *Prereq: 380.* Techniques of needs assessment, program design, administration, and evaluation of community health education programs in various settings.

H S 485. Directed Field Experience in Health Education. Cr. arr. *Prereq: All required health studies courses and permission of coordinator.* Advance registration required. Supervised experience in health education. Satisfactory-fail only.

H S 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in health studies and permission of coordinator.*

Landscape Architecture

www.design.iastate.edu/LA/

Douglas Johnston, Chair of Depatment

Distinguished Professor (Emeritus): Dyas

Professors: Anderson, Engler, Hightshoe, Johnston, Keller

Professors (Emeritus): Boon, Harvey, Lane

Associate Professors: Badenhope, Grundmann, Hohmann, Martin, Wagner

Assistant Professors: Rogers, Seeger

Assistant Professors (Adjunct): Kane, M. Miller, Pritchard

Lecturers: Belkacemi, Groe

Undergraduate Study

Landscape architecture is an environmental design discipline. Landscape architects actively shape the human environment: they map, interpret, imagine, draw, build, conceptualize, synthesize, and project ideas that transform landscapes. The design process involves creative expression that derives from an understanding of the context of site (or landscape) ecosystems, cultural frameworks, functional systems, and social dynamics. Students in our program learn to change the world around them by re-imagining and re-shaping the landscape to enhance its aesthetic and functional dimensions, ecological health, cultural significance, and social relevance. The profession addresses a broad range of landscapes in urban, suburban, rural, and wilderness settings. The scale of landscape architecture projects varies from broad, regional landscape analysis and planning to detailed, individual site-scale designs. The curriculum at Iowa State prepares students for this challenge as they develop their abilities to design and communicate ideas through a sequence of foundational courses and studios.

Graduates draw upon scientific and historical/cultural knowledge in applying their creative and technical skills in the planned arrangement of natural and constructed elements on the land with a concern for the stewardship and conservation of natural, constructed, and human resources. The resulting environments serve useful, aesthetic,

safe, and enjoyable purposes. Graduates are able to communicate clearly and work effectively with others on complex land design and planning problems. They understand the ethical, social, and environmental/ecological dimensions of issues involving changes in the landscape.

The curriculum includes one year of the College's core design program followed by a four-year professional program. Admission to the professional program is subject to the approval of a faculty committee at the completion of the preprofessional program. Scholastic performance, aptitude, and personal development are the qualifications considered. The department also cooperates in the undergraduate minor in design studies.

Following admission to the professional program, students embark on the traveling studio during the fall semester of their second year. This studio is a full semester's credit of integrated departmental courses and involves extensive travel within and beyond the great midwest region of North America, to study regional natural systems and the cultural response to those systems.

To enhance the study of landscape architecture in off-campus settings, the department recommends that each student participate in optional College or Department-led international study opportunities such as the Rome or Pacific Rim summer offerings. In addition, the department requires students to choose from among the following three options during the spring and summer of their fourth year: a professional internship, an independent study abroad experience, or National Student Exchange. The department assists students with placement, and additional information through the department and the College of Design's Career Services Office.

Personal laptop/notebook computers and appropriate software are regularly used in classes starting with the second year. Refer to the college for options and recommendations.

The curriculum is accredited by the Landscape Architecture Accreditation Board and provides the education which, combined with experience, is necessary for professional licensure.

For undergraduate curriculum in landscape architecture leading to the degree bachelor of landscape architecture, see *College of Design, Curricula.*

Graduate Study

The department offers opportunities for post-professional study leading to the degree master of landscape architecture. Minor work is offered to students taking major work in other departments.

The M.L.A. degree is granted upon completion of 36 credits and the acceptance of a thesis or creative component. Typically, the program will require four semesters of study for students with a bachelor's degree in landscape architecture. Students with a bachelor's degree in landscape architecture may also enter a special program to earn both the M.L.A. and the master of community and regional planning (M.C.R.P.) degrees in three years. Graduate students who do not possess a bachelor's degree in landscape architecture may complete additional coursework in the fundamental skill areas of the profession. This is accomplished by concurrent enrollment in the undergraduate program to earn the B.L.A. degree before fully engaging in graduate study. The time necessary to earn the B.L.A. in addition to the M.L.A. will vary according to the student's background upon admission. Students interested in the concurrent B.L.A./M.L.A. and double degree M.L.A./M.C.R.P. programs should contact the department to receive a detailed description of requirements.

Graduates have a broad understanding of landscape architecture and related disciplines. They are able to communicate effectively with colleagues in the sciences and/or humanities as well as in the allied professions. Graduates are prepared to work individually and in multidisciplinary teams to address complex problems dealing with the cultural/ecological environment. They are skilled at undertaking research and/or creative activities and communicating the results of these efforts in a concise and persuasive manner. The department participates in the Graduate Certificate Program in Geographic Information Systems (GIS), administered by the Department of Community and Regional Planning.

Courses primarily for undergraduate students

L A 201. Studio: Landscape Interpretation and Representation. (1-15) Cr. 6. F. *Prereq: Enrollment in the professional program.* Reading and representing varied landscapes; development of aesthetic sensitivity to the geomorphology, vegetation and cultural influences on these landscapes. Small scale interventions and exploration of landscape phenomena and change. Emphasis on a variety of documentation and drawing techniques.

L A 202. Studio: Site Design I. (1-15) Cr. 6. S. *Prereq: 201.* Fundamental issues of landscape planning and design at a site scale. Projects introduce a variety of (objective and subjective) site inquiry methods, space and place making, and sensitive integration of architecture and landscape for specific land uses. User needs, precedent study, programming, site engineering, planting design, and outdoor space design expressed through a variety of three-dimensional modeling, graphic, and written media.

L A 221. Native Plants of the Savanna Ecotone. (2-3) Cr. 3. F. *Prereq: Enrollment in the professional program.* Observation and study of the wetland, prairie, and woodland vegetation native to the savanna ecotone. Emphasis on plant communities, their distribution, structure, habitat and aesthetics. Plant identification and use in landscape design. Precedent and case studies of vegetation preservation, restoration and use in built works.

L A 222. Introduced Plants of the Midwest. (2-3) Cr. 3. S. *Prereq: 221.* Identification, observation and study of plants introduced to cultivation in the Midwest region. Plant cultural requirements, including adaptations to climate changes, solar exposure and soil conditions. Investigation of history of plant introduction and use in designed landscape, including consequent impacts of plant introduction such as plant invasion. Introduction to planting design at the site scale, including matching plant cultural requirements to site conditions, functional uses of plants and expressive composition using plant form, texture and color.

L A 241. Developing Identity as a Landscape Architect. (1-0) Cr. 1. F. *Prereq: Enrollment in the professional program.* Designed to accompany L A 201, 221, 272, 281. Development of life skills for conflict resolution, effective interpersonal communication, and CPR/First Aid. Examination of personal values as they relate to the backgrounds, abilities, attitudes, and values of others; exploration of how these influence personal decision-making and group interaction. Reading, discussion, class activities, journal-keeping, writing.

L A 272. Cultural Landscape Studies. (3-0) Cr. 3. F. *Prereq: Enrollment in the professional program.* Exploration of cultural landscapes, from broad settlement patterns to individual sites, with an emphasis on the origins and evolution of landscapes. Investigation of relationships between vernacular and designed landscapes. Landscapes considered as modes of cultural production that shape and are shaped by social, political, and economic processes. Exploration of landscapes as persistent (yet ephemeral) repositories of culture. Lectures, reading, field studies, and writing.

L A 274. The Social and Behavioral Landscape. (Cross-listed with Dsn S). (3-0) Cr. 3. S. Exploration of social and behavioral factors pertinent to design of the domestic, civic, and commercial landscape. Focus on working familiarity with design principles as they relate to the behavior and activities of people across a broad demographic and cultural spectrum; application of these principles to design of outdoor environments. Lectures and discussions, including group exercises and field trips.

L A 281. Investigating Landscape form, Process, and Detail. (1-6) Cr. 3. F. *Prereq: Enrollment in professional program.* Exploration of the poetics and principles of landscape construction. Investigation and interpretation of landform and geomorphic processes such as the hydrologic cycle, erosion, and sedimentation. Close observation and representation of detail design, with an emphasis on material types, their connections and weathering. Readings, field studies, and drawings.

L A 285. The National Parks: Culture and Nature. (Cross-listed with NREM). (2-0) Cr. 2. Alt. F., offered 2010. Reviews cultural setting for park establishment and management, ideas about wilderness, and Philosophy of parks as types of land use. History of landscape architecture in the National Park Service, the development of American parks, the history of park wildlife management and nature interpretation. Recent initiatives in ecosystem management, community conservation, and international points of comparison. Readings, discussion, exercises.

L A 301. Site Design II. (1-15) Cr. 6. F. *Prereq: 202.* Development of half-acre to hundred-acre landscape design and planning proposals. Apply critical methodological frameworks to shape site systems while providing appropriate support for diverse user groups and creating culturally meaningful places. Assess and interpret a program of use, organize subjective and objective site inventory and analysis, develop functional and poetic design strategies for infrastructure and natural systems, and craft artistic and functionally explicit landscape architectural proposals. Development of appropriate technique and high level of craft in representations to support design thinking process and final scheme presentation.

L A 302. Ecological Design at the Regional Scale. (1-15) Cr. 6. S. *Prereq: 301, 381, 465 and Agronomy 156.* Application of ecological theories and processes in design and planning at the hundred plus-acre scale specifically focusing on urban and urban fringe landscapes. Apply advanced landscape analysis of soil, water, and vegetation utilizing geographic information systems. Particular focus on stream and wetland restoration, mitigation, and regulations and developing design representations for public use.

L A 309. Field Travel. Cr. 1. Repeatable. F.S.SS. *Prereq: Enrollment in the professional program and permission of instructor.* Observation of professional practice and landscapes in urban, rural, and wilderness areas. Satisfactory-fail only.

L A 322. Fundamentals of Planting Design. (2-6) Cr. 4. Alt. F., offered 2009. *Prereq: 221.* The art and techniques of creating plant compositions in the landscape that respond to cultural and biophysical contexts. Investigation of soil properties and plant/soil relationships relevant to the built environment. Methods of site inventory and analysis, developing plant palettes and composing plant assemblages that address expressive and functional needs. Introduction to the techniques of preparing planting plans, including standards for plant selection, plant lists and plant specification.

L A 341. Contemporary Landscape Architecture. (1-0) Cr. 1. S. *Prereq: 301.* Exploration of contemporary landscape architecture practice through individualized research into practicing firms. Preparation of paper and presentation outlining broad framework and specific parameters of a selected area of contemporary practice using specific projects as examples. Work may result in invitation of current practitioner(s) as a lecture series or event. Resume and portfolio preparation in advance of required off-campus semester (L A 451 A, B or C).

L A 371. Landscape Architectural History: 1750 to Present. (Cross-listed with Dsn S). (3-0) Cr. 3. S. Investigation of landscape design concepts and trends as observed over time, from approximately 1750 to the present, with emphasis on the United States and Europe. Examination of significant figures and outstanding works (sites, gardens, landscapes, monuments, subdivisions, city plans, etc.) of varied geographic regions. Analysis of the social, economic, political, and technical forces contributing to the development of landscape design styles, vocabulary, and literature. Lectures, readings, projects, research papers.

L A 373. Landscape Architectural History: Prehistory to 1750. (Cross-listed with Dsn S). (3-0) Cr. 3. F. Investigation of international landscape design concepts and trends as observed over time, from pre-history to the mid 18th century. Examination of significant figures and outstanding works (sites, gardens, landscapes, monuments, subdivisions, city plans, etc.) of varied geographic regions. Analysis of the social, economic, political, and technical forces contributing to the development of landscape design styles, vocabulary, and literature. Lectures, readings, projects, research papers.

L A 381. Shaping the Land. (3-0) Cr. 3. F. *Prereq: 281, Math 141.* Manipulation of the land form and its change through the use of contour maps and models. Transformation of the landform and its implications on the surrounding environment. Surface drainage and storm water runoff calculations, contour manipulation to insert swales, channels, ditches, walls, walks, steps, terraces, buildings, road layout and alignment and other constructed elements. Class exercises, case study precedents, and preliminary construction documents.

L A 401. Community Design. (1-15) Cr. 6. F. *Prereq: 402.* Design of urban and/or rural places utilizing participatory methods and techniques. Projects address midwestern community issues including reuse of abandoned sites, in-fill, recreation, and peri-urban agriculture. Emphasis on development of user-client relationship skills and design research.

L A 402. Urban Design. (1-15) Cr. 6. F. *Prereq: 302.* Comprehensive planning and design for urban Sites or for sites within urban contexts. Projects typically include planning for a variety of integrated land uses, and cover the full range of design scales from master planning to proposals for site details. Emphasis on written and verbal as well as graphic communications. Integrated seminar component.

L A 403. Senior Thesis Preparation Tutorial. Cr. 2. F. *Prereq: 402, permission of thesis advisor, enrollment in Honors program.* Preparation for senior thesis.

L A 404. Advanced Landscape Architectural Design. (Cross-listed with Dsn S). (1-15) Cr. 6. Repeatable. S. *Prereq: L A 401.* Advanced forum for the demonstration of sophistication in landscape architectural design. Experimentation and innovation are encouraged.

L A 405. Senior Thesis. (0-15) Cr. 6. S. *Prereq: 401, 402, 403, and enrollment in Honors program; permission of advisor, chair and thesis advisor.* Individual advanced forum for the demonstration of sophistication in landscape architectural design. Experimentation and innovation are expected.

L A 421. Advanced Planting Design. (2-6) Cr. 4. Alt. S., offered 2011. *Prereq: 221, 222 or equivalent.* Introduction to the theory and practice of planting design, with emphasis on the ecological, cultural and aesthetic factors affecting planting design and vegetation management in the built environment. Three venues for collaborative learning form the basis of the course: topical research inquiry, case history investigation and completion of one comprehensive project design.

L A 441. Professional Practice. (2-0) Cr. 2. S. *Prereq: 481.* Studies of conventional and developing forms of public and private practice. Explore relationships between professional life and the culture of the professional design firm; investigate firm identities and structures; understand design projects, their delivery process, and contractual agreements. Lecture and class discussion.

L A 451. Landscape Architecture Professional Internship, Study Abroad, or National Student Exchange. Cr. R. Repeatable. F.S.SS. *Prereq: L A 341, permission of adviser and chair.* Independent educational enrichment through exploration of landscape architectural practice in a professional internship (451A), international studies (451B), or out-of-region national study experience (451C)
A. Professional Internship.
B. Study Abroad.
C. National Student Exchange.

L A 461I. Introduction to GIS. (Cross-listed with la LL, EnSci, Env S). Cr. 4. SS. Descriptive and predictive GIS modeling techniques, spatial Statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management. Nonmajor graduate credit.

L A 465. Landscape Change and Conservation. (Dual-listed with 565). (Cross-listed with NREM). (3-0) Cr. 3. F. *Prereq: 202.* Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

L A 478. Topical Studies in Landscape Architecture. (Dual-listed with 578). (Cross-listed with Dsn S). Cr. arr. Repeatable. F.S.SS. *Prereq: L A 371 or senior classification or graduate standing.* Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.
A. Landscape Design
B. Planting Design
C. Construction
D. History/Theory/Criticism
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social/Behavioral
N. Natural Resources

L A 481. Landscape Construction. (1-4) Cr. 3. F. *Prereq: 381.* Development of construction details with emphasis on materials and their aesthetic and functional uses as building materials. Explore characteristics and uses of construction materials; investigate structural theory; application of wood systems, paving systems, retaining walls, masonry and concrete systems, and metals. Preliminary preparation of construction documents.

L A 482. Advanced Landscape Construction. (1-4) Cr. 3. S. *Prereq: 481.* Advanced site construction issues, with emphasis on water and irrigation systems, mechanical and electrical systems, site lighting, proposal preparation, project scheduling, project costing and estimating. Final construction document preparation including drawings and specifications.

L A 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on required form.* Investigation of a topic of special interest to the student.
A. Landscape Design
B. Planting Design
C. Construction
D. History
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social/Behavioral
N. Natural Resources

Courses primarily for graduate students, open to qualified undergraduate students

L A 501. Landscape Architectural Theory. (3-0) Cr. 3. S. *Prereq: Admission to graduate program or permission of instructor.* Exploration of major theories of landscape architectural design and their relationships to broader cultural and theoretical practices. Examination of key texts and projects in landscape architecture, architecture, art, and related fields. Emphasis on developing critical ways of analyzing ideas. Lectures, readings, discussion, and writings.

L A 541. Principles of Research for Landscape Architects. (3-0) Cr. 3. F. *Prereq: Admission to graduate program or permission of instructor.* Examination of design inquiry and research methods appropriate to landscape architectural projects, including bibliographical, historical, numerical, statistical, survey, and geographical methods. Readings, discussions, and application problems. Preparation of a research proposal.

L A 562. Studio in Resource Conservation and Management. Cr. arr. Repeatable. S. *Prereq: 465 or 565, admission to graduate program or permission of instructor.* Developing plans and policies that feature ecological landscape description, planning, and resource conservation. Hands-on field experience with professional resource planners and managers. Contact hours (1-3) to (1-15) depending on number of credits.

L A 565. Landscape Change and Conservation. (Dual-listed with 465). (Cross-listed with NREM). (3-0) Cr. 3. F. *Prereq: 202.* Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

L A 567. Advanced GIS Landscape Modeling. (0-6) Cr. 3. *Prereq: 302 or C R P 451/551.* Application of Geographic Information Systems (GIS) modeling techniques to landscape planning and management issues. Selection, acquisition, and conversion of digital landscape data. Modeling applications for studio projects, outreach projects, and research projects.

L A 572. Landscape Architectural History and Preservation. (3-0) Cr. 3. F. *Prereq: Admission to graduate program or permission of instructor.* Methods applied to preservation of historic landscapes, including current federal standards and regulations. Outstanding historic landscapes and recent landscape preservation projects of varied time periods and scales used to familiarize students with methods of archaeological and documentary research, Philosophical issues of significance and interpretation, and technical concerns of treatment, management, and maintenance. Lectures, readings, discussion, and independent and group research.

L A 578. Topical Studies in Landscape Architecture. (Dual-listed with 478). (Cross-listed with Dsn S). Cr. arr. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing.* Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.
A. Landscape Design
B. Planting Design
C. Construction
D. History/Theory/Criticism
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social/Behavioral
N. Natural Resources

L A 580. Thesis, Creative Component Tutorial. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of major professor.* Hands-on participation in a creative or research activity in the student's area of specialization. Development of a detailed prospectus that defines the thesis or creative component.

L A 582. Research Colloquium. (1-0) Cr. 1. Repeatable. F. *Prereq: Admission to graduate program or permission of instructor.* Examination and discussion of professional practice, research in landscape architecture, and environmental planning through research and projects by faculty and graduate students in landscape architecture and related fields.

L A 590. Special Topics. Cr. arr. Repeatable. F.S.SS.
A. Landscape Design
B. Planting Design
C. Construction
D. History
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social/Behavioral
N. Natural Resources

L A 591. Environmental Law and Planning. (Cross-listed with C R P, Dsn S). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

L A 599. Creative Component. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of major professor.* Comprehensive study and original development of a project selected by the student and approved by the major professor. Completed project must be submitted to and approved by a graduate faculty committee as evidence of mastery of the principles of landscape architecture.

Course for graduate students, major or minor

L A 699. Thesis Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of major professor.*

Liberal Arts and Sciences Cross-Disciplinary Studies

Zora D. Zimmerman, Associate Dean for Academic Programs

Cross-disciplinary studies in the College of Liberal Arts and Sciences encompass a variety of interdisciplinary and cross-disciplinary areas of study as well as courses that cross established departmental lines. Students may enroll in Program courses; declare majors or minors where offered, or develop an Interdisciplinary Studies major built upon Program offerings. (see Index for Program courses).

Cross-Disciplinary Programs

African American Studies Program (Minor only) see *Index, African and African American Studies.*

American Indian Studies Program (Minor only) see *Index, American Indian Studies.*

Biological/Premedical Illustration Program (Major or minor) see *Index, Biological/Pre-Medical Illustration.*

Classical Studies (Minor only)
see *Index, Classical Studies.*

Communication Studies (Major or minor)
see *Index, Communication Studies.*

Criminal Justice Studies (Minor only) see *Index, Criminal Justice Studies.*

International Studies Program (Second major or minor) see *Index, International Studies.*

Latino/a Studies, U.S. Program

Program Director: H. Avalos

U.S. Latino/a Studies is devoted to the study of Mexican Americans, Puerto Ricans, Cuban Americans and other groups of people living in the United States who trace their ancestry to the Spanish-speaking countries of Latin America, and who comprise the fastest growing ethnic groups in America. U.S. Latino/a Studies is to be distinguished from Latin American Studies, which focuses on people living in Latin America. The methodology of U.S. Latino/a Studies is cross-disciplinary, drawing from the methods established inanthropology, sociology, political science, economics, history, literary studies, and other fields.

In addition to the general requirements of a major in Interdisciplinary Studies, (see Index, Interdisciplinary Studies) a major in Interdisciplinary Studies focusing on U.S. Latino/a Studies would require the completion of 24 credits. At least 15 of the 24 credits must be in courses numbered 300 and above. These 24 credits in the major focusing on U.S. Latino/a Studies must include the following courses, each of which is worth three credits: LAS 211 (Introduction to U.S. Latino/a Studies), Anthr 323 (Peoples and Cultures of Latin America), Engl 344 (U.S. Latino/a Literature); Hist 441 (History of Mexico and Central America) or a course in U.S. Latino/a history, Relig 338 (The Latino/a Religious Experience), and Soc 332 (The Latino/a Experience in U.S. Society). The student must have an average grade of C in the required courses of the major. Fulfillment of the foreign language requirement with Spanish is strongly recommended, but not required. For a list of other eligible courses and more information on the U.S. Latino/a Studies Program, contact the program committee chair.

Linguistics Program (Major or minor; graduate minor) *see Index, Linguistics.*

Speech Communication Program (Major or minor) see Index, Speech Communication.

Teacher Education Program
see Index, Teacher Education, Courses and Programs.

Technology and Social Change (Minor, graduate minor) *see Index, Technology and Social Change.*

Women's Studies Program (Major or minor)
see Index, Women's Studies.

Interdepartmental Degree Programs

(Administered by the College of Liberal Arts and Sciences)

Bioinformatics and Computational Biology (Major only) *see Index, Bioinformatics and Computational Biology.*

Emerging Global Disease (Minor only)
see Index, Emerging Global Disease.

Entrepreneurial Studies (Minor only)
see Index, Entrepreneurial Studies.

Environmental Science (Major or minor)
see Index, Environmental Science.

Environmental Studies (Secondary minor or major) *see Index, Environmental Studies.*

Gerontology (Minor only)
see Index, Gerontology.

The Honors Program in Liberal Arts and Sciences *see Index, Honors Program.*

Interdisciplinary Studies Program (Major only) *see Index, Interdisciplinary Studies.*

Premedical and Preprofessional Health Programs *see Index, Preprofessional Study.*

Teacher Education Program *see Index, Teacher Education, Courses and Programs.*

Certificate Programs

Community Leadership and Public Service (Certificate Only)
Interdisciplinary undergraduate program
Dianne Bystrom, Director

This interdisciplinary certificate program utilizes university courses offered in a variety of academic disciplines to provide a strong foundation and appropriate experiences for undergraduate students who plan to become community leaders and engage in public service—regardless of their profession—in the public, nonprofit or private sectors.

The program requires the completion of 21 credits through three, three-hour core required courses in leadership, speech communication and public administration; a three-hour elective course in communication; six hours of elective courses in leadership; and a three-hour capstone experience through a course, internship or study abroad experience.

The certificate will be awarded by the College of Liberal Arts and Sciences. Completion of the certificate will be noted on the student's transcript and via a certificate provided by the Registrar.

Objectives:
- Provide opportunities for students to learn about leadership and organizational theories, ethics and decision-making, principles of public service, effective communication, leadership practices in groups and organizations, and diversity issues.
- Develop leadership skills—including written and oral communication, creative thinking, personal management, group and organizational effectiveness, and problem-solving—important to students' careers, communities and personal development.
- Bring students into contact with faculty members from diverse academic departments, backgrounds and leadership experiences.
- Prepare students to undertake leadership roles in their careers and in service to their community through course work and co-curricular activities.

Learning outcomes:
Upon completion of the Certificate in Community Leadership and Public Service, students will:
- Demonstrate understanding of key concepts of leadership theories and effective practices within groups and organizations and diverse communities.
- Demonstrate understanding of key concepts of organizational theories, ethics and principles of public service.
- Demonstrate proficiencies in written and oral communication.
- Demonstrate awareness of cultural values and diversity issues as they pertain to community leadership and public service.
- Become engaged citizens through service to the university and larger community.

General requirements:
The Certificate in Community Leadership and Public Service requires 21 credits. At least 9 credits must be taken in courses numbered at the 300 level or above. At least 9 credits used for the certificate cannot be used to meet any other department, college or university requirement for the baccalaureate degree except to satisfy the total credit requirement for graduation and to meet credit requirements in courses numbered 300 or above. Courses for the certificate cannot be taken pass-fail. A cumulative grade point average of at least 2.0 is required in courses taken for the certificate.

The 21 credits required for the certificate are fulfilled by:

• 9 credits of core required courses—LAS 222, Leadership Styles and Strategies in a Diverse Society, 3 credits; Sp Cm 312, Business and Professional Speaking, 3 credits; and Pol S 371, Introduction to Public Administration, 3 credits.
• 3-credit communication course chosen from the designated list.
• 6 credits of leadership courses chosen from the designated list.
• 3 credits of a capstone course or experience, which can be fulfilled by a 3-credit course from the list of approved capstone courses, or a 3-credit internship with a community leadership or public service focus, or a 3-credit study abroad experience. Capstone courses focus on the scholarship of leadership in particular fields of study whereas an internship or study abroad provides a leadership-in-practice experience.
Required courses (9 credits): LAS 222, Sp Cm 312, Pol S 371.

Additional communication course (3 credits), from: Engl 302, 309, 412; Jl MC 305; Sp Cm 212, 322, 323,327

Additional leadership topic courses (6 credits), from: AESHM 287, 379; A E/C E/E E 388; AgEds 315; Con E 380; C R P 291, 293 332. 425, 429, 435, 455, 481, 484, 491, 492; Engr 150, 327X, HD FS 395, 445; LAS/W S 333; LAS 381; M E 412; M E/Hist 488; Mgmt 371, 419, 472; Pol S 310, 311, 344, 385, 413. 477, 480, 487; Soc 310, 334, 420, 435; Sp Cm 416, 417; U St 170; W S 301, 435

Capstone Course, Internship or Study Abroad (3 credits), from: AESHM 421, C R P 432, 475; Engl 418; HD FS 449; LAS/W S 488; M E/WLC 484; Pol S 475, Psych 450, Soc 464

Instead of a capstone course, students may complete a 3-credit internship. The internship must have a public service or community leadership focus and must be approved by the department of the student's major and the Community Leadership and Public Service Advisory Committee. Information on internships is available through the participating colleges and departments, including career services offices. Examples: LAS 380, 382, 490G, 491, 499; Pol S 499; W S 491.

Instead of a capstone course or internship, students may participate in a study abroad experience that includes 3 hours of credit. The study abroad experience must include a public service or community leadership focus. It must be approved by the student's major department and by the Community Leadership and Public Service Advisory Committee. Information is available through the ISU Study Abroad Center and international programs offices in the participating colleges and departments. Examples: International Leadership Seminar in Sydney, Australia; International Leadership in Educational Technology Academy in Spain and England; International Partnership for Service Learning and Leadership; College of Design Programs in Rome: Community and Regional Planning; LAS 395, Interdisciplinary Study Abroad Series.

Additional courses may be proposed and approved for inclusion in the list of communication, leadership and capstone courses applicable to the certificate program. Students and advisers should contact the Carrie Chapman Catt Center for Women and Politics, 309 Catt Hall, 294-3181, cattcntr@iastate.edu, www.las.iastate.edu/Catt-Center/ for the current list of courses.

Application and selection process: Enrollment is limited to 20 entering students per academic year, with applications reviewed twice each year. Selection will be based on current and past leadership experiences; previous leadership education and training; academic performance; and, most important, how completion of the certificate program will add value to the student's major/minor areas of study and future leadership goals.

Applicants should meet with their adviser on course planning and questions regarding prerequisites and then submit an application packet consisting of a Application for Admission form, Leadership Involvement Worksheet, and Proposed Program of Study form (signed by the adviser) by March 1 or October 1 to the Community Leadership and Public Service Advisory Committee, 309 Catt Hall, Iowa State University, Ames, IA, 50011-1305. The committee will be comprised of one representative each from the Catt Center, Public Policy and Administration, Speech Communication and Student Affairs and one representative from another participating department.

Latin American Studies (Certificate only)
(Interdepartmental undergraduate program)
Kathy S. Leonard, Director

The certificate in Latin American Studies is a cross-disciplinary course of study in the College of Liberal Arts and Sciences and is designed for undergraduates in any major who wish to enhance their degree and employment possibilities by adding expertise in Latin America and linguistic competence in a primary and secondary foreign language.

Completion of the Certificate is noted on the student's transcript, and via a Certificate provided by the Registrar

Objectives:
• Provide opportunities for students to develop skills and understanding about issues concerning Latin America by bringing them into contact with faculty members from many different academic backgrounds
• Provide students with an international immersion experience where they gain cultural awareness and sensitivity
• Prepare students for work or advanced study in Latin America, such as in foreign service, journalism, advocacy organizations, scientific or research institutions
• Help students acquire proficiency in at least two of the languages of Latin America (Spanish and Portuguese)
• Guide students in interdisciplinary study leading to an understanding of the multi-faceted picture of the past, present, and future of Latin America
Learning Outcomes:
Upon Completion of the Certificate in Latin American Studies, students will be able to:
• Demonstrate understanding of key concepts pertaining to Latin American cultural, historical and political events
• Understand, interpret and articulate the major processes, theories and problems of selected contemporary and historical issues in Latin America
• Demonstrate oral, aural, and written proficiency in a primary foreign language (Spanish or Portuguese) equivalent to the mid advanced level
• Demonstrate oral, aural, and written proficiency in a secondary foreign language (Spanish or Portuguese) equivalent to the low Intermediate level
• Effectively communicate with persons of Latin American cultures
• Become effective global citizens through knowledge and comparison of the cultures and issues of the United States and Latin American countries
• Be able to read Latin American cultural, literary, and historical texts in the target language with comprehension and analytical insight
• Demonstrate awareness of cultural values, beliefs, and ideologies of the various Latin American countries
• Demonstrate a thorough knowledge of the geography of the Latin American countries
General Requirements:
Requirements for the Certificate in Latin American Studies are satisfied through formal language instruction and by completing a minimum of 24 credits at the 300 level or above. Students will take coursework in at least four different disciplines and departments (Spanish, Portuguese, Anthropology, and Political Science) with other possible course offerings in LAS, History, Agriculture, and Agronomy.

Course Requirements:
Students will complete 12 credits of core courses: Pol S, 343, Anthr 323

(Should one of the above courses not be offered, students should consult the adviser to find an appropriate substitute).

Choice of one of the following 3 –credit courses: Span 332, 333

Choice of one of the following 3- credit courses: Anthr 337; Span 324, 322

Other Requirements:
Students will complete an additional 12 credits selected from the approved list of courses in Latin American Studies at the 300 level or above. At least one of these courses must be at the 400 level and approved by the Latin American Studies Program adviser.

• In order to stress the interdisciplinary aspect of the Certificate no more than three courses from one single department will count toward the Certificate.
•No more than 3 credits may be taken as a 490, independent study, and the topic must deal with Latin America.
• A minimum of 12 credits applied toward the Certificate cannot be used to meet any other departmental, college, or university requirement.
• Students may receive credit on a pre-approved basis for internships completed in Latin America. No more than 3 credits from this area may be applied to the Certificate.
• Courses taken for the Certificate may not be taken on a pass not-pass basis.
• Credits for a Certificate may be used to satisfy the credit requirement for graduation and to meet the credit requirements for courses numbered 300 and above.
• A certificate is not awarded if the baccalaureate degree is not finished.
• for students earning an ISU baccalaureate degree, a certificate is awarded concurrent with or after the ISU baccalaureate degree.
• After receiving a baccalaureate degree from any accredited institution, a student may enroll at ISU to earn a certificate.
• A cumulative grade point average of at least 2.00 is required in courses taken at ISU for a certificate.
Language Requirement:
• The minimum requirement in formal language instruction is completion of two years or the equivalent of a primary language (Spanish or Portuguese) at the university level. At ISU the completion of 202 in the appropriate language satisfies this requirement.
• Students are required to take at least one year or the equivalent of a secondary language (Spanish or Portuguese) at the university level. At ISU the completion of 102 or 112 in the appropriate language satisfies this requirement.
• Native speakers, or those with in-field experience of another Latin American language with a level equivalent to 202 can have the primary language requirement waived. Equivalence will normally be assessed

by a faculty member/CLEP exam in the Dept. of World Languages and Cultures.
•While students are encouraged to enroll in language instruction courses (i.e., conversation and composition) above the 300 level, no more than 6 credits of language study (301,303, 304) may be applied toward fulfilling language requirements for the Certificate. Students should be aware that all 300-level literature and culture/civilization courses in the Dept. of World Languages and Cultures have pre requisites such as Spanish 303 and 301.

Study Abroad

Students are required to participate in an ISU-approved study abroad program in a Latin American country with a minimum duration of 4 consecutive weeks. The Study Abroad Office has a list of ISU-approved programs. Students may elect to participate in other study abroad programs with the approval of the Latin American Studies Program Advisory Committee.

Approved courses available toward the Certificate:

The decision as to whether or not a class can be counted toward the Certificate is based primarily on the course title and description as it appears in the ISU General Catalog. Courses which deal primarily with Hispanic or Latina/o cultures in the U.S. will not count towards credit for the Certificate in Latin American Studies. Courses which primarily deal with Spain or Portugal and their cultures also do not count toward the certificate. When in doubt students should consult with the Director of the Latin American Studies Program.

AgEds 496 (3 cr.); Agron 496; Anthr 323, 337, 445/545 3 cr.); Hist 340, 341, 441, 442; IntSt 420; LAS 320, 395; Port 370; Pol S 343; Span 322, 324, 326, 332, 333, 370, 395, 445, 463, 499 (3 cr.)

Note: Study Abroad courses must be in Latin America. No more than 6 credits from each study abroad program may apply to the Certificate.

Courses primarily for undergraduate students

LAS 101. Orientation for Open Option and Preprofessional Students. (1-0) Cr. 0.5. F.S. First 8 weeks. Self-responsibility and university procedures. LAS general education requirements, ISU departments and programs, time management, academic study skills, adjustment to the university environment. Required of all first year students in the Open Option and Preprofessional Health Programs. Satisfactory-fail only.

LAS 103. Frontiers of the Discipline. (1-0) Cr. 1. *Prereq: First-year student.* Seminar focusing entirely on the on "cutting edge" research activities of faculty members. Satisfactory-fail only.
A. General
B. Humanities
C. Communication.
D. Mathematics and Natural Sciences
E. Social Sciences

LAS 104. Personal Career Development. (2-0) Cr. 2. F.S. *Prereq: 12 credits of ISU coursework.* Comprehensive approach to personal career development; intensive self-analysis; utilization of a computerized career exploration system; contact with area professionals; examination of work in modern Society and the impact of technology on the future of work; exposure to job search skills necessary for career choice implementation.

LAS 125. Connections. (1-0) Cr. 1. Links a large lecture class with a small learning community / seminar session led by the same faculty member teaching the lecture. In each case the professor teaching the large lecture will facilitate a small weekly seminar. The seminar is designed to explore the connections between the lecture topic and issues and areas beyond the lecture discipline. Features informal discussions about critical issues of the day through films, public lectures and other events which students and the faculty leader attend. At the end of the semester all of the Connections seminars will have a joint event in conjunction with an exhibit at the Brunnier Museum entitled Shattered Earth.
A. General
B. Humanities
C. Communication.
D. Mathematics and Natural Sciences
E. Social Sciences

LAS 140. Advancing Citizenship Together Learning Community Seminar. (1-0) Cr. 1. Repeatable. Fowler. First semester of required seminar for participants in the ACT (Advancing Citizenship Together) Learning Community. Build citizenship skills with a focus on womens issues and politics, and includes a service-learning component. Linked with Introduction to Women's Studies and Speech Communication classes. Satisfactory-fail only.

LAS 160. Intro to Race and Ethnicity in America. (3-0) Cr. 3. *Prereq: Permission of Instructor.* One of two courses linked with the Multicultural Learning Community (MLC). Concepts and methods employed in understanding the social and cultural experiences of the major ethnic minority groups in the U.S. with explorations primarily of Native, African, Latino, and Asian Americans

LAS 161. Studies in Race and Ethnicity in America. (1-0) Cr. 1. *Prereq: 160. Permission of Instructor.* Second of two courses linked with the Multicultural Learning Community (MLC). Application of concepts and methods to understanding the social and cultural experiences of the major ethnic minority groups in the U. S. with explorations of Native, African, Latino, and Asian.

LAS 211. Introduction to U.S. Latino/a Studies. (3-0) Cr. 3. S. A survey of the people in the United States who trace their origin to the Spanish-speaking countries of Latin America, focusing principally on Mexican Americans, Puerto Ricans, and Cuban Americans. History, religion, social structure, political participation, literature, and other aspects of each group within the framework of various Sociological theories of ethnic identity and relationship.

LAS 222. Leadership Styles and Strategies in a Diverse Society. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification.* Develop and practice leadership skills through understanding personal leadership styles, leadership theory and communication theory, including how they relate to gender issues and cultural diversity; exploring personality types, communication styles, and leadership styles, networking and developing mentoring relationships; setting goals and participating in leadership opportunities and service.

LAS 250. Cultures in Transition. (3-0) Cr. 3. An interdisciplinary introduction to a world region in a state of rapid social and cultural transition. Discussion of the history, social and political institutions, arts, economy, agriculture, and environment of the new nations.

LAS 290. Special Problems. Cr. arr. Repeatable. F.S.SS. *Prereq: Freshman or sophomore classification; Permission of the director of the Catt Center for LAS 290G.: other topics need: permission of the dean of the College of Liberal Arts and Sciences..*
A. LAS Ambassadors.
B. Advising Project.
C. Pre-Law Project.
D. General.
G. Catt Center Project.

LAS 298. Internship/Co-op. Cr. R. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services; sophomore classification.* Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student Status. Satisfactory-fail only.

LAS 325. Introduction to Asian American Studies. (3-0) Cr. 3. A survey of the peoples in the United States who trace their origins to Asia, focusing primarily on the experiences of Chinese, Japanese, Korean, Filipino, South Asian and Pacific Islander Americans. Study and discussion of history, culture, literature, social relations, and political participation of these groups, with assigned readings, writings, and in-class presentations.

LAS 333. Women and Leadership. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification.* Examine historical and contemporary barriers to and opportunities for women's leadership in a variety of contexts, including professions and public service. Examine theories of women's leadership, gender differences in leadership styles, and the perceptions and expectations about women's leadership. Multiple perspectives of women's leadership will be highlighted through lectures, readings, videos, guest speakers and group work.

LAS 350. Topics in Interdisciplinary Studies. (3-0) Cr. arr. Repeatable.
A. Interdisciplinary
B. Humanities
C. Mathematics and Nature Science
D. Social Sciences

LAS 381. Life in Iowa Seminar: Place and Purpose. (3-0) Cr. 3. F.S. Study of Midwestern culture and environments with emphasis on Iowa. Students will reflect on personal identity, vocation, and other life choices in relation to sustainable communities and natural landscapes. Writing intensive.

LAS 385. The Holocaust. (2-0) Cr. arr. F. An examination of the religious, social, scientific, and historical contexts for the Nazi destruction of European Jewry. Topics covered include anti-semitism, German volkish philosophy, eugenics, World War II, the Final Solution, rescuers, and contemporary issues. Optional third credit requires a term paper.

LAS 395. Interdisciplinary Study Abroad. Cr. arr. Repeatable. Multi-faceted exploration of a selected world region directed at developing a comprehensive understanding of a selected culture's role in contemporary society.
A. Pre-Departure Seminar. Cr. 1.
B. Humanities. Cr. 1-4.
C. Communications. Cr. 1-4.
D. Mathematics and Natural Science. Cr. 1-4.
E. Social Sciences. Cr. 1-4.

LAS 398. Internship/Co-op. Cr. R. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services; junior classification.* Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student Status.

LAS 488. Interdisciplinary Research on Women and Leadership. (Cross-listed with W S). (3-0) Cr. 3. Research on women and leadership in selected content areas (e.g., Athletics, Business, Education, Politics and Public Service, and Science and Engineering). Following overview of quantitative and qualitative methods and critical analyses of journal articles on women and leadership. Students will work with a faculty mentor in selected content areas to research, write and present paper.

LAS 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the instructor for LAS 490G; other topics need: permission of the dean of the College of Liberal Arts and Sciences.* No more than 9 credits of LAS 490 may be applied toward graduation.
E. Entrepreneurial Studies.
G. Catt Center Project.

LAS 491. Service Learning. Cr. arr. F.S.SS. *Prereq: Permission of the dean of the College of Liberal Arts and Sciences.* Service work as appropriate to the student's degree program. Academic work under faculty supervision may include written project, report, and guided reading.

LAS 498. Internship/Co-op. Cr. R. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services; senior classification.* Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student Status.

LAS 499. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services.* Work experience in professional setting appropriate to the student's degree program. Academic work under faculty supervision may include written projects, reports, and guided reading.

Liberal Studies

The bachelor of liberal studies degree (B.L.S.) was established by the three Iowa Regent universities to meet the needs of Iowans who want to earn a college degree but whose circumstances present obstacles to completing a traditional on-campus degree program. The degree may be earned from Iowa State University, the University of Iowa, or the University of Northern Iowa.

The B.L.S. is a general studies degree in the liberal arts. There is no traditional major. Instead, students take coursework in three areas of distribution. These areas may be focused in a single discipline or diversified over several disciplines. With the assistance of a B.L.S. adviser, students can structure a program that meets their individual educational, vocational or personal goals.

Up to three-fourths of the total degree requirements can be transferred from accredited institutions. Work done in community colleges or other accredited colleges and universities can be applied toward the degree, as can applicable courses taken at any of the three Iowa Regent universities, whether on or off campus.

The B.L.S. program has no residence requirements. To complete the degree, students may offer credits earned in various study formats: correspondence courses; telecourses; Saturday and evening courses; off-campus courses, including those with distance-learning formats; and regular on-campus courses. Students may also earn credits by proficiency or test-out examinations.

Admission

Admission to the B.L.S. program is open to persons who meet either of the following levels of previous educational attainment:

Hold the associate in arts (A.A.) or associate in science (A.S.) degree from an accredited two-year college. (Holders of the associate in applied science or associate in applied arts degree are not automatically eligible, although some courses may be found applicable upon review.)

Have at least 62 semester credits of collegiate work acceptable toward graduation at ISU with a total cumulative grade point average of at least 2.00 (a C average).

Library

Olivia Madison, Dean of Library Sciences

Professors: Cole, Gerhard, Goedeken, Madison

Professors (Emeritus): Dobson, Galejs, Kuhn, Morris, Yates

Associate Professors: Boydston, Christian, Coffey, Gregory, Jackson, Kappmeyer, King, Kushkowski, Lawson, Leysen, Marinko, McKiernan, Parsons, Pedersen, Pellack, Shonrock, Stacy-Bates, Vega-Garcia, Wool, Zanish-Belcher

Associate Professors (Emeritus): Mathews, Pelzer, Wendell

Assistant Professors: Arcand, Dinkelman, Kuruppu, Lewin, Matava, McMinn, Passonneau, Seo

Assistant Professor (Emeritus): Fryer

Assistant Professor (Adjunct): Lesar

Undergraduate Study

A foundation of library instruction is the Library 160 course, which is a requirement for undergraduate graduation. Library faculty also offer course-related instruction for undergraduate students in the effective use of library resources in all fields of study. Offered F.S.SS. For more information, call the Library at 294-3642.

Graduate Study

Library faculty offer course-related instruction for graduate students in the effective use of library resources. These sessions cover sources of information in all fields of study. Offered F.S.SS. For more information, call the Library at 294-3642.

Courses primarily for undergraduate students

Lib 160. Library Instruction. (1-0) Cr. 0.5. F.S.SS. *Prereq: for students whose native language is not English: Completion of English 101 requirement.* 8 week course required for undergraduate degree. Use of research libraries and information sources, including services of the University Library, with an emphasis on finding, evaluating, and using scholarly information. To be taken as early as possible in the student's undergraduate career. See course descriptions of Engl 150 and 250 for prerequisite related to Lib 160. Satisfactory-fail only.

Linguistics

www.public.iastate.edu/~apling/Lingprog.html

(Interdepartmental Program)
Program Committee: C.A. Chapelle (Chair), K.S. Leonard, J. M. Levis, Nick Pendar, W. S. Robinson, H. Venkatagiri

Undergraduate Study

Linguistics is a cross-disciplinary program in the College of Liberal Arts and Sciences designed to meet the needs of students interested in various aspects of language—its structure, history, varieties, meanings, and uses. The program includes courses in anthropology, English, computer science, psychology, and speech communication and world languages and cultures, thus providing a multi-disciplinary approach to the study of human language.

Courses in linguistics serve as background for students interested in any career that involves working with language, such as linguistic anthropology, computational linguistics, second language studies, teaching English both as a first and as a second language, psycholinguistics, cross-cultural communication, speech-language pathology and audiology.

In the College of Liberal Arts and Sciences, courses in linguistics can be applied as electives or as part of the group requirements. They may also be used in a minor or in a major.

Majors in linguistics complete a minimum of 36 hours in linguistics with a grade of C or better in each linguistics course. Courses specifically required are Ling 119, 120, 207, 219, 220, 309, 371, 413, 420, and 437. In addition, linguistics majors must choose 6 credits of courses from one or more of the following areas: communication disorders (Ling 275, 286, 471), computational linguistics (Ling 331, 520), second language studies (Ling 425, 486, 487, 519, 524, 525, 526), sociolinguistics and language use (Ling 305, 422, 514, 527), or world language (351, 352, 462, 463). Additional courses on world languages are available through study abroad. Majors in linguistics must show proficiency in a foreign language equivalent to that achieved after two years of university-level study.

Minors in linguistics are individually tailored to the interests of the student, who consults with the chair of the supervisory committee for linguistics. All minors must have a minimum of 15 credits in linguistics, of which 6 must be in courses numbered over 300. All programs must include Ling 219.

Communication Proficiency requirement: The linguistics program requires grades of C+ or better in each of the following: English 150; 250 (or 250H); and one of English 305, 314, or a World Languages and Cultures 370 course; or one of Cl St 372, 373, 374, or 376.

For information about using linguistics courses in an interdisciplinary studies major, see *Liberal Arts and Sciences, Cross-Disciplinary Studies.*

Graduate Study

A graduate minor in linguistics is offered through a cooperative agreement with the departments and programs of Anthropology, Computer Science, English, Psychology, Speech Communication, and World Languages and Cultures. The minor permits students to investigate a variety of aspects of linguistics, emphasizing the ability to think about language in a systematic and disciplined way and to apply the methods of the field to research problems in their own disciplines.

For the master's degree, a declared minor consists of 9 credits in linguistics including two foundation courses (511 and either 514, 527 or 537) and one elective from the list of courses approved for graduate credit. For the Ph.D. degree, the minor consists of 12 credits in linguistics including three foundation courses (511, 527, and 537) and one elective. Additional courses beyond those listed below may be used as electives. The chair of the supervisory committee can provide information about these.

At least one member of the linguistics faculty will serve on a student's program of study committee. A list of faculty members may be obtained from the Linguistics program website. Ph.D. candidates will write one section of the preliminary examination on an area of linguistics. All students in the minor are expected to attend linguistics lectures and colloquia. Students in Teaching English as a Second Language/Applied Linguistics are not eligible for a graduate minor in linguistics.

Courses primarily for undergraduate students

Ling 101. Introduction to the Study of Linguistics. (1-0) Cr. 1. S. Cross-disciplinary perspectives on the study of linguistics. Applications of linguistics to real world problems. Careers in linguistics.

Ling 119. Introduction to World Languages. (Cross-listed with WLC). (3-0) Cr. 3. Study of language diversity and the personal, social and political effects of diversity. Language families, attitudes toward language and dialects, language and culture, multilingualism, foreign language learning, written codes, official languages, and language policy.

Ling 120. Computers and Language. (Cross-listed with Engl). (3-0) Cr. 3. Introduction to the use of linguistic knowledge in computer applications today and the basic computational techniques used in such applications. The development of these techniques throughout the history of computational linguistics. How the study of language has contributed to the advancement of technology and how certain computational problems have influenced the way linguists study language.

Ling 207. Introduction to Symbolic Logic. (Cross-listed with Phil). (3-0) Cr. 3. S. Introduction to fundamental logical concepts and logical symbolism. Development of natural deduction through first order predicate logic with identity. Applications to arguments in ordinary English and to Philosophical issues. Majors should take Phil 207 as early as possible.

Ling 219. Introduction to Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Sophomore classification.* Introduction to linguistic concepts and principles of linguistic analysis with English as the primary source of data. Sound and writing systems, sentence structure, vocabulary, and meaning. Issues in the study of usage, regional and social dialects, language acquisition, and language change.

Ling 220. Descriptive English Grammar. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Engl 250.* Overview of grammatical structures and functions. Parts of speech; phrase, clause, and sentence structure; sentence types and sentence analysis; rhetorical grammar and sentence style; terminology. Not a remedial, English composition, or ESL course.

Ling 275. Introduction to Communication Disorders. (Cross-listed with CmDis). (3-0) Cr. 3. Survey of nature, causes, and types of major communication disorders including phonological, adult and child language, voice, cleft palate, fluency, and hearing disorders.

Ling 286. Basic Sign Language. (Cross-listed with CmDis). (3-0) Cr. 3. Development of basic skills in the use and understanding of signed English, a modification of American Sign Language. Overview of the types, causes and consequences of hearing impairment, deaf culture and the education of hearing-impaired children.

Ling 305. Language, Thought and Action. (Cross-listed with Sp Cm, ComSt). (3-0) Cr. 3. F.S.SS. *Prereq: Engl 250.* The study of symbolic processes and how meaning is conveyed in words, sentences, and utterances; discussion of modern theories of meaning; and an exploration of relationships among language, thought and action. Nonmajor graduate credit.

Ling 309. Linguistic Anthropology. (Cross-listed with Anthr). (2-2) Cr. 3. F. *Prereq: Anthr 201.* Language as a human attribute; language versus animal communication; human communication in cultural context; paralanguage, kinesics, proxemics, artifacts as communication; language and culture; cross-cultural Sociolinguistics; ethnoscience; and language policies. Participatory lab: focus on analysis of a non-Western language and communication system.

Ling 331. Theory of Computing. (Cross-listed with Com S). (3-1) Cr. 3. F.S. *Prereq: C- or higher in 228, C- or higher in Com S 330 or Cpr E 310, C- or higher in Math 166, and Engl 250..* Models of computation: finite state automata, pushdown automata and Turing machines. Study of grammars and their relation to automata. Limits of digital computation, unsolvability and Church-Turing thesis. Chomsky hierarchy and relations between classes of languages. Nonmajor graduate credit.

Ling 352. Introduction to Spanish Phonology. (Cross-listed with Span). (3-0) Cr. 3. F.S. *Prereq: Spanish 301, 303 or 304.* An introductory study of the articulation, classification, distribution, and regional variations of the sounds of the Spanish language. Taught in Spanish. Nonmajor graduate credit.

Ling 371. Phonetics and Phonology. (Cross-listed with CmDis). (3-0) Cr. 3. *Prereq: CmDis 275 or Engl 219.* Analysis of speech through study of individual sounds, their variations, and relationships in context; English phonology; practice in auditory discrimination and transcription of sounds of American English; description of speech sounds in terms of their production, transmission, and perception.

Ling 413. Psychology of Language. (Cross-listed with Psych). (3-0) Cr. 3. *Prereq: Psych 101.* Introduction to psycholinguistics. Topics may include origin of language, speech perception, language comprehension, reading, bilingualism, brain bases of language, and computational modeling of language processes. Nonmajor graduate credit.

Ling 420. History of the English Language. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Engl 219, 220.* Comparison of English to other languages by family background and by type. Analysis of representative Old, Middle, Early Modern and present-day English texts, including both literary works and non-literary documents. Nonmajor graduate credit.

Ling 422. Women, Men, and the English Language. (Cross-listed with Engl, W S). (3-0) Cr. 3. *Prereq: Engl 219.* The ways men and women differ in using language in varied settings and the ways in which language both creates and reflects gender divisions. Nonmajor graduate credit.

Ling 425. Second Language Learning and Teaching. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Engl 219; junior classification.* The process of second language learning and principles and techniques of teaching second languages. Learning and teaching in specific situations and for particular purposes. Current applications of technology in teaching and assessment. Nonmajor graduate credit.

Ling 437. Grammatical Analysis. (Dual-listed with 537). (Cross-listed with Engl). (3-0) Cr. 3. *Prereq: Engl 220; junior classification.* Theories and methods for analysis of English syntax with emphasis on recent syntactic theory.

Ling 462. Contrastive Analysis of Spanish/English for Translators. (Cross-listed with Span). (3-0) Cr. 3. *Prereq: Spanish 351.* Linguistic study of the major differences between the Spanish and English grammatical systems and their applications in the translation of Spanish to English. Taught in Spanish. Nonmajor graduate credit.

Ling 463. Hispanic Dialectology. (Cross-listed with Span). (3-0) Cr. 3. *Prereq: Spanish 352.* Intensive study of the phonology, morphosyntax and lexicon of the Hispanic dialects of Spain and Latin America in their historical context. Taught in Spanish. Nonmajor graduate credit.

Ling 471. Language Development. (Cross-listed with CmDis). (3-0) Cr. 3. *Prereq: CmDis 275 or Psych 230 or Engl 219.* Definition of components of language. Overview of theories and developmental processes related to each component of linguistic skill (semantics, lexicon, syntax, morphology, phonology, pragmatics). Overview of normative information available for infants, children, adolescents, and adults. Attention to metalinguistic skills and the complementary nonlinguistic and paralinguistic skills. Nonmajor graduate credit.

Ling 486. Methods in Elementary School World Language Instruction. (Cross-listed with WLC, C I). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language.* Current educational methods and their application in the elementary school classroom. Special emphasis on planning, evaluation, and teaching strategies. Nonmajor graduate credit.

Ling 487. Methods in Secondary School World Language Instruction. (Cross-listed with WLC, C I). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language, admission to teacher education program.* Theories and principles of contemporary world language learning and teaching. Special emphasis on designing instruction and assessments for active learning.

Ling 489. Undergraduate Seminar. (Cross-listed with Engl). (3-0) Cr. 3. Repeatable. F. *Prereq: 9 credits in English beyond 250.* Intensive study of a selected topic in literature, criticism, rhetoric, writing, or language. Cross-listing with linguistics acceptable only when offered as a course in linguistics. Nonmajor graduate credit.

Ling 490B. Independent Study. (Cross-listed with Engl). Cr. arr. Repeatable. F.S. *Prereq: 9 credits in English beyond 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee.* Designed to meet the needs of students who wish study in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields.
B. Linguistics, Semantics (Engl 490B)

Ling 490D. Independent Study: Linguistic Anthropology. (Cross-listed with Anthr). Cr. arr. Repeatable. *Prereq: 9 credits in anthropology.*
D. Linguistic Anthropology (Same as Anthr 490D)

Courses primarily for graduate students, open to qualified undergraduate students

Ling 500. Language and Culture. (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 309 or 510.* Approaches to the study of the relationship between language structure, world view, and cognition; social and structural linguistic variation; cross-cultural aspects of verbal and non-verbal communication; linguistic change; contemporary applications of linguistic anthropology.

Ling 510. Introduction to Computers in Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Use of applications software for language teaching, linguistic analysis, and Statistical analysis. Issues and problems in applied linguistics related to computer methods.

Ling 511. Introduction to Linguistic Analysis. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Principles and methods of linguistic analysis with emphasis on phonology, morphology, and syntax. Description of linguistic variation and current theoretical approaches to linguistics.

Ling 512. Linguistic Change in English: Historical Analysis of Literary and Non-Literary Texts. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Linguistic change in English, connections to literary and rhetorical history. Development of formal written English and its conventions. Historical survey of ideas about the English language.

Ling 514. Sociolinguistics. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Theories and methods of examining language in its social setting. Analysis of individual characteristics (e.g., age, gender, ethnicity, social class, region), interactional factors (e.g., situation, topic, purpose) and national policies affecting language use.

Ling 515. Statistical Natural Language Processing. (Cross-listed with Engl, HCI). (3-0) Cr. 3. F. *Prereq: Stat 330 or equivalent; recommended 219 or 511.* Introduction to computational techniques involving human language and speech in applications such as information retrieval and extraction, automatic text categorization, word prediction, intelligent Web searching, spelling and grammar checking, speech recognition and synthesis, statistical machine translation, n-grams, POS-tagging, word-sense disambiguation, on-line lexicons and thesauri, markup languages, corpus analysis, and Python programming language.

Ling 517. Second Language Acquisition. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Theory, methods, and results of second language acquisition research with emphasis on approaches relevant to second language teaching.

Ling 518. Teaching English as a Second Language Methods and Materials. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Introduction to approaches, methods, techniques, materials, curricular design, and assessment for various levels of ESL instruction. Attention to issues related to the teaching of listening, speaking, reading, writing, vocabulary, pronunciation, and culture.

Ling 520. Computational Analysis of English. (Cross-listed with Engl, HCI). (3-0) Cr. 3. F. *Prereq: Engl 510 or 511.* Concepts and practices for analysis of English by computer with emphasis on the applications of computational analysis to problems in applied linguistics such as corpus analysis and recognition of learner language in computer-assisted learning and language assessment.

Ling 524. Literacy: Issues and Methods for Non-native Speakers of English. (Cross-listed with Engl). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 511 or an introductory course in linguistics.* Theoretical and practical issues and techniques in the teaching of

literacy in a variety of contexts, involving children and adults at basic skill levels and teens and adults in academic and vocational programs.

Ling 525. Methods in Teaching Listening and Speaking Skills to Nonnative Speakers of English. (Cross-listed with Engl). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 511 or an introductory course in linguistics.* Theoretical and practical issues and techniques in the teaching of second language pronunciation, listening, and speaking skills. Topics will be relevant to those intending to teach in various contexts involving both K-12 and adult learners.

Ling 526. Computer-Assisted Language Learning. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: 511 or equivalent.* Theory, research, and practice in computer use for teaching non-native speakers of English. Methods for planning and evaluating computer-based learning activities.

Ling 527. Discourse Analysis. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Methods and theoretical foundations for linguistic approaches to discourse analysis. Applications of discourse analysis to the study of texts in a variety of settings, including academic and research contexts.

Ling 537. Grammatical Analysis. (Dual-listed with 437). (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: 219, 220, or 511; junior classification.* Theories and methods for analysis of English syntax with emphasis on recent syntactic theory.

Ling 588. Supervised Practicum in Teaching English as a Second Language. (Cross-listed with Engl). (1-5) Cr. 3. F.S.SS. *Prereq: 15 credits toward the TESL/Applied Linguistics master's degree.* Intensive observation of ESL instruction and supervised practice in teaching learners of English in a context appropriate to the practicum student's goals. Seminar discussion of observed practices in relation to language teaching theories and methods.

Ling 590. Special Topics: Teaching English as a Second Language (TESL)/Applied Linguistics. (Cross-listed with Engl). Cr. arr. Repeatable. *Prereq: Permission of the English Department Graduate Studies Committee according to guidelines available in the department office.*
B. Teaching English as a Second Language (TESL)/Applied Linguistics. (Cross-listed with Engl 590B)

Ling 591. Studies in Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. Repeatable. *Prereq: 6 credits in TESL/Applied Linguistics.* Intensive study of applied linguistic theory as it relates to specific issues in language acquisition, teaching, or use.

Ling 623. Research Methods in Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: 511, 517, 518, Engl 519.* Survey of research traditions in applied linguistics. Focus on theoretical and practical aspects of quantitative and qualitative approaches to applied linguistic study, including experimental and quasi-experimental methods, classroom observation and research, introspective methods, elicitation techniques, case studies, interactional analysis, ethnography, and program evaluation. Computational tools and resources for linguistic research will be highlighted.

Ling 630. Seminar in Technology and Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: Engl 510, 511, 517, 518, others depend on the topic.* Topic changes each semester. Topics include advanced methods in natural language processing, technology and literacy in a global context, feed back in CALL programs, and advances in language assessment.

Ling 671. Discourse in Classrooms. (Cross-listed with C I). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: graduate classification.* Explores both foundational and current literature on discourse in K-12 classrooms; focuses on both discourse as a classroom phenomenon and discourse as an analytic tool for doing research in classrooms; and provides a close look at enacted and hidden curricula through an examination of interactions and communication patterns.

Ling 688. Practicum in Technology and Applied Linguistics. (Cross-listed with Engl). (1-5) Cr. 3. F.S.SS. *Prereq: Engl 510, 626, or equivalent; 2nd year PhD student.* Focus on integrating theoretical knowledge with practical expertise. Assess client needs; develop, integrate, and evaluate solutions. Practical understanding of computer applications used in multimedia development. Create web-based or CD-ROM-based multimedia materials. Work with advanced authoring applications.

Courses for graduate students

Ling 623. Research Methods in Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F. Prereq*: 511, 517, 518, Engl 519.* Survey of research traditions in applied linguistics. Focus on theoretical and practical aspects of quantitative and qualitative approaches to applied linguistic study, including experimental and quasi-experimental methods, classroom observation and research, introspective methods, elicitation techniques, case studies, interactional analysis, ethnography, and program evaluation. Computational tools and resources for linguistic research will be highlighted.

Ling 630. Seminar in Technology and Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F. Prereq*: Engl 510, 511, 517, 518, others depend on the topic.* Topic changes each semester. Topics include advanced methods in natural language processing, technology and literacy in a global context, feed back in CALL programs, and advances in language assessment.

Ling 671. Discourse in Classrooms. (Cross-listed with C I). (3-0) Cr. 3. Alt. S., offered 2009. Prereq*: graduate classification.* Explores both foundational and current literature on discourse in K-12 classrooms; focuses on both discourse as a classroom phenomenon and discourse as an analytic tool for doing research in classrooms; and provides a close look at enacted and hidden curricula through an examination of interactions and communication patterns.

Ling 688. Practicum in Technology and Applied Linguistics. (Cross-listed with Engl). (1-5) Cr. 3. F.S.SS. *Prereq: Engl 510, 626, or equivalent; 2nd year PhD student.* Focus on integrating theoretical knowledge with practical expertise. Assess client needs; develop, integrate, and evaluate solutions. Practical understanding of computer applications used in multimedia development. Create web-based or CD-ROM-based multimedia materials. Work with advanced authoring applications.

Logistics and Supply Chain Management

(Administered by the Department of Logistics, Operations, and Management Information Systems)

Richard Poist, Chair of Department

Distinguished Professor (Emeritus): Baumel

Professors: Crum, Poist, Walter

Professors (Emeritus): Thompson, Voorhees

Associate Professors: Blackhurst, Johnson, Mennecke, Montabon, Nilakanta, Ruben, Suzuki, Tiwana, Townsend, Zhu

Assistant Professors: Jiang, Martens, Scheibe

Instructor (Adjunct): Choobineh

Lecturer: Helmer

Undergraduate Study

For the undergraduate curriculum in business, major in Logistics and Supply Chain Management, see *College of Business, Curricula.*

Logistics and Supply Chain Management is a program of study concerned with the efficient flow of materials, products, and information within and among organizations. Logistics management entails a wide variety of activities that have a significant influence on customer service, including inventory control, transportation, warehousing, facility location analysis, packaging, materials handling, parts and service support, and product returns. Supply chain management involves the integration of business processes across organizations, from material sources and suppliers through manufacturing and processing to the final customer. Logistics management is, thus, taught in the context and framework of inter-organizational supply chain systems.

The study of Logistics and Supply Chain Management prepares students for professional careers with shippers (e.g., manufacturers and distributors), transportation carriers, and logistics service providers. The curriculum provides the required theoretical/conceptual base and analytical methods for making sound operational and strategic business decisions.

The requirements for the Logistics and Supply Chain Management major are met by completion of the following courses: LSCM 460, 461, 485, 486, 487, plus one course from an approved list.

The department also offers a minor for non-Logistics and Supply Chain Management majors in the College of Business. The minor requires 15 credits from an approved list of courses, of which 9 credits must stand alone. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

For graduate study options, including the Ph.D. degree, see the Supply Chain Management listing

Courses primarily for undergraduate students

LSCM 360. Business Logistics. (3-0) Cr. 3. *Prereq: Econ 101.* Introduction and analysis of the logistics concept to include the management of transportation, inventory, packaging, warehousing, materials handling, order processing, facility location, and customer service.

LSCM 440. Supply Chain Information Systems. (Cross-listed with MIS, OSCM). (3-0) Cr. 3. *Prereq: MIS 330, OSCM 320, LSCM 360.* Internal and inter-organizational information systems necessary for a supply chain to achieve competitive advantage. Topics include: design, development, implementation, and maintenance of supply chain information systems; enterprise resource planning; advanced planning and scheduling, manufacturing execution systems; and the interface between manufacturing planning and control processes, logistics processes, and the information system.

LSCM 460. Decision Tools for Logistics and Operations Management. (3-0) Cr. 3. *Prereq: LSCM 360, OSCM 320.* Technical tools and skills required for problem solving and decision making in logistics and operations management. Transportation and network planning, inventory decision making, facility location planning, vehicle routing, scheduling, and production planning. Quantitative tools include linear and integer programming, non-linear programming, and simulation. Emphasis on the use of PC-based spreadsheet programs. Nonmajor graduate credit.

LSCM 461. Principles of Transportation. (3-0) Cr. 3. *Prereq: LSCM 360.* Economic, operating, and service characteristics of the various modes of transportation, with a special emphasis on freight transportation. Factors that influence transport demand, costs, market structures, carrier pricing, and carrier operating and service characteristics and their influence on other supply chain costs and supply chain performance. Nonmajor graduate credit.

LSCM 462. Transportation Carrier Management. (3-0) Cr. 3. *Prereq: Credit or enrollment in LSCM 461.* Analysis of transport users' requirements. Carrier management problems involving ownership and mergers, routes, competition, labor, and other decision areas. Nonmajor graduate credit.

LSCM 466. International Transportation and Logistics. (3-0) Cr. 3. *Prereq: LSCM 360.* Logistics systems and legal framework for the international movement of goods. Operational characteristics of providers of exporting and importing services. The effects of government trade policies on global logistics. Nonmajor graduate credit.

LSCM 469. Transportation and Logistics Issues. (3-0) Cr. 3. *Prereq: LSCM 460, 461.* An integrative course designed to study contemporary problems and issues in transportation and logistics. Nonmajor graduate credit.

LSCM 485. Demand Planning and Management. (Cross-listed with OSCM). (3-0) Cr. 3. *Prereq: LSCM 360, OSCM 320.* Demand planning process which synchronizes demand with manufacturing and distribution. Addresses linking business plans and demand forecasts both horizontally and vertically within the organization and collaboratively among supply chain partners. Forecasting, customer relationship management, sales and operations planning, customer service, distribution channels, e-fulfillment, and information systems requirements. Nonmajor graduate credit.

LSCM 486. Principles of Purchasing and Supply Management. (Cross-listed with OSCM). (3-0) Cr. 3. *Prereq: LSCM 360, OSCM 320.* Sourcing strategies, concepts, tools and dynamics in the context of the integrated supply chain. Make or buy decision, supplier evaluation and selection, global sourcing, the total cost of ownership, contracts and legal terms, negotiation, purchasing ethics, and information systems requirements. Nonmajor graduate credit.

LSCM 487. Strategic Supply Chain Management. (Cross-listed with OSCM). (3-0) Cr. 3. *Prereq: LSCM 460 or OSCM 422 or OSCM 424; LSCM 485 or LSCM 486.* Capstone course in supply chain management. Integrating and applying the theories, concepts, and methods covered in the prerequisite courses through the use of readings, case studies, projects, and industry speakers. Nonmajor graduate credit.

LSCM 490. Independent Study. Cr. arr. Repeatable. *Prereq: LSCM 360, senior classification, permission of instructor.*

Courses primarily for graduate students, open to qualified undergraduate students

The department offers graduate courses under the heading of Supply Chain Management. These courses include SCM 601, 602, 603, 604, 605, 650, 651, and 699. For descriptions of these courses, see Supply Chain Management.

Management

Thomas Chacko, Chair of Department

University Professors: McElroy, Morrow Shrader

Professors: Chacko, Van Auken, Werbel

Professor (Emeritus): Hunger

Associate Professors: Blackburn, Demarie, Herrmann, Johnson

Associate Professor (Emeritus): Aitchison

Assistant Professors: Anderson, Schwab, Zhang

Senior Lecturer: Elston, R. Smith

Lecturer: Mullen

Undergraduate Study

For undergraduate curriculum in business, major in management, see *College of Business, Curricula*.

The Department of Management offers a major in management. Students will complete the general education requirements (including business foundation courses), and business core requirements for the bachelor of science (B.S.) degree and 18 credits in the major. The instructional objective of the Department of Management is to provide students with knowledge of organizations and management functions within organizations. Management majors will demonstrate an understanding of (1) employee work-related attitudes and behaviors, (2) competitive strategy and advantage, (3) challenges and strategies in international business, and (4) human resource management practices in firms. Students will demonstrate an awareness of the role of diversity, ethics, and technology in business decisions, the impact of external forces and global issues on organizations, and an ability to think critically, to communicate effectively, and to work effectively as a member of a team.

Management is a broadly defined discipline and activity, which is neither industry nor function specific. Management concepts, theories, techniques, and skills are applicable to all business functional areas and are essential components for successful organizations. Management requires sound conceptual, technical, and human Skills for the effective utilization of organizational resources. In addition to the basic business foundation and core courses, management majors are required to complete 18 credits of management or department approved courses. Included in these 18 credits are four required courses: Mgmt 371, 377, 414, and 471.

The department also offers a minor for non-Management majors in the College of Business. The minor requires 15 credits from an approved list of courses, of which 9 credits must stand alone. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

The Department of Management participates in three graduate programs: the M.S. in Business, the M.B.A. full-time and part-time programs, and the Ph.D. program in Business and Technology. The M.S. in Business is a 30-credit curriculum culminating in a thesis. The M.B.A. program is a 48-credit curriculum. Twenty four of the 48 credits are core courses and the remaining 24 are graduate electives. The Ph.D. program is a 56 credit curriculum that culminates in a dissertation.

Courses primarily for undergraduate students

Mgmt 310. Entrepreneurship and Innovation. (3-0) Cr. 3. F.S. *Prereq: Sophomore classification.* Review of the entrepreneurial process with emphasis on starting a new business. How to analyze opportunities, develop an innovative product, organize, finance, market, launch, and manage a new venture. Deals with the role of the entrepreneur and the importance of a business plan. Speakers and field project.

Mgmt 313. Feasibility Analysis and Business Planning. (3-0) Cr. 3. S. *Prereq: 310 and Entrepreneurship Minor or Management Major.* Developing an idea for a new business venture, conducting a feasibility study, researching the potential market, analyzing the competition, and writing a formal business plan. Basic business functions are discussed in terms of their application to conducting feasibility analysis and writing a business plan for an entrepreneurial venture.

Mgmt 370. Management of Organizations. (3-0) Cr. 3. F.S.SS. *Prereq: Econ 101 or 102 or equivalent.*. A management functions approach is used to explain what managers do in organizations; how they deal with external constituents, how they structure their companies, and how they deal with employees. A contingency approach is used as a framework for understanding how to increase the effectiveness and efficiency of organizations in today's dynamic, highly competitive business environment.

Mgmt 371. Organizational Behavior. (3-0) Cr. 3. F.S. *Prereq: 370.* The study of individual attributes, interpersonal relations, and employee attitudes in organizations. Instructional emphasis is placed on how management concepts such as reward systems, job design, leadership, teams, etc., can be used to manage employee attitudes and behavior.

Mgmt 377. Competitive Strategy. (3-0) Cr. 3. F. *Prereq: Econ 101 and junior classification.* Developing competitive strategy and achieving competitive advantage in firms, including: industry analysis, generic strategies, hypercompetition, competing against time, and building distinctive capabilities.

Mgmt 414. International Management. (3-0) Cr. 3. F. The nature and economic role of the multinational firm and entrepreneurial ventures, including the impact of legal, political, and cultural variables upon firm performance and managerial activity; case studies illustrate interdependent nature of functional areas of business projected across national boundaries. Nonmajor graduate credit.

Mgmt 415. Managing New Ventures. (3-0) Cr. 3. F.S. *Prereq: 370; Mkt 340; Fin 301; LSCM 360, OSCM 320.* Examination of business problems and issues in new and growing firms. Emphasis is on analyzing existing businesses. Includes a field project. Nonmajor graduate credit.

Mgmt 419. Social Responsibility of Business. (3-0) Cr. 3. S. A consideration of the role of business in Society. Critical analysis of ethical, managerial, and public issues as they affect the corporation.

Mgmt 471. Personnel and Human Resource Management. (3-0) Cr. 3. F.S. *Prereq: Junior standing.* Recruitment and selection, utilization, and development of people in organizations. Examination of each personnel function; interrelationships among the functions.

Mgmt 472. Management of Diversity. (3-0) Cr. 3. F.S. *Prereq: Junior classification.* One of the most crucial problems in organizations today is the management of diversity. Attempts to define the difference between equal employment opportunity/affirmative action, which has a legal basis, and diversity which has an educational basis. Organized around the concepts of: (1) cultural diversity and cultural unity; (2) development of skills and tools to manage diversity; and (3) structure of diversity development programs in organizations. Nonmajor graduate credit.

Mgmt 478. Strategic Management. (3-0) Cr. 3. F.S.SS. *Prereq: 370; OSCM 320; Fin 301; Mkt 340; LSCM 360; Acct 285; graduating senior.* Strategy formulation, implementation, and evaluation and control in today's organizations. Emphasis is on strategic planning and decision making using the case method and/or projects.

Mgmt 490. Independent Study. Cr. arr. Repeatable. *Prereq: 370, senior classification, permission of instructor.*

Courses primarily for graduate students, open to qualified undergraduate students

Mgmt 501. Strategy Formation. (1-0) Cr. 1. F. *Prereq: Graduate classification.* An introduction to the strategic planning process. How to formulate strategy in context of environmental opportunities and threats, how to analyze industry competition and build competitive advantages.

Mgmt 507. Organizational Behavior. (2-0) Cr. 2. F. *Prereq: Graduate classification.* Understanding human behavior in organizations and the nature of organizations from a managerial perspective. Special emphasis is placed on how individual differences, such as perceptions, personality, and motivation, influence individual and group behavior in organizations and on how behavior can be influenced by job design, leadership, groups, and the structure of organizations.

Mgmt 511. Ethics and Social Responsibility. (1-0) Cr. 1. S. *Prereq: Graduate classification.* The ethical issues, moral dilemmas, and stakeholder responsibilities embraced by today's corporate decision makers. The morality of current management models and practices. Corporate governance and control, moral reasoning in groups, whistleblowing, employee safety, truth in advertising, environmental pollution, plant closings, insider trading, employee rights.

Mgmt 512. Strategic Management. (2-0) Cr. 2. S. *Prereq: 501, 507, OSCM 502, MIS 503, Mkt 504, Fin 505, Acct 508.* Critical analysis of case studies in strategic management with an emphasis on integrative decision making. Strategy implementation in light of the legal, regulatory, economic, social, and political contexts of business.

Mgmt 565. Technology Transfer and Feasibility Analysis. (3-0) Cr. 3. *Prereq: Graduate classification.* Commercialization of new technology. Topics covered include market analysis, intellectual property, product development, feasibility analysis, and new business evaluation.

Mgmt 566. Entrepreneurship and New Business Creation. (3-0) Cr. 3. *Prereq: Graduate classification or permission of instructor.*. The essentials of starting and operating a new business. Topics include current research on entrepreneurial perspective, starting and developing a new business, financing the venture, managing the growing firm, and special issues.

Mgmt 567. International Entrepreneurship. (3-0) Cr. 3. Essentials of operating an entrepreneurial firm in an international environment. Topics include international entrepreneurship, starting and developing a business in an international market, financing international ventures, international management issues, exchange rates, and culture.

Mgmt 570. Managing Employee Attitudes and Behaviors. (3-0) Cr. 3. F.SS. *Prereq: 371 or 507 or Psych 450.* Advanced topics germane to the management of individuals and groups over their work lives; sustained work commitment, motivation and job/career satisfaction, absenteeism, turnover, stress, leadership and career development (e.g., career ladders, mentoring).

Mgmt 571. Seminar in Personnel and Human Resources Management. (3-0) Cr. 3. S. *Prereq: 371 or 507 or Soc 420.* Topics and issues in personnel management with a focus on the management of human resources in organizations. Current personnel practices, Philosophies, and behavioral science research.

Mgmt 575. Compensation Management. (3-0) Cr. 3. F. *Prereq: 571.* Concepts, techniques, and issues dealing with remuneration of the work force. The impact of government legislation as well as organizational and Societal issues.

Mgmt 581. Strategic Planning and Environmental Analysis. (3-0) Cr. 3. F. *Prereq: 501 or permission of instructor.* Discussion of concepts and techniques used in long range strategic planning. Examination of planning practices in business and not-for-profit organizations. Topics include environmental scanning, industry analysis, forecasting, corporate and competitive strategies, and tactics.

Mgmt 582. Corporate Governance and Leadership. (Cross-listed with Acct). (3-0) Cr. 3. *Prereq: 502 or permission.* Examination of top managers and corporate boards of directors in terms of roles, responsibilities, and tasks. Examination of corporate governance structure and functioning. Topics include CEO tenure and compensation, board monitoring and composition, board responsibility and accountability, board structure and performance, CEO and board roles in strategic management, shareholder and stakeholder representation, corporate social responsibility, ethics and corporate governance, international governance, and executive leadership style.

Mgmt 583. Strategic Management of Innovation. (3-0) Cr. 3. *Prereq: 501 or permission of instructor.* Critical analysis and discussion of cases focused on strategic management of innovation. Assessment of a firm s innovative capabilities and competitive dynamics to manage innovative processes. Practical applications through emphasis on implementation including internal corporate venturing, management of the corporate R&D function, and institutionalization of innovation.

Mgmt 584. Management Consulting. (3-0) Cr. 3. *Prereq: 501 or permission of instructor.* Provides the opportunity for students to understand the role of the professional consultant, the issues facing the management consulting industry, the competencies of various management consulting firms, the nature and form of strategic consulting engagement, and the nature and scope of strategic change in business firms. Students will learn about management consulting functions and will practice the consultant role though cases and field studies.

Mgmt 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor. For students* wishing to do individual research in a particular area of management.

Courses for graduate students

Mgmt 601. Philosophy of Science. (3-0) Cr. 3. *Prereq: enrollment in the PhD program.* This course provides a Philosophical introduction to the theoretical and empirical development of scientific knowledge. It focuses on a variety of basic problems common to the social sciences: the nature of explanation, the structure of theories, forms of knowledge, scientific laws, nature of theory and ethics. The purpose of the course is to help doctoral students define a research context by addressing the purposes, assumptions and primary components of scientific inquiry.

Mgmt 602. Organizational Theory. (3-0) Cr. 3. *Prereq: enrollment in the PhD program.* This seminar involves the examination of the core theories and perspectives in organizational theory, as well as their applications and extensions. This material addresses the fundamental rationale for organizations in modern society, basic processes of organizing and organizational structure, a consideration of inter-organizational relationships and the external environment, and a variety of factors that help determine organizational effectiveness..

Mgmt 603. Strategic Management of Technology and Innovation. (3-0) Cr. 3. *Prereq: Mgmt 601.* This course will offer a critical review of organizational decision making with respect to technology and innovation. Students will learn how technological change can alter the basis of competition; how competitive strategy drives technology investment decisions; how market-orientation should be the other backbone of technological innovation; and best practices of organizing and managing the new product development process to achieve strategic goals.

Mgmt 604. Seminar in Organizational Behavior. (3-0) Cr. 3. *Prereq: enrollment in the PhD program.* The purpose of this seminar is to introduce behavioral science literature relevant to the study of behavior in organizational settings. The course will focus on the individual's role within organizations and cover topics such as individual differences, motivation, leadership, decision-making. Learning, risk taking, interpersonal relations, etc. Both theoretical and empirical contributions will be examined, with emphasis on integration of diverse theoretical perspectives.

Mgmt 650. Research Practicum I. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

Mgmt 651. Research Practicum. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

Mgmt 699. Dissertation. Cr. arr. *Prereq: Graduate classification, permission of dissertation supervisor.* Research.

Management Information Systems

(Administered by the Department of Logistics, Operations and Management Information Systems)

Richard Poist, Chair of Department

Distinguished Professor (Emeritus): Baumel

Professors: Crum, Poist, Walter

Professors (Emeritus): Thompson, Voorhees

Associate Professors: Blackhurst, Johnson, Mennecke, Montabon, Nilakanta, Ruben, Suzuki, Tiwana, Townsend, Zhu

Assistant Professors: Jiang, Martens, Scheibe

Instructor (Adjunct): Choobineh

Lecturer: Helmer

Undergraduate Study

For undergraduate curriculum in business, major in management information systems, (MIS) see *College of Business, Curricula.*

The MIS Program is designed to provide students with a strong educational foundation that prepares them as information system (IS) professionals. The academic program consists of a specially designed curriculum that emphasizes conceptual, analytical, technical and interpersonal skills. The major offers students comprehensive training in the application, use and management of information systems to prepare them to provide effective information services and support to organizations. The coursework is designed to provide the technical and conceptual skills associated with the use of information technology in business organizations. The program will: impart knowledge on existing and emerging information technologies and their impact on the IS function; train to critically analyze business processes, identify inefficiencies and problems, assess information requirements, create business solutions and technical specifications for the supporting system; provide expertise to design and develop database applications using the latest database technologies; provide expertise in the latest telecommunication technologies; train in interpersonal and communication skills to effectively interact with various information systems' clients; and provide managerial skills to manage IS projects.

The MIS major requires students to take seven courses. The required courses are: MIS 331, 432, 433, 435, and 438. In addition they will take two courses from an approved list. These courses are designed to provide the conceptual, technical, and managerial skills necessary to design and develop systems in organizations

The department also offers a minor for non-Management information Systems majors in the College of Business. The minor requires 15 credits from an approved list of courses, of which 9 credits must stand alone. The 15 credits must include either MIS 423 or 433. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

The MIS area participates in four graduate programs in the College of Business—M.S. in Business, MSIS, full-time and part-time M.B.A. programs and Ph.D. in Business and Technology. The M.S. program is a 30-credit curriculum with a thesis. The Management of Information Technology specialization in the Ph.D. program is a 56-credit curriculum with a 12-credit dissertation.

The MIS area also participates in an interdepartmental MS program in Information Assurance, as well as in a Masters and Ph.D. program in Human Computer Interaction. Students in any of these programs can be enrolled through the College of Business.

The M.B.A. program is a 48-credit curriculum. Twenty-four of the 48 credits are core business courses and the remaining 24 credits are graduate electives. Students can obtain a MIS specialization in the M.B.A. program by taking 12 credits of graduate MIS courses from a selected list of courses.

The masters of science in information systems (MSIS) is a 32 credit (minimum) curriculum designed around three inter-related areas - Foundation, IS core, and electives. All students are expected to be familiar with basic computing skills before they enter the program. The MSIS will educate students on applying IS theory and concepts to modern IS development through classes that enable them to learn and use the latest software in application projects. Students graduating from the program will have advanced technical and managerial skills to develop and manage information systems projects.

The Ph.D. in Business and Technology with a MIT specialization is a 56 credit (minimum) curriculum designed around four inter-related areas—Core, MIT specialization, Minor, and Research Methods—and dissertation. The MIT area examines issues related to the development, building, management, and use of information and knowledge-based technologies. Such technologies enable users to collect organizational data, provide a platform for organizing and disseminating the data, and offer operational, decision support, and knowledge management tools through which users can leverage data and information for making better organizational decisions. Students in the MIT specialization will study areas such as information technology analysis and development, database and knowledge management systems, decision support and data mining, human computer interaction, system security and integrity, and project management and collaborative teamwork.

Courses primarily for undergraduate students

MIS 330. Management Information Systems. (3-0) Cr. 3. *Prereq: Com S 103.* The role of information technology in organizations. Overview of methodologies for design and development of systems including decision support systems, expert systems, data bases, end-user computing, etc. Computer applications relate concepts to practice. Lecture and laboratory work emphasizes the enabling role of IT in contemporary organizations.

MIS 331. File Structures and Programming. (3-0) Cr. 3. *Prereq: Credit or enrollment in Com S 207.* Introduction to the concepts and use of data structures, file accesses and object oriented programming methodologies in contemporary business environments. Application development environments will be covered.

MIS 423. Information Systems for Managerial Decision Making. (3-0) Cr. 3. *Prereq: MIS 330.* Design development, modeling, and implementation of critical business processes that support global managerial decision making. Transforming and enhancing student abilities to act on data derived from spreadsheets, databases, business intelligence, data mining, and knowledge management sources to develop alternative plans and comprehensive solutions to common business problems. Designed to complement a range of student business majors. Students will build a variety of business models, analyze case studies, and propose solutions to real world situations. Only one of MIS 423 or 433 may count towards graduation. Nonmajor graduate credit.

MIS 431. Software Development in Contemporary Languages. (3-0) Cr. 3. *Prereq: 331.* Advanced software development and topics in contemporary programming languages. Topics include basic syntax, advanced programming techniques, file structures and management, database access, algorithm design, web forms and graphical user interfaces.

MIS 432. Information Systems Analysis. (3-0) Cr. 3. *Prereq: 330.* Critical analysis of business processes, data and process modeling, feasibility studies, CASE tools, and developing system design specifications. Nonmajor graduate credit.

MIS 433. Database Management Systems. (3-0) Cr. 3. *Prereq: Credit or enrollment in 331.* Database design, development, and implementation. Focus on data models, both classical and object oriented. Uses relational and/or object oriented database management systems. Only one of MIS 423 and 433 may count towards graduation. Nonmajor graduate credit.

MIS 434. Electronic Commerce Strategy. (3-0) Cr. 3. *Prereq: 330, Mkt 340, LSCM 360.* Overview of business strategies and technologies used for electronic commerce. Emphasis is on the strategic, operational, and technical issues associated with global electronic commerce using class lecture/discussion and case studies. Nonmajor graduate credit.

MIS 435. Business Telecommunications. (3-0) Cr. 3. *Prereq: 330.* Overview of Internet and telecommunications technology used in business applications. Understand Internet and network protocols, network and application architectures, design, and implementation. Nonmajor graduate credit.

MIS 437. Project Management. (3-0) Cr. 3. Equips students to support team activities in the general project management environment and better manage their careers. Practical experience using project management techniques and tools. Course topics include project initiation and execution, risk assessment, estimating and contracts, planning, human factors, and standard methods. Nonmajor graduate credit.

MIS 438. Information Systems Development. (3-0) Cr. 3. *Prereq: 432, 433, credit or enrollment in 435.* Design of business systems using contemporary tools and methods such as SQL, CASE tools, OOD tools, etc. Focuses on synthesizing concepts from earlier MIS courses. Nonmajor graduate credit.

MIS 439. Topics in Management of Information Systems. (3-0) Cr. 3. Repeatable. *Prereq: 330, permission of instructor.* A variety of topics will be covered and topics may vary between semesters. Some of the topics are information resources management, electronic commerce, decision support systems, and expert systems.

MIS 440. Supply Chain Information Systems. (Cross-listed with LSCM, OSCM). (3-0) Cr. 3. *Prereq: MIS 330, OSCM 320, LSCM 360.* Internal and inter-organizational information systems necessary for a supply chain to achieve competitive advantage. Topics include: design, development, implementation, and maintenance of supply chain information systems; enterprise resource planning; advanced planning and scheduling, manufacturing execution systems; and the interface between manufacturing planning and control processes, logistics processes, and the information system.

MIS 445. Advanced Data Communication. (3-0) Cr. 3. *Prereq: 435.* Contemporary theories, concepts, and practices in network infrastructure, network design, and information security. Design, install, and administer a complex network infrastructure. Study security threats and attacks and countermeasures. Investigate exposure to attacks, firewalls, and development of intrusion detection systems. Other security topics such as risk management, IT audit, and security regulations will also be addressed.

MIS 490. Independent Study. Cr. arr. Repeatable. *Prereq: 330, senior classification, permission of instructor.*

Courses primarily for graduate students, open to qualified undergraduate students

MIS 503. Management Information Systems. (2-0) Cr. 2. *Prereq: Graduate classification.* Current theories and practices of information processing and decision making. Focus on information technology and its uses in improving work practices, products, and tools for decision support. Use of artificial intelligence and other developments in technology. Competitive pressures and risks of information technology (IT). Setting IT strategy, information system planning and development of enterprise architecture. Focus on systems development and implementation.

MIS 531. Business Intelligence and Software. (3-0) Cr. 3. *Prereq: 503.* Focus on IT-enabled business intelligence systems. Conceptualize, design, and implement software applications that transform data into intelligence.

MIS 532. Advanced Business Software Development. (3-0) Cr. 3. *Prereq: 531 or equivalent.* A survey of business-oriented programming languages with emphasis on state-of-the-art development techniques for business software. Topics include object-oriented and Internet programming issues and methods.

MIS 533. Data Management for Decision Makers. (Cross-listed with Acct. (3-0) Cr. 3. *Prereq: 503.* Addresses data needs of functions such as marketing, finance, and production. Advanced skills needed to design, develop and use database, data warehousing and data mining systems for effective decision support. Emphasis on importance of contemporary technologies.

MIS 534. Electronic Commerce. (3-0) Cr. 3. *Prereq: 503.* Overview of how modern communication technologies including the internet and world wide web have revolutionized the way we do business. Provides an understanding of various internet technologies and how companies are using the internet for commercial purposes. Explores future scenarios on the use of these technologies and their impact on various industries and the Society.

MIS 535. Telecommunications Management. (3-0) Cr. 3. *Prereq: 503.* Issues involved in the management of telecommunications function. Overview of communications technology used in various business applications, local area network, wide area network, broad band network, wireless and voice networks. Internet technologies and protocols. Analyzing the strategic impact of these technologies on organizations. Strategic planning for telecommunications, including network planning and analysis.

MIS 537. Information Resource Management. (3-0) Cr. 3. *Prereq: 503.* Information Resource Management (IRM) is a popular concept of viewing information systems resources from a strategic resource perspective. Discuss the IRM concept as well as provide pragmatic tools for implementing this approach within the organization. Topics will include: IS outsourcing, total cost of ownership, IS planning and strategic analysis, justification for IT investment, management of IT human resources, traditional project management theory, and project management techniques derived from the Theory of Constraints (TOC).

MIS 538. Business Process Systems. (3-0) Cr. 3. *Prereq: 503.* Examine current and historical perspectives on business process management. Topics include

process identification, mapping, and improvement. Additional topics will address business process automation and integration, business process outsourcing. Investigate current and potential tools and methods for business process management. Include process management projects.

MIS 539. Topics in Management of Information Systems. (3-0) Cr. 3. Repeatable. *Prereq: 503.* A variety of topics may be offered in different semesters. Topics may include electronic commerce, information resources management, decision support systems, and expert systems.

MIS 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* For students wishing to do individual research in a particular area of MIS.

MIS 598. Research Seminar in Management Information Systems. (3-0) Cr. 3. *Prereq: Graduate classification.* Examines issues such as the nature and content of information systems research; aspects of starting and pursuing research topics in information systems; exploring and understanding relevant research methods and tools. Develop preliminary research proposals.

MIS 599. Creative Component. Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair.* Preparation and writing of creative component.

Courses for graduate students,

MIS 601. Behavioral Issues in IS Research. (3-0) Cr. 3. *Prereq: MIS 503 or equivalent, enrollment in PhD program.* The state of behavioral research in the IS function. MIS activities in an organization span the following three major areas: design and implementation of the MIS, use of the MIS, and management of the MIS function. Each of these processes is carried out at several levels: individual, group, organizational and inter-organizational. Identify behavioral issues of relevance for the cells defined by the process and level dimensions. Reading and discussion of the research literature surrounding the development, use, and implications of information technology.

MIS 602. Current Issues in IS Research. (3-0) *Prereq: MIS 503 or equivalent, enrollment in PhD program.* Three fundamental areas of information Systems, namely, infrastructure, management, and processes. Infrastructure studies examine the IT architecture including computing, communication, data, and application. Management focuses on addressing the value added notion of IT. Finally processing addresses topics related to enabling role of IT in myriad of areas.

MIS 603. Seminar on IT Strategy and Structure. (3-0) Cr. 3. *Prereq: MIS 601.* Strategic issues in IT management. Address issues such as aligning IT strategy with corporate strategy and functional strategies, IT structure, valuation, governance and control, and related topics. Provide students with research skills related to the boundary between IT and the firm's external environment.

MIS 604. Collaboration, Knowledge, and Intelligence in Organizations. (3-0) Cr. 3. *Prereq: MIS 601.* Research issues in the emerging areas of collaboration, knowledge management, and enterprise intelligence. Topics will include emerging and contemporary technologies of Data Mining, Knowledge Discovery from Databases, Web Mining, organizational memory, and knowledge management.

MIS 650. Research Practicum I. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

MIS 651. Research Practicum II. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

MIS 655. Organizational and Social Implications of Human Computer Interaction. (Cross-listed with HCI). (3-0) Cr. 3. *Prereq: Graduate classification.* Examine opportunities and implications of information technologies and human computer interaction on social and organizational systems. Explore ethical and social issues appurtenant to human computer interaction, both from a proscriptive and prescriptive perspective. Develop informed perspective on human computer interaction. Implications on research and development programs.

MIS 699. Research. Cr. arr. Repeatable. *Prereq: Graduate classification, permission of dissertation supervisor.* Research.

Marketing

Thomas Chacko, Chair of Department

Distinguished Professor (Emeritus): Teas

Professors: Agarwal, Laczniak, Ramaswami

Professors (Emeritus): Zober

Associate Professors: Kim, Palan, Wong

Assistant Professors: Brocato, Raju, Roy, Smarandescu, Walker

Lecturer: Folger

Undergraduate Study

For undergraduate curriculum in business, major in marketing, see *College of Business, Curricula.*

The Department of Marketing offers a major in marketing. Students will complete the general education requirements (including business foundation courses), and business core requirements for the bachelor of science (B.S.) degree and 18 credits in the major.

Marketing is concerned with management decisions that deal with the satisfaction of customer needs and wants in the purchase and use of goods and services. The primary decision areas in marketing involve the identification of market segments and decisions dealing with product design, pricing, promotion (including personal selling and marketing communications), and distribution. A major in marketing prepares the student for careers in selling and sales management, marketing research, marketing management, retail management, marketing communications, promotion management, and/or international marketing. Each area of study may be applied to consumer, business-to-business, and/or services marketing environments in business and nonprofit organizations.

The instructional objective of the Marketing department is to provide knowledge of the marketing process and an understanding of its functions. The students are expected to develop decision-making skills, computational skills, and communication skills with appreciation for global marketplace and ethical concerns. In addition to the basic business foundation and core courses, marketing majors are required to complete 18 credits of marketing or department approved courses. Included in these 18 credits are three required courses: Mkt 443, 444, and 447.

The department also offers a minor for non-Marketing majors in the College of Business. The minor required 15 credits from an approved list of courses, of which 9 credits must stand alone. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

The Department of Marketing participates in the following graduate programs: the M.S. in Business, the M.B.A. full-time and part-time programs, and the Ph.D. program in Business and Technology. The M.S. in business is a 30-credit curriculum culminating in a thesis or creative component. The M.B.A. program is a 48-credit, nonthesis, noncreative-component curriculum. Twenty four of the 48 credits are core courses and the remaining 24 are graduate electives. Within the M.B.A. program, students may develop an area of specialization in marketing. This specialization requires that 12 of the 24 credits of graduate electives be from marketing.

The Ph.D. program in Business and Technology with a Customer Management (CM) major is a 56 credit (minimum) curriculum designed around four inter-related areas–Core, CM major, Minor, and Research Methods—and dissertation. The focus of the CM major will be on customer management issues—selection of target customers, design of individualized customer programs, maximizing satisfaction, loyalty and retention and getting the maximum ROI out of customer investments.

Courses primarily for undergraduate students

Mkt 340. Principles of Marketing. (3-0) Cr. 3. F.S.SS. *Prereq: credit or current enrollment in Econ 101.* The role of marketing in Society. Markets, marketing institutions, and marketing functions with emphases on product, price, marketing communication, and marketing channel decisions.

Mkt 343. Personal Sales. (3-0) Cr. 3. *Prereq: 340.* Analysis of the theory and practice of personal selling with the context of relationship marketing and sales force automation. Topics include: goal setting, prospecting, time/territory management, questioning, presentations, objections, commitment and customer service; simulations of selling situations.

Mkt 410. Promotional Strategy. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in 447.* Principles, concepts, and problems involved in the development and implementation of promotional strategies. Coordination of a variety of promotional elements: advertising, sales promotion, direct marketing, public relations and publicity of web communications, and personal selling. Nonmajor graduate credit.

Mkt 442. Sales Management. (3-0) Cr. 3. F.S. *Prereq: 340.* Functional aspects of sales force management; personal selling methods; procedures for recruiting, selecting, and training new salespeople; compensation and expense control systems; problems of sales force motivation and supervision; methods of territorial and quota assignment; sales department budgets; distributor-dealer relations; other selected topics. Nonmajor graduate credit.

Mkt 443. Strategic Marketing Management. (3-0) Cr. 3. F.S. *Prereq: 444, 447.* Analysis of major elements of strategic marketing management. May include case studies or business simulations involving decision making using marketing tools from previous courses. (For marketing majors only.)

Mkt 444. Fundamentals of Marketing Research. (3-0) Cr. 3. F.S. *Prereq: 340, Stat 226.* Marketing research techniques: problem formulation, research design, questionnaire construction, sampling, data collection procedures, and analysis and interpretation of data related to marketing decisions. Nonmajor graduate credit.

Mkt 446. Retailing. (3-0) Cr. 3. F.S. *Prereq: 340.* Basic areas of retail management: buying, merchandising, retail promotion, store location, store layout, credit management, and inventory control. Emphasis on practical application of retail management principles.

Mkt 447. Fundamentals of Consumer Behavior. (3-0) Cr. 3. F.S. *Prereq: 340.* Study of how consumers select, purchase, use, and dispose of goods and services. Includes analyses of how markets and others influence these processes. Application of concepts and methods of the behavioral sciences to marketing management decision making. Nonmajor graduate credit.

Mkt 448. Fundamentals of International Marketing. (3-0) Cr. 3. F.S. *Prereq: 340.* Introduction to terms used in international marketing and sources of information on international markets. Development of sensitivity toward foreign business environment and familiarity with operations of multinational corporations. Nonmajor graduate credit.

Mkt 449. Marketing Seminar. (3-0) Cr. 3. *Prereq: 340.* Analysis of current issues and problems in marketing with emphasis on new theoretical and methodological developments. Additional seminars may be offered. Nonmajor graduate credit.

Mkt 451. Marketing Channels. (3-0) Cr. 3. F.S. *Prereq: 340.* Focuses on marketing channels, the downstream part of a value chain, companies that come together to bring products and services from their point of origin to the point of consumption. Topics include channel institutions, channel design, channel coordination and implementation. Highlights international and technological aspects of marketing channels so that students can Successfully develop and manage marketing channels in a contemporary business environment.

Mkt 453. Brand Management. (3-0) Cr. 3. F.S. *Prereq: 447* Examines the role of brands and branding in market environments characterized by intense competition and consumer power. Covers issues relating to why branding is important to firms, what brands represent to consumers, and what should be done to manage them effectively.

Mkt 490. Independent Study. Cr. arr. Repeatable. *Prereq: 340, senior classification; permission of instructor.*

Mkt 492. Comparative Marketing. (3-0) Cr. 3. SS. *Prereq: 340.* Provides experience to students in culture, social, economic, and political environment of marketing in a foreign country. Students complete a term project (e.g., a marketing plan) based on information collected in the foreign country. Students attend briefings by experts/officials of private and public organizations. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Mkt 504. Marketing. (2-0) Cr. 2. *Prereq: Graduate classification.* The scope of marketing and the identification and assessment of marketing opportunities. Consumer behavior and decision making process, organizational buyer behavior, and the role of research in the marketing planning process. Market definition and analysis, segmentation, competitor analysis, targeting and strategic decisions involved in developing the marketing program. Developing marketing mix strategies and relating them to the overall strategic marketing plan. Organizational design for marketing strategy implementation and control, and effectiveness.

Mkt 509. International Business. (2-0) Cr. 2. *Prereq: Graduate classification.* Survey of the structure and environment of international business. Patterns of international trade, economic and monetary systems, cross-cultural and legal aspects of international business. Global dimensions of the functional disciplines of business. Tools for developing global strategies such as economic analysis and risk analysis.

Mkt 540. Marketing Management. (3-0) Cr. 3. F.S. *Prereq: 504.* Strategic marketing and decision making, with emphasis on cases utilizing qualitative and quantitative techniques and marketing models.

Mkt 541. International Marketing. (3-0) Cr. 3. F. *Prereq: 504, 509.* Scope and nature of global marketing operation; the context of international environment in which firms operate. Recent developments of international business activities, and a framework for better understanding of the basic forces driving international business and marketing operations. Development of market entry strategies and global marketing mix policies, as well as export operations. Organizational issues related to the globalization of the firm.

Mkt 542. New Product Development and Marketing. (3-0) Cr. 3. S. *Prereq: 504.* Principles and concepts of new product development and introduction; decision areas include market definition and structure, idea generation, concept evaluation, test marketing, launch tracking, and global product planning; models and techniques of new product evaluation used by consumer product companies.

Mkt 544. Marketing Research. (3-0) Cr. 3. S. *Prereq: 504, Stat 328 or 401.* Marketing research methods are examined with emphasis on the use of advanced research methods in business research. Application of advanced sampling, measurement, and data analysis methods in research on market segmentation, market structure, consumers' perceptions and decision processes, marketing communication, new product development, and pricing.

Mkt 545. Integrated Marketing Communication. (3-0) Cr. 3. *Prereq: 504.* Introduces the student to the field of marketing communications. Covers a number of topics and areas essential for understanding how to design and evaluate communication strategies necessary for the successful marketing of products and services. An integrated marketing communications (IMC) perspective is employed in covering material, with a corresponding focus on various elements of an IMC strategy, including advertising, promotions, point-of-purchase communications, direct marketing techniques, and other topics.

Mkt 546. Customer Relationship and Business-To-Business Marketing. (3-0) Cr. 3. *Prereq: 504.* Core concepts and issues involved in customer relationship strategy and management in consumer and business-to-business markets. Emphasis on customer opportunity analyses, customer relationship management tools and strategies.

Mkt 547. Consumer Behavior. (3-0) Cr. 3. S. *Prereq: 504.* The behavior of consumers. Intensive review of literature from relevant disciplines. Applications of concepts and methods of the behavioral sciences to marketing management decision making.

Mkt 549. Global Marketing Planning and Execution. (3-0) Cr. 3. *Prereq: 501, 504, 509.* Allows students to develop the ability to plan and execute a B2B business by integrating aspects of marketing with other business functions in the international context. Product strategy, innovation, foreign market entry, supply strategies for foreign markets, pricing strategy, market research, customer service, international payments, managing international subsidiaries, licensing, distribution strategy, and responding to changing international environmental conditions. Involves a simulation-based instruction in planning and managing an international B2B business.

Mkt 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* For students wishing to do individual research in a particular area of marketing.

Courses for graduate students

Mkt 601. Seminar in Consumer Behavior. (3-0) Cr. 3. *Prereq: Mgmt 601.* A rigorous foundation of the major conceptual and methodological paradigms in the consumer-behavior literature. Seeks to aid students in understanding the psychological, sociological, and Anthropological roots of consumer behavior research. Read the latest research in the area reported in leading consumer behavior/psychology journals.

Mkt 602. Marketing Strategy. (3-0) Cr. 3. *Prereq: Mgmt 601.* Review major contributions and recent developments in marketing strategy research and practice. Review commonly used modeling approaches and research methods to study strategic interaction between firms seeking to build competitive advantages. Provide an overview of empirical research regarding measurement, level and persistence of business success and implications of findings for theory and strategy development.

Mkt 603. Customer Management Strategy and Implementation. (3-0) Cr. 3. *Prereq: Mkt 601.* Addresses key strategy and implementation issues behind customer management. Topics such as typology of CM strategies, antecedents and outcomes; environmental and managerial influences on strategy formation; technology and impact on CM strategy; and value of CM strategy. Examine theories and concepts behind important CM issues such as customer satisfaction, customer loyalty and customer profitability.

Mkt 604. Marketing Issues in Inter-Organizational Relations. (3-0) Cr. 3. *Prereq: Mgmt 602.* Inter-firm and network competition; relationship among suppliers, distributors, alliance partners, external employees, and internal employees. Theories including agency theory, network theory, relationship marketing, channels of distribution theories on cooperation versus competition, IOS theories.

Mkt 644. Research Methods. (3-0) Cr. 3. *Prereq: Knowledge of introductory Statistics, Stat 401, enrollment in the PhD program.* Introduction to methodological issues that arise when addressing a wide variety of research questions in organizational and consumer studies. Address measurement issues (scales, reliability and construct validity), design (for experiments, surveys, or qualitative studies), sampling, and analysis (univariate and multivariate Statistical procedures). Measurement issues in cross-cultural and international research will also be covered. It is assumed that students entering the course have knowledge of introductory Statistics.

Mkt 650. Research Practicum I. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

Mkt 651. Research Practicum II. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

Mkt 699. Dissertation. Cr. 12. *Prereq: Graduate classification, permission of dissertation supervisor.* Research

Materials Engineering

(Administered by the Department of Materials Science and Engineering)

Richard Lesar, Chair of Department

Distinguished Professors: Gschneidner, Pecharsky, Thiel, Thompson, Trivedi

Distinguished Professors (Emeritus): Verhoeven

University Professors: S. Martin

Professors: Akinc, Chumbley, Genalo, Gleeson, King, Lesar, Levitas, Mallapragada, Rajan, Russell, Shechtman

Professors (Emeritus): Larsen, D. Martin, McGee, Patterson, J. Smith, Wechsler, Wilder

Professors (Adjunct): Anderson, McCallum

Professors (Collaborators): Jiles, Tsukruk

Associate Professors: Bowler, K. Constant, Napolitano, X. Tan, Ustundag

Associate Professors (Adjunct): Athreya, Biner, Kramer

Assistant Professors: Beckman, Chaudhary, Hong, Kessler, Lin

Assistant Professors (Adjunct): Selby

Lecturer: A. Constant, M. Martin

Undergraduate Study

For the undergraduate curriculum in materials engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*. This curriculum is accredited by the Engineering Accreditation Committee of ABET. Materials engineering is a broadly-based discipline relating the composition, microstructure, and processing of materials to their properties, uses and performance. Materials engineering includes a variety of traditional and modern technologies involving metals, ceramics, polymers, composites, and electronic materials.

Because of its interdisciplinary nature, career opportunities for materials engineers bridge all industrial and government sectors including: materials based technologies (materials production), communication/information technologies (semiconducting materials, fiber optics), medical/environmental technologies (biomedical, energy production, waste containment), nanotechnolgies consumer products (building and construction, durable goods), and transportation industries (automotive, aerospace).

The objectives of the materials engineering program are to produce graduates who

•practice materials engineering in a broad range of industries including materials production, semiconductors, medical/environmental, consumer products, and transportation products

•respond to environmental, social, political, ethical and economic constraints to improve the quality of life in Iowa and the world

•work independently and in teams and are proficient in written, oral and graphical communication

•engage in lifelong learning in response to the rapidly expanding knowledge base and changing environment of our world

•engage in advanced study in materials and related or complementary fields.

Graduates in materials engineering are able to apply scientific and engineering principles to select or design the best materials to solve engineering problems. They are also able to control the microstructure of materials through processing to optimize properties and performance. They are skilled in creative, independent problem solving under time and resource constraints. Graduates will have gained experience in materials engineering practice through cooperative work experience or internships in industry, national laboratories, or other funded research work. They will have hands-on skills with a broad range of modern materials processing and characterization equipment and methods.

A degree in materials engineering relies on a strong foundation of math, chemistry and physics. The core materials courses include fundamentals of materials, kinetics and thermodynamics, mechanical properties, computational methods, design, and professional practice experience. Students tailor their programs to their goals and interests through the selection of two areas of specialization from the four available: ceramic materials, electronic materials, metallic materials and polymeric materials. In lieu of the second specialty from the four listed, a student may propose an individually designed, materials related technical specialty to meet specific career goals. Students must have a 3.00 gpa and a B+ in Mat E 215. Students may learn other requirements and procedures for applying in the Undergraduate Handbook or by speaking with their adviser. Approval of this proposal rests with the department's curriculum committee. Additional technical electives can be taken in other areas of interest. The breadth and depth of the program provide excellent preparation for both immediate entry into industry or further study in graduate school.

The department also offers a cooperative education program that combines classroom learning with work experience. (See *College of Engineering Cooperative Programs)*.

Well qualified juniors in materials engineering who are interested in graduate study may apply for concurrent enrollment during their senior year in the Graduate College to simultaneously pursue both bachelor of science and master of science degrees. See Materials Science and Engineering for more information.

Courses primarily for undergraduate students

Mat E 201. Materials Science and Engineering - Professional Planning. Cr. R. F. *Prereq: Sophomore classification in Mat E.* Preparation for a career in materials engineering; experiential learning, resumes, interviewing, Myers-Briggs Type Indicator, leadership, undergraduate research, international opportunities, graduate school preparation and opportunities, and alternative career paths. Satisfactory-fail only.

Mat E 214. Structural Characterization of Materials. (2-3) Cr. 3. S. *Prereq: 215, credit or enrollment in Phys 221.* Structural characterization of ceramic, electronic, polymeric and metallic materials. Techniques include optical and electron microscopy, x-ray diffraction, and thermal analysis. Identification of materials type, microstructure, and crystal structure.

Mat E 215. Introduction to Materials Science and Engineering I. (3-0) Cr. 3. F. *Prereq: Chem 177 or 167.* Materials Engineering majors only. Structure and properties of ceramic, electronic, polymeric and metallic materials, emphasizing differences based on structure and bonding. Phase equilibria and phase transformations. Only one of Mat E 215, 272, or 392 may count toward graduation.

Mat E 215L. Introduction to Materials Science and Engineering I - Lab. (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 215 or 272 or 392.* Materials Engineering majors only. Laboratory exercise in materials.

Mat E 216. Introduction to Materials Science and Engineering II. (3-3) Cr. 4. S. *Prereq: 215, Credit or enrollment in Phys 222.* Materials Engineering majors only. Fundamentals of polymers and composite materials, degradation. Electronic, thermal, magnetic and optical properties of materials. Materials for energy, biomaterials and nanomaterials. Laboratory exercise in materials property measurements.

Mat E 272. Principles of Materials Science and Engineering. (2-0) Cr. 2. F.S.SS. *Prereq: Sophomore classification; Chem 167 or 177; Math 165.* Introduction to the structure of metals, polymers and ceramics. Crystal structure and imperfections in metals. Diffusion, mechanical properties, and failure mechanisms. Phase equilibrium diagrams and heat treatment principles for steels, composite materials, and aluminum alloys. Engineering applications. Only one of Mat E 215, 272, or 392 may count toward graduation.

Mat E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

Mat E 311. Thermodynamics in Materials Engineering. (3-0) Cr. 3. F. *Prereq: 216, Chem 178, Phys 222, credit or enrollment in Math 267.* Basic laws of thermodynamics applied to materials systems. Thermodynamics of chemical reactions. Homogeneous and heterogeneous equilibrium. Phase diagrams for materials systems. Nonmajor graduate credit.

Mat E 314. Kinetics and Phase Equilibria in Materials. (3-0) Cr. 3. S. *Prereq: 216, 311.* Kinetic phenomena and phase equilibria relevant to the origins and stability of microstructure in metallic, ceramic and polymeric systems. Application of thermodynamics to the understanding of stable and metastable phase equilibria, interfaces and their effects on stability: defects and diffusion, empirical rate equations for transformation kinetics, driving forces and kinetics of nucleation, diffusional and diffusionless phase transformations. Nonmajor graduate credit.

Mat E 316. Computational Methods in Materials. (2-2) Cr. 3. S. *Prereq: 216.* Use of Mathematical and Statistical computer tools for materials design and analysis. Applications of Statistical principles to problems concerned with materials. Computer-assisted design of experiments. Nonmajor graduate credit.

Mat E 317. Introduction to Electronic Properties of Ceramic, Metallic, and Polymeric Materials. (3-0) Cr. 3. F. *Prereq: 216 and Phys 222.* Materials Engineering majors only. Introduction to electronic properties of materials and their practical applications. Classical conduction models and electronic properties of metallic and ceramic materials. Elementary quantum mechanics and band theory of electron states in solids. Quantum theory of metallic conduction. Elementary semiconductor theory and devices. Polarization and dielectric properties of materials. Electron conduction in polymeric systems. Magnetic properties and applications of metals and ceramics.

Mat E 321. Introduction to Ceramic Science. (3-0) Cr. 3. F. *Prereq: 216.* Ceramic crystal structures, defects, diffusion and transport. Phase equilibria and microstructures. Powder packing. Thermal, electronic, optical and magnetic properties of ceramics. Nonmajor graduate credit.

Mat E 322. Introduction to Ceramic Processing. (2-3) Cr. 3. S. *Prereq: 321.* Synthesis and characterization of ceramic powders. Colloidal phenomena, rheology of suspensions, ceramic forming methods, and drying. High temperature ceramic reactions, liquid and solid-state sintering, grain growth, microstructure development. Processing/microstructure/property relationships. Nonmajor graduate credit.

Mat E 332. Semiconductor Materials and Devices. (Cross-listed with E E). (3-0) Cr. 3. S. *Prereq: Phys 222, and for Mat E majors only Mat E 334.* Introduction to semiconductor material and device physics. Quantum mechanics and band theory of semiconductors. Charge carrier distributions, generation/recombination, transport properties. Physical and electrical properties and fabrication of semiconductor devices such as MOSFETs, bipolar transistors, laser diodes and LED's. Nonmajor graduate credit.

Mat E 334. Electronic Properties of Materials. (2-2) Cr. 3. S. *Prereq: 317.* Electronic properties of conductors, semiconductors and dielectric materials. Quantum mechanical description of electron wave-particle duality and solutions of Shrodinger equation for free and bound electrons. Development of band theory of electron states in solids. Statistical mechanics and the density-of-states in energy bands. Thermal properties of lattices. Quantum model for metallic conduction. Semiconductor theory and semiconductor device physics. Polarization phenomena and dielectric properties of materials. Superconductivity and BCS Theory. Nonmajor graduate credit.

Mat E 342. Structure/Property Relations in Nonferrous Metals. (2-3) Cr. 3. S. *Prereq: 216.* Processing of metals and alloys to obtain desired mechanical properties by manipulation of their microstructure and composition of constituent phase(s). Relevance of defects to mechanical properties, plastic flow. Strengthening mechanisms in metals and alloys. Microstructure, heat treatment and mechanical properties of engineering alloys. Metal-matrix composites. Nonmajor graduate credit.

Mat E 351. Introduction to Polymeric Materials. (3-0) Cr. 3. F. *Prereq: 216.* Introduction to polymeric materials, synthesis, structure and properties. Relationship between polymer composition, processing and properties. Nonmajor graduate credit.

Mat E 362. Principles of Nondestructive Testing. (Cross-listed with E M). (3-0) Cr. 3. S. *Prereq: Phys 112 or 222.* Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection, and other techniques. Physical bases of tests; materials to which applicable; types of defects detectable; calibration standards, and reliability safety precautions. Nonmajor graduate credit.

Mat E 362L. Nondestructive Testing Laboratory. (Cross-listed with E M). (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 362.* Application of nondestructive testing techniques to the detection and sizing of flaws in materials and to the characterization of material's microstructure. Included are experiments in hardness, dye penetrant, magnetic particle, x-ray, ultrasonic and eddy current testing. Field trips to industrial laboratories. Nonmajor graduate credit.

Mat E 370. Toying with Technology. (Cross-listed with Cpr E). (2-2) Cr. 3. F.S. *Prereq: C I 201, junior standing in non-engineering major.* A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on laboratory experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Future K-12 teachers will leave the course with complete lesson plans for use in their upcoming careers.

Mat E 388. Sustainable Engineering and International Development. (Cross-listed with A E, C E, E E, M E). (2-2) Cr. 3. F. *Prereq: Junior classification in engineering.* Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as nongovernment organizations (NGOs). Course readings, final project/design report.

Mat E 391. Introduction to US Women's roles in Industry and Preparation for Summer Study. (3-0) Cr. 3. S. Introduction to the historical role of women as related to US industry, family and community with emphasis on the years 1830 - 1945, but also related to the current climate. Topics completed in 392 with arranged lectures at Brunel University. Orientation for Brunel summer study program. Credit for graduation allowable only upon completion of Mat E 392. Satisfactory-fail only.

Mat E 392. Principles of Materials Science and Engineering. (3-0) Cr. 3. SS. *Prereq: 391, Chem 167 or 177.* Structure and properties of ceramic, electronic, polymeric and metallic materials, emphasizing differences based on structure and bonding. Phase equilibria and phase transformations. Taught on Brunel University campus. Only one of Mat E 215, 272, or 392 may count toward graduation. Satisfactory-fail only.

Mat E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period.

Mat E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services; junior classification.* Professional work period, one semester maximum per academic year.

Mat E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

Mat E 413. Materials Design and Professional Practice I. (2-2) Cr. 3. F. *Prereq: Senior Status in Mat E.* Fundamentals of materials engineering design, information sources, team behavior, professional preparation, quantitative design including finite-element analysis and computer aided design, materials selection, informatics and combinatorial methods. Analysis of design problems, development of solutions, selected case studies. Oral presentation skills. Preparations for spring project.

Mat E 414. Materials Design and Professional Practice II. (2-2) Cr. 3. S. *Prereq: Senior Status in Mat E.* Integration of materials processing, structure/composition, properties and performance principles in materials engineering problems. Multi-scale design of materials, materials processing, case studies including cost analysis, ethics, risk and safety. Team projects specified by either industry or academic partners. Written and oral final project reports.

Mat E 418. Mechanical Behavior of Materials. (2-3) Cr. 3. S. *Prereq: 216 and credit or enrollment in E M 324.* Mechanical behavior of ceramics, metals, polymers, and composites. Relationships between materials processing and atomic aspects of elasticity, plasticity, fracture, and fatigue. Life prediction, stress- and failure analysis. Nonmajor graduate credit.

Mat E 425. Glasses and Advanced Ceramics. (2-3) Cr. 3. F. *Prereq: 321.* Composition, structure, properties and manufacturing of inorganic glasses. Properties and applications of advanced ceramics. Structural, thermal, optical, electronic, magnetic and biological applications of ceramic materials. Contemporary topics in ceramic engineering. Laboratory exercises in preparation and characterization of glasses and advanced ceramics. Nonmajor graduate credit.

Mat E 432. Microelectronics Fabrication Techniques. (Cross-listed with E E). (2-4) Cr. 4. *Prereq: Phys 222, Math 267. E E 332 or Mat E 334 recommended.* Techniques used in modern integrated circuit fabrication, including diffusion, oxidation, ion implantation, lithography, evaporation, sputtering, chemical-vapor deposition, and etching. Process integration. Process evaluation and final device testing. Extensive laboratory exercises utilizing fabrication methods to build electronic devices. Use of computer simulation tools for predicting processing outcomes. Recent advances in processing CMOS, ICs and micromechanical systems (MEMS). Nonmajor graduate credit.

Mat E 433. Advanced Electronic Materials. (2-3) Cr. 3. F. *Prereq: 334.* Advanced concepts in band theory of solids including chemical bonding in solids and the linear combination of atomic orbitals, phase transitions in electronic, magnetic, and optical materials. Dielectric materials, ferroelectricity, piezoelectricity, sensors, and non-stoichiometric conductors. Optical properties, optical spectra of materials, optoelectronic devices. Magnetic and superconducting materials. Nonmajor graduate credit.

Mat E 442. Polymers and Polymer Engineering. (Cross-listed with Ch E). (3-0) Cr. 3. S. *Prereq: Ch E 382 and Chem 331 or Mat E 351.* Chemistry of polymers, addition and condensation polymerization. Physical and mechanical properties, polymer rheology, production methods. Applications of polymers in the chemical industry. Nonmajor graduate credit.

Mat E 443. Physical Metallurgy of Ferrous Alloys. (2-3) Cr. 3. F. *Prereq: 214, 216, 311.* Production and processing of ferrous metals. Extraction of pig iron from ore. Steelmaking processes. Equilibrium and nonequilibrium phases in the Fe-C system. Properties and processing of cast irons, plain carbon and alloy steels, stainless and specialty steels. Transformation diagrams, hardenability, and surface treatments. Continuous casting, forging, hot rolling, quenching, and tempering as they apply to ferrous materials. Cost and mechanical performance considerations in cast iron and steel selection and heat treatment. Nonmajor graduate credit.

Mat E 444. Corrosion and Failure Analysis. (2-2) Cr. 3. S. *Prereq: 216 and credit or enrollment in 418.* Corrosion and corrosion control of metallic systems. Corrosion fundamentals, classification of different types of metallic corrosion, corrosion properties of various engineering alloys, corrosion control. Failure analysis. Characteristics of common types of metallic failures, case studies of failures, designing to reduce failure risk. Nonmajor graduate credit.

Mat E 453. Physical and Mechanical Properties of Polymers. (Dual-listed with M S E 553). (2-3) Cr. 3. F. *Prereq: 351.* Overview of polymer chemical composition, microstructure, thermal and mechanical properties, rheology, and principles of polymer materials selection. Intensive laboratory experiments include chemical composition studies, microstructural characterization, thermal analysis, and mechanical testing. Nonmajor graduate credit.

Mat E 454. Polymer Composites and Processing. (Dual-listed with M S E 554). (3-0) Cr. 3. S. *Prereq: 351.* Basic concepts in polymer composites, blends, and block copolymers. Phase separation and miscibility, microstructures and mechanical behavior. Fiber reinforced and laminated composites. Viscosity, rheology, viscoelasticity of polymers. Polymer melt processing methods such as injection molding and extrusion; selection of suitable processing methods and their applications. Nonmajor graduate credit.

Mat E 456. Biomaterials. (Dual-listed with M S E 556). (3-0) Cr. 3. S. *Prereq: 216 or 272 or 392.* Presentation of the basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

Mat E 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Aer E, Cpr E, E E, Engr, I E, M E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of the instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

Mat E 488. Eddy Current Nondestructive Evaluation. (Dual-listed with M S E 588). (Cross-listed with E E). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Math 265 and (Mat E 216 or 272 or E E 311 or Phys 364).* Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

Mat E 490. Independent Study. Cr. arr. Repeatable. Investigation of individual research or special topics.

Mat E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Materials Science and Engineering

Richard Lesar, Chair of Department

Distinguished Professors: Gschneidner, Pecharsky, Thiel, Thompson, Trivedi

Distinguished Professor (Emeritus): Verhoeven

University Professor: S. Martin

Professors: Akinc, Chumbley, Genalo, Gleeson, King, Lesar, Levitas, Mallapragada, Rajan, Russell, Shechtman

Professors (Emeritus): , D. Martin, McGee, Patterson, J. Smith, Wechsler, Wilder

Professors (Adjunct): Anderson, McCallum

Professors (Collaborators): Jiles, Tsukruk

Associate Professors: Bowler, Constant, Napolitano, X. Tan, Ustundag

Associate Professors (Adjunct): Athreya, Biner, Kramer

Assistant Professors: Beckman, Chaudhary, Hong, Kessler, Lin

Assistant Professors (Adjunct): Selby

Lecturer: A. Constant, M. Martin

Graduate Study

The department offers work toward the following advanced degrees: Master of Science in Materials Science and Engineering and Doctor of Philosophy in Materials Science and Engineering.

Built on a foundation of thermodynamics, kinetics of phase transformations, mechanical behavior, physical properties, solid state science, and the structure and chemistry of materials, the graduate program offers advanced studies in many areas of materials science and engineering, including the design and control of materials for structural, electronic, photonic, magnetic, optical, and biological functionality. Graduates of the program have a fundamental understanding of the critical aspects of the field and how they are applied to real materials systems. The program is highly flexible and research-oriented, where students work carefully with their major professor in tailoring the various academic and research components to meet their interests.

With the ability to address complex problems in materials science while considering the various constraints inherent to both academic and industrial environments, our graduates are well prepared for a wide range of academic and research-related careers. They are skilled in carrying out independent and collaborative research, able to communicate effectively in formal and informal settings, and are proficient at writing persuasive technical articles and grant proposals.

The department boasts excellent facilities for academic materials research, maintaining a wide range of faculty laboratories across the ISU campus. In addition, departmental research is highly integrated with the operation of several Research Centers, such as the Ames Laboratory, the Center for Nondestructive Evaluation, the Microelectronics Research Center, and the Center for Advanced Technology Development. These laboratories offer excellent resources and opportunities for graduate student research.

Prerequisite to major graduate work is completion of an undergraduate curriculum in physical science, biological science, or engineering discipline. Graduate students from disciplines other than materials science and engineering may expect that supplemental coursework will be needed, in addition to the required graduate coursework. Well qualified students (juniors) enrolled in the undergraduate materials engineering program at Iowa State University can apply to the Graduate College for admission to the concurrent enrollment program, where students may simultaneously pursue both master of science and bachelor of sciences degrees.

The requirements for the M.S. and Ph.D. degrees are established by the student's program of study committee within the established guidelines of the Graduate College. Minimum requirements include coursework, research, proposal, preliminary oral examination (Ph.D. only), dissertation, and a final oral examination. Academic coursework requirements include 18 credits for the M.S. degree and 26 credits for the Ph.D., with additional specific rules for choices available from the department.

There are no foreign language requirements for either of the graduate degrees administered by the Department of Materials Science and Engineering. Graduate students wishing to declare a formal minor in materials science and engineering will have at least one materials science and engineering faculty member serving on their program of study committee. For the M.S. and Ph.D. degrees, they will take a minimum of 8 and 12 materials science and engineering course credits, respectively.

Courses primarily for graduate students, open to qualified undergraduate students

M S E 510. Fundamentals of Structure and Chemistry of Materials. (3-0) Cr. 3. F. *Prereq: Math 165, Phys 221, and Chem 167.* Geometric and algebraic representations of symmetry. Pair distribution function. Structure, chemistry, and basic properties of covalent, ionic, and metallic solids, glasses and liquids, and polymers. Interactions of materials with particles and waves. Relationships between direct and reciprocal spaces. The kinematical theory of diffraction, with an introduction to the dynamical theory.

M S E 520. Thermodynamics and Kinetics in Multicomponent Materials. (3-0) Cr. 3. F. *Prereq: Mat E 311 or Chem 321, Math 266 or Math 267.* A review of the fundamental principles of heat, work, basic thermodynamic relations, and criteria for equilibrium. Analytical treatments for the thermodynamic description of multicomponent chemical solutions and reacting systems are developed and employed to predict phase equilibria in materials systems. Builds on the thermodynamic construction to treat the kinetics of chemical reactions and phase transformations. Topics include general first order and second order transitions, along with chemical diffusion. Detailed examples involving nucleation and diffusion limited growth, spinodal decomposition, martensitic transformations, magnetic and electric transitions, and glass formation will be considered.

M S E 521. Mechanical Behavior and Manufacturing of Polymers and Composites. (Cross-listed with M E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: ME 324 or Mat E 272 and E M 324.* Effect of chemical structure and morphology on properties. Linear viscoelasticity, damping and stress relaxation phenomena. Structure and mechanics of filler and fiber reinforced composites. Mechanical properties and failure mechanisms. Material selection and designing with polymers. Processing of polymer and composite parts.

M S E 530. Solid State Science. (3-0) Cr. 3. S. *Prereq: Mat E 334 or E E 332 or Phys 322.* Development of a quantitative description of the electronic structure of solids starting with fundamentals of atoms, atomic bonding, basic crystallography, and band theory of solids. Continuum properties of solids in response to electromagnetic fields and thermal gradients. Quantitative description of the atomistic properties of solids through electron-electron interactions, electron-phonon interactions, and dipole interactions.

M S E 540. Mechanical Behavior of Materials. (3-0) Cr. 3. F. *Prereq: Mat E 418, Math 266 or Math 267.* Mechanical behavior of materials with emphasis on micromechanics of deformation in three generic regimes: elasticity, plasticity, and fracture. A materials science approach is followed to understand and model the mechanical behavior that combines continuum mechanics, thermodynamics, kinetics, and microstructure. Some topics include elastic properties of materials, permanent deformation mechanisms at different temperatures (e.g., via dislocation motion and creep), and fracture in ductile and brittle materials. Specific classes of materials that are studied: metals, ceramics, polymers, glasses and composites.

M S E 550. Fundamentals of Nondestructive Evaluation. (Cross-listed with E M). (3-2) Cr. 4. S. *Prereq: E M 324, Math 385.* Principles of five basic NDE methods and their application in engineering inspections. Materials behavior and simple failure analysis. NDE reliability, and damage-tolerant design. Advanced methods such as acoustic microscopy, laser ultrasonics, thermal waves, computed tomography, and thermoelectrics are analyzed. Laboratory experiments on all basic methods: ultrasonics, eddy currents, x-ray, liquid penetrants, magnetic testing, and visual inspection are performed.

M S E 551. Characterization Methods in Materials Science. (2-3) Cr. 3. *Prereq: Mat E 214.* Characterization of ceramic, metal, polymer and glassy materials using modern analytical techniques. Spectroscopic (IR, Raman, UV/VIS/NIR, and NMR), thermal (DSC, DTA/TGA, and DMA) methods, mechanical and rheological testing, magnetic and electrical characterization, and powder characterization.

M S E 552. Scanning and Auger Electron Microscopy. (2-3) Cr. 3. *Prereq: Phys 222.* Characterization of materials using scanning electron microscope (SEM), electron microprobe, and auger spectrometer. Compositional determination using energy and wavelength dispersive x-ray and Auger spectroscopies. Specimen preparation. Laboratory covers SEM operation.

M S E 553. Physical and Mechanical Properties of Polymers. (Dual-listed with Mat E 453). (2-3) Cr. 3. F. *Prereq: Mat E 351.* Overview of polymer chemical composition, microstructure, thermal and mechanical properties, rheology, and principles of polymer materials selection. Intensive laboratory experiments include chemical composition studies, microstructural characterization, thermal analysis, and mechanical testing.

M S E 554. Polymer Composites and Processing. (Dual-listed with Mat E 454). (3-0) Cr. 3. S. *Prereq: Mat E 351.* Basic concepts in polymer composites, blends, and block copolymers. Phase separation and miscibility, microstructures and mechanical behavior. Fiber reinforced and laminated composites. Viscosity, rheology, viscoelasticity of polymers. Polymer melt processing methods such as injection molding and extrusion; selection of suitable processing methods and their applications.

M S E 555. Advanced Polymer Materials. (3-0) Cr. 3. *Prereq: Mat E 351.* Overview of basic principles of polymeric materials and the latest developments. Recently introduced polymeric materials (functional block-copolymers, biomedical, conductive, nanocomposites, electrooptical, non-linear optical polymers) and prospective applications in functional coatings, artificial implants, microelectronics, nanodevices, chemo/bio-sensors, and optical computing.

M S E 556. Biomaterials. (Dual-listed with Mat E 456). (3-0) Cr. 3. S. *Prereq: Mat E 216 or 272 or 392.* Presentation of the basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

M S E 564. Fracture and Fatigue. (Cross-listed with E M, M E). (3-0) Cr. 3. F. *Prereq: E M 324 and either Mat E 216 or 272 or 392. Undergraduates: Permission of instructor.* Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

M S E 569. Mechanics of Composite and Combined Materials. (Cross-listed with E M). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: E M 324.* Mechanics of fiber-reinforced materials. Micromechanics of lamina. Macromechanical behavior of lamina and laminates. Strength and interlaminar stresses of laminates. Failure criteria. Stress analysis of laminates. Thermal moisture and residual stresses. Joints in composites.

M S E 570. Toying With Technology for Practicing Teachers. (Cross-listed with C I). (2-0) Cr. 2. SS. *Prereq: C I 201, non-engineering major.* A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Other technological advances with K-12 applications will be explored. K-12 teachers will leave the course with complete lesson plans for use in their classrooms.

M S E 588. Eddy Current Nondestructive Evaluation. (Dual-listed with Mat E 488). (Cross-listed with E E). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Math 265 and (Mat E 216 or 272 or E E 311 or Phys 364).* Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

M S E 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

M S E 599. Creative Component. Cr. arr. Repeatable.

Courses primarily for graduate students

M S E 610. Academic Teaching Practices. (2-0) Cr. 2. Repeatable. F.S. *Prereq: Permission of instructor.* Provides instruction and directed experience in undergraduate level teaching practices. Students engage in lesson planning, classroom/laboratory teaching, student and course assessment, web-based lessons, and other aspects of academic course delivery.

M S E 620. Fundamentals of Phase Transformations. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: M S E 520.* Explores various advanced theoretical treatments of the energetics and kinetics of multi-component materials. Topics include analytical and computational descriptions of thermodynamic quantities, experimental measurement of essential physical properties, analytical and computational treatments of kinetic processes, and the use of theoretical predictions of phase equilibria and evolution in materials systems.

M S E 630. Physical Properties of Solids. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: M S E 530.* Advanced course in the behavior of solids within the framework of solid state physics and chemistry. Includes magnetic, dielectric, transport, and optical phenomena in solids. Influence of phase transformations and crystal symmetry on the physical properties.

M S E 651. Powder Diffraction Methods. (3-0) Cr. 3. S. *Prereq: M S E 510.* Advanced structural characterization of materials using powder diffraction. Production of X-ray and neutron radiation. Review of symmetry, group and kinematical theories of diffraction. Mathematical and computational backgrounds of powder diffraction data. Introduction to single crystal diffraction methods, origin of powder diffraction pattern, history of the technique. Modern powder diffraction methods. Indexing of powder diffraction patterns, figures of merit, precise lattice parameters. Phase problem, determining crystal structures from symmetry and geometry, Patterson, direct and Fourier methods. Rietveled method, precise crystal structures: atomic parameters, qualitative and quantitative phase identification, preferred orientation, grain size, strain, residual stress, order-disorder. Powder diffraction at non-ambient conditions. Applications of powder diffraction: data bases, phase transformations, phase diagrams, local structures, magnetism.

M S E 652. Transmission Electron Microscopy. (3-3) Cr. 4. S. *Prereq: 534.* Characterization of inorganic materials using TEM. Selected area and convergent beam electron diffraction, bright field/dark field/high resolution imaging. Compositional analysis using x-ray and electron energy loss spectroscopy.

M S E 690. Advanced Topics in Materials Science. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

M S E 697. Engineering Internship. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of department, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

M S E 699. Research. Cr. arr. Repeatable.

Mathematics

www. math.iastate.edu

Wolfgang Kliemann, Chair of Department

Distinguished Professors: Athreya, Levine

Distinguished Professors (Emeritus): R. Miller, Vinograde

University Professor (Emeritus): Cornette

Professors: Bergman, Dahiya, Evans, Hentzel, Hogben, Hou, E. Johnston, Kliemann, Lieberman, Liu, Luecke, J. Lutz, Maddux, Murdock, Peters, Rothmayer, Sacks, Sethuraman, Smiley, J. Smith, Tesfatsion, Weerasinghe, Willson, Wu

Professors (Emeritus): Barnes, Cain, Carlson, Colwell, Fink, Gautesen, Homer, Mathews, Pigozzi, Rudolph, Sanderson, Seifert, A. Steiner, E. Steiner, Tondra, Weiss, Wright

Professor (Collaborator): Driessel

Associate Professors: Alexander, Axenovich, D'Alessandro, Davidson, Hansen, Keinert, Ng, Poon, S. Song, Tidriri, J. Wilson

Associate Professor (Emeritus): Heimes

Associate Professor (Collaborators): Ashlock

Assistant Professors: Boushaba, Long, R. Martin, Matzavinos, Su, Weber, Yan

Assistant Professor (Emeritus): Peake

Senior Lecturers: Bolles, G. Johnston

Lecturers: Allen, Chan, Diesslin, Ellis, Gaalswyk, B. Hall, Kramer, Pan, Roettger, Schultz, Wagner

Undergraduate Study

For the undergraduate curriculum in liberal arts and sciences, major in mathematics, leading to the degree bachelor of science, see Liberal Arts and Sciences, Curriculum.

The program in mathematics offers training suitable for students planning to enter secondary school teaching, to work in mathematics and computation for industry or government, or to continue their studies in graduate school. The requirements for an undergraduate major in mathematics are designed so that the student may have opportunity for appropriate specialization to meet one or more of the foregoing objectives and, at the same time, obtain a thorough introduction to the mathematics underlying all of them.

Graduates understand a broad range of mathematical topics and are familiar with a broad range of mathematical models. They have skills for solving problems in diverse situations. They can construct rigorous arguments to demonstrate mathematical facts. They can communicate their mathematical methods to others and can justify their assumptions.

The requirements for an undergraduate major include:

(a) Math 165, 166, 201, 265, 317, 301, 414, and either 266 or 267.

(b) 15 additional credits in mathematics courses at the 300 level or above.

(c) The courses used to satisfy a) and b) above must include one of the sequences 301, 302; 414, 415; 435, 436.

(d) In addition to the credits in (b), either Math 492 or 2 credits of C I/LAS 480C. (C I/LAS 480C is available only for students seeking secondary school certification).

(e) Communication Proficiency requirement: The department requires a grade of C– or better in each of English 150 and 250 (or 250H) and an upper-level communication skills requirement that may be met by writing an acceptable undergraduate thesis (Math 491) or by taking at least one of Engl 302, 305, 314 or JI MC 201. A grade of C- or better is required.

The department strongly recommends that each student majoring in mathematics include in the program substantial supporting work beyond the minimum general education requirement of the college in one or more areas of application of mathematics, such as other mathematical sciences, engineering, natural science, or social science. In particular, it recommends that each student take Com S 207, 208; Phys 221, 222; and Stat 341, 342 (or Math 304). It also recommends that students contemplating graduate study in mathematics acquire a reading knowledge of French, German, or Russian. Credits earned in Math 104, 105, 140, 141, 142, 150, 151, 160, 181, 182, 195, 196, cannot be counted toward graduation by mathematics majors.

The department offers a minor in mathematics which may be earned by credit in Math 201, 265, (266 or 267), (307 or 317), and 301.

Graduate Study

The department offers programs leading to a master of science or doctor of philosophy degree in mathematics or applied mathematics, as well as minor work for students whose major is in another department. The department also offers a program leading to the degree of master of school mathematics (M.S.M.).

Students desiring to undertake graduate work leading to the M.S. or Ph.D. degree should have at least 12 semester credits of work in mathematics beyond calculus. It is desirable that these credits include advanced calculus and abstract algebra.

The M.S. degree requires at least 30 credits and students must write a creative component or thesis and pass a comprehensive oral examination over their coursework and their creative component or thesis. See the department handbook for specific requirements.

The Ph.D. degree requires a student to take 54 hours of coursework in addition to research hours, pass written qualifying examinations, pass an oral preliminary exam, and perform an original research project culminating in a dissertation

which is defended by an oral exam. Ph.D. candidates must have at least one year of supervised teaching experience. See the on-line Mathematics Graduate Handbook for specific requirements.

The M.S.M. degree is primarily for inservice secondary mathematics teachers. Students desiring to pursue the M.S.M degree should present some undergraduate work in mathematics beyond calculus. Candidates for the M.S.M. degree must write an approved creative component and pass a comprehensive oral examination over their course work and their creative component.

Courses primarily for undergraduate students

Math 010. High School Algebra. (4-0) F.S.SS. For students who do not have adequate facility with topics from high school algebra or do not meet the algebra admission requirement. The course is divided into tracks of one- and two-semester lengths. For most students a diagnostic exam will determine which track must be taken. Students will receive a grade in Math 25 or 30 respectively depending on the level of material covered. Satisfactory completion of Math 30 is recommended for students planning to take Math 140 or 151, while Math 25 is sufficient for Math 104, 105, 150, 195, Stat 101 or 105. Students must complete Math 30 to remove a deficiency in the algebra admission requirement. Topics include signed numbers, polynomials, rational and radical expressions, exponential and logarithmic expressions, and equations. Satisfactory-fail only.

Math 025. High School Algebra. (4-0) F.S.SS. Students should initially enroll in Math 10. See description of Math 10. Satisfactory-fail only.

Math 030. High School Algebra. (4-0) F.S.SS. Students should initially enroll in Math 10. See description of Math 10. Satisfactory-fail only.

Math 101. Orientation in Mathematics. Cr. R. F. For new majors. Issues to consider in planning a program of study. Sources of general information and perspectives concerning mathematics. Discussion of possible areas of study and careers. Satisfactory-fail only.

Math 104. Introduction to Probability and Matrices. (3-0) Cr. 3. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Permutations, combinations, probability, binomial and multinomial theorems, matrices, expected value. Either Math 104 or 150 may be counted toward graduation, but not both.

Math 105. Introduction to Mathematical Ideas. (3-0) Cr. 3. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Topics from mathematics and mathematical applications with emphasis on their nontechnical content.

Math 140. College Algebra. (3-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra; 1 year of high school geometry.* Coordinate geometry, complex numbers, quadratic and polynomial equations, functions, graphing, linear, polynomial and rational functions, exponential and logarithmic functions, inverse functions, linear inequalities, systems of equations. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, or 195 toward Group III of the General Education Requirements.

Math 141. Trigonometry. (2-0) Cr. 2. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra; 1 year of high school geometry, or enrollment in 140.* May be taken concurrently with 140. Trigonometric functions and their inverses, solving triangles, trigonometric identities and equations, graphing. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, or 195 toward Group III of the General Education Requirements. Only one of Math 141, 142 may count toward graduation.

Math 142. Trigonometry and Analytic Geometry. (2-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry, or enrollment in 140.* May be taken concurrently with 140. Trigonometric functions and their inverses, solving triangles, trigonometric identities and equations, graphing, polar coordinates, complex numbers, standard equations of lines and conic sections, parametric equations. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, or 195 toward Group III of the General Education Requirements. Only one of Math 141, 142 may count toward graduation.

Math 150. Discrete Mathematics for Business and Social Sciences. (2-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Linear equations and inequalities, matrix algebra, linear programming, discrete probability. Either Math 104 or 150 may be counted toward graduation, but not both.

Math 151. Calculus for Business and Social Sciences. (2-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Differential calculus, applications to max-min problems, integral calculus and applications. Will not serve as prerequisite for 265 or 266. Only one of Math 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 160. Survey of Calculus. (4-0) Cr. 4. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of geometry.* Analytic geometry, derivatives and integrals of elementary functions, partial derivatives, and applications. Will not serve as a prerequisite for 265 or 266. Only one of Math 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 165. Calculus I. (4-0) Cr. 4. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry or enrollment in 141 or 142.* Differential calculus, applications of the derivative, introduction to integral calculus. Only one of Math 151 or 160 or the sequence 165-166, or the sequence 181-182 may be counted towards graduation. **Math 166. Calculus II.** (4-0) Cr. 4. F.S.SS. *Prereq: Grade of C- or better in 165 or high math placement scores.* Integral calculus, applications of the integral, infinite series. Only one of Math 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 166H. Honors Calculus II. (4-0) Cr. 4. F.S. *Prereq: Permission of instructor and 165 or high math placement scores.* Integral calculus, applications of the integral, infinite series. Additional material of a theoretical, conceptual, computational, or modeling nature. Some of the work may require more ingenuity than is required for Math 166. Preference will be given to students in the University Honors Program. Only one of Math 151 or 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 181. Calculus and Mathematical Modeling for the Life Sciences I. (4-0) Cr. 4. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry, 1 semester of trigonometry or enrollment in 141 or 142.* Exponential and logarithm functions, difference equations, derivatives, and applications of the derivative. Examples taken from biology. Only one of Math 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 182. Calculus and Mathematical Modeling for the Life Sciences II. (4-0) Cr. 4. S. *Prereq: 181.* Integration, differentiation and integration of transcendental functions, first and second order differential equations, applications of the definite integral. Examples taken from biology. Only one of 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 195. Mathematics for Elementary Education I. (2-2) Cr. 3. F.S. *Prereq: Satisfactory performance on placement exam, 2 years high school algebra, 1 year of high school geometry, enrollment in elementary education or early childhood education.* Theoretical and hands-on models; standard and non-standard algorithms and properties related to whole numbers and whole number operations. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, or 195 toward Group III of the General Education Requirements.

Math 196. Mathematics for Elementary Education II. (2-2) Cr. 3. F.S. *Prereq: Grade of C- or better in 195 and enrollment in elementary education.* Two-and three-dimensional measurement, probability, data fitting, statistics, operations and algorithms for computing with integers, fractions, and decimals.

Math 201. Introduction to Proofs. (3-0) Cr. 3. F.S. *Prereq: 166 or 166H.* Reading and writing simple proofs, using logical reasoning, including quantifiers and truth tables. Proof Techniques. Mathematical induction. Proofs in set theory, number theory, and calculus.

Math 265. Calculus III. (4-0) Cr. 4. F.S.SS. *Prereq: Grade of C- or better in 166 or 166H.* Analytic geometry and vectors, differential calculus of functions of several variables, multiple integrals, vector calculus.

Math 265H. Honors Calculus III. (4-0) Cr. 4. F.S. *Prereq: Permission of the instructor; and 166 or 166H.* Analytic geometry and vectors, differential calculus of functions of several variables, multiple integrals, vector calculus. Additional material of a theoretical, conceptual, computational, or modeling nature. Some of the work may require more ingenuity than is required in Math 265. Preference will be given to students in the University Honors Program.

Math 266. Elementary Differential Equations. (3-0) Cr. 3. F.S.SS. *Prereq: Grade of C- or better in 166 or 166H.* Solution methods for ordinary differential equations. First order equations, linear equations, constant coefficient equations. Eigenvalue methods for systems of first order linear equations. Introduction to stability and phase plane analysis.

Math 267. Elementary Differential Equations and Laplace Transforms. (4-0) Cr. 4. F.S.SS. *Prereq: Grade of C- or better in 166 or 166H.* Same as 266 but also including Laplace transforms and series solutions to ordinary differential equations.

Math 268. Laplace Transforms. (1-0) Cr. 1. Alt. F., offered 2009. *Prereq: 266.* Laplace transforms and series solutions to ordinary differential equations. Together, Math 266 and 268 are the same as 267.

Math 290. Independent Study. Cr. arr. Repeatable. H. Honors

Math 297. Intermediate Topics for School Mathematics. (2-2) Cr. 3. F.S. *Prereq: Enrollment in elementary education and grade of C- or better in 196.* Mathematical reasoning, data fitting, and topics in Euclidean and non-Euclidean geometry. Discrete mathematics topics selected from graphs, networks, recurrence relations, probability, Markov chains. Use of technology to learn and teach mathematics.

Math 298. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Math 301. Abstract Algebra I. (3-0) Cr. 3. F.S. *Prereq: 166 or 166H, 307 or 317, and 201.* Theory of groups. Homomorphisms. Quotient groups. Introduction to rings. Emphasis on writing proofs. Nonmajor graduate credit.

Math 302. Abstract Algebra II. (3-0) Cr. 3. S. *Prereq: 301.* Theory of rings and fields. Introduction to Galois theory. Emphasis on writing proofs. Nonmajor graduate credit.

Math 304. Introductory Combinatorics. (3-0) Cr. 3. F. *Prereq: 166 or 166H; 201 or experience with proofs.* Permutations, combinations, binomial coefficients, inclusion-exclusion principle, recurrence relations, generating functions. Additional topics selected from probability, random walks, and Markov chains. Nonmajor graduate credit.

Math 307. Matrices and Linear Algebra. (3-0) Cr. 3. F.S.SS. *Prereq: 2 semesters of calculus.* Systems of linear equations, determinants, vector spaces, linear transformations, orthogonality, least-squares methods, eigenvalues and eigenvectors. Emphasis on methods and techniques. Only one of Math 307, 317 may be counted toward graduation. Nonmajor graduate credit.

Math 314. Graphs and Networks. (3-0) Cr. 3. S. *Prereq: 166 or 166H; 201 or experience with proofs.* Structure and extremal properties of graphs. Topics are selected from: trees, networks, colorings, paths and cycles, connectivity, planarity, Ramsey theory, forbidden structures, enumeration, applications. Nonmajor graduate credit.

Math 317. Theory of Linear Algebra. (4-0) Cr. 4. F.S. *Prereq: 166; credit or enrollment in 201.* Systems of linear equations, determinants, vector spaces, inner product spaces, linear transformations, eigenvalues and eigenvectors. Emphasis on writing proofs and results. Only one of Math 307, 317 may be counted toward graduation. Nonmajor graduate credit.

Math 331. Topology. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 307 or 317.* Topological properties of metric spaces, including Euclidean n-space, continuous functions, homeomorphisms, and topological invariants. Examples from surfaces, knots, links, and three-dimensional manifolds. Nonmajor graduate credit.

Math 341. Introduction to the Theory of Probability and Statistics I. (Cross-listed with Stat). (3-0) Cr. 3. F.S. *Prereq: Math 265 (or 265H).* Probability; distribution functions and their properties; classical discrete and continuous distribution functions; multivariate probability distributions and their properties; moment generating functions; simulation of random variables and use of the R statistical package.

Math 342. Introduction to the Theory of Probability and Statistics II. (Cross-listed with Stat). (3-0) Cr. 3. S. *Prereq: Stat 341; Math 307 or 317.* Transformations of random variables; sampling distributions; confidence intervals and hypothesis testing; theory of estimation and hypothesis tests; linear model theory, enumerative data; use of the R statistical package for simulation and data analysis.

Math 350. Number Theory. (Cross-listed with Com S). (3-0) Cr. 3. S. *Prereq: 166.* Divisibility, integer representations, primes and divisors, linear diophantine equations, congruences, and multiplicative functions. Applications to cryptography. Nonmajor graduate credit.

Math 365. Complex Variables with Applications. (3-0) Cr. 3. S. *Prereq: 265.* Functions of a complex variable, including differentiation, integration and series expansions, residues, evaluation of integrals, conformal mapping. Nonmajor graduate credit.

Math 373. Introduction to Scientific Computation. (3-0) Cr. 3. S. *Prereq: 265.* Vector, matrix and graphics programming in MATLAB for scientific applications. Algorithms for interpolation, systems of linear equations, least squares, nonlinear equations and optimization in one and several variables. Additional topics may include ordinary differential equations, symbolic calculation and the Fast Fourier Transform. Emphasis on effective use of mathematical software, and understanding of its strengths and limitations. Nonmajor graduate credit.

Math 385. Introduction to Partial Differential Equations. (3-0) Cr. 3. F.S. *Prereq: 265 and one of 266, 267.* Separation of variables methods for elliptic, parabolic, and hyperbolic partial differential equations. Fourier series, Sturm-Liouville theory, Bessel functions, and spherical harmonics. Nonmajor graduate credit.

Math 397. Teaching Secondary Mathematics Using University Mathematics. (2-2) Cr. 3. S. *Prereq: 201, 301.* Coursework in university mathematics including calculus, abstract algebra, discrete mathematics, geometry, and other topics as it relates to teaching mathematics in grades 7-12.

Math 398. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Math 414. Analysis I. (3-0) Cr. 3. F.S.SS. *Prereq: 201; 265; and 307 or 317.* A careful development of calculus of functions of a real variable: limits, continuity, differentiation, integration, series. Nonmajor graduate credit.

Math 415. Analysis II. (3-0) Cr. 3. S. *Prereq: 414.* Sequences and series of functions of a real variable, uniform convergence, power series and Taylor series, Fourier series, topology of n-dimensional space, implicit function theorem, calculus of the plane and 3-dimensional space. Additional topics may include metric spaces or Stieltjes or Lebesgue integration. Nonmajor graduate credit.

Math 421. Logic for Mathematics and Computer Science. (Cross-listed with Com S). (3-0) Cr. 3. S. *Prereq: Math 301 or 307 or 317 or Com S 330.* Propositional and predicate logic. Topics selected from Horn logic, equational logic, resolution and unification, foundations of logic programming, reasoning about programs, program specification and verification, model checking and binary decision diagrams, temporal logic and modal logic. Nonmajor graduate credit.

Math 426. Mathematical Methods for the Physical Sciences. (3-0) Cr. 3. F. *Prereq: 266 or 267.* A fast-paced course primarily for first-year graduate students in physics and chemistry. Emphasis on techniques needed for quantum mechanics and electrodynamics. Functions of a complex variable and contour integration, integral transforms and applications, series methods for ordinary differential equations, Green's functions, Sturm-Liouville problems and orthogonal functions, boundary-value problems for partial differential equations. Nonmajor graduate credit.

Math 435. Geometry I. (3-0) Cr. 3. F. *Prereq: 307 or 317.* Euclidean geometry. Points, lines, circles, triangles, congruence, similarity, properties invariant under rigid motions. Synthetic, analytic, and axiomatic methods. Nonmajor graduate credit.

Math 436. Geometry II. (3-0) Cr. 3. S. *Prereq: 435.* Continuation of Euclidean geometry with topics from elliptic, projective, or hyperbolic geometry. Emphasis on analytic methods. Nonmajor graduate credit.

Math 439. Mathematics of Fractals and Chaos. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 265.* Iterated function systems; periodic points; algorithms for generation of fractals; fractal dimension; Julia sets and the Mandelbrot set; chaos. Nonmajor graduate credit.

Math 471. Computational Linear Algebra and Fixed Point Iteration. (Cross-listed with Com S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Math 265 and either Math 266, or 267; knowledge of a programming language.* Computational error, solutions of linear systems, least squares, similarity methods for eigenvalues, solution of nonlinear equations in one and several variables. Nonmajor graduate credit.

Math 481. Numerical Solution of Differential Equations and Interpolation. (Cross-listed with Com S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 265 and either Math 266 or 267; knowledge of a programming language.* Polynomial and spline interpolation, orthogonal polynomials, least squares, numerical differentiation and integration, numerical solution of ordinary differential equations. Nonmajor graduate credit.

Math 489. History of Mathematics. (3-0) Cr. 3. S. *Prereq: 6 credits in mathematics at the 300 level or above. Recommended credit or enrollment in 301, 414 or 435.* History of mathematical ideas found in the undergraduate curriculum. It includes a discussion of the historical and cultural settings in which these ideas arose, and the influence of the culture on the type of mathematical ideas that developed. Some of the particular cultures and their mathematics that are studied include: Babylonian and Ancient Egyptian. Ancient Greek, Arabic, Indian, Western European and Chinese. Nonmajor graduate credit.

Math 490. Independent Study. Cr. arr. Repeatable. *Prereq: 301 or 317; 6 credits in mathematics.* No more than 9 credits of Math 490 may be counted toward graduation.
H. Honors

Math 491. Undergraduate Thesis. Cr. arr. Writing a formal mathematics paper. Upon approval by the department, the paper will satisfy the departmental advanced English requirement.

Math 492. Undergraduate Seminar. (2-0) Cr. 2. S. *Prereq: Consent of instructor.* Introduction to mathematics research, a participating seminar on advanced topics in mathematics. Mathematical literature search, reading a mathematical article with the guidance of the instructor, mathematical presentation. Seminar content varies.

Math 497. Teaching Secondary School Mathematics. (Cross-listed with C I). (3-0) Cr. 3. F. *Prereq: 15 credits in college mathematics; if in a teacher licensure program, concurrent enrollment in C I 426 or 526.* Theory and methods for teaching mathematics in grades 7-12. Includes critical examination of instructional strategies, curriculum materials, learning tools, assessment methods, National Standards in Mathematics Education, and equity issues.

Math 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

Math 501. Introduction to Real Analysis. (3-0) Cr. 3. F. *Prereq: 265 and 307 or 317.* A development of the real numbers. Study of metric spaces, completeness, compactness, sequences, and continuity of functions. Differentiation and integration of real-valued functions, sequences of functions, limits and convergence, equicontinuity.

Math 504. Abstract Algebra I. (3-0) Cr. 3. F. *Prereq: 302.* Algebraic systems and their morphisms, including groups, rings, modules, and fields.

Math 505. Abstract Algebra II. (3-0) Cr. 3. S. *Prereq: 504.* Continuation of Math 504.

Math 510. Linear Algebra. (3-0) Cr. 3. F. *Prereq: 307 or 317.* Advanced topics in linear algebra including canonical forms; unitary, normal, Hermitian and positive-definite matrices; variational characterizations of eigenvalues, and applications to other branches of mathematics.

Math 511. Functions of a Single Complex Variable. (3-0) Cr. 3. S. *Prereq: 414 or 465 or 501.* Theory of analytic functions, integration, topology of the extended complex plane, singularities and residue theory, maximum principle.

Math 515. Real Analysis I. (3-0) Cr. 3. F. *Prereq: 414 or 501.* Lebesque measure and Lebesgue integral, one variable differentiation theory, product integration, Lp spaces.

Math 516. Real Analysis II. (3-0) Cr. 3. S. *Prereq: 515.* Metric spaces, topological spaces, compactness, abstract theory of measure and integral, differentiation of measures, Banach spaces.

Math 517. Finite Difference Methods. (3-0) Cr. 3. S. *Prereq: 481 or 503.* Finite difference methods for partial differential equations, with emphasis on parabolic and hyperbolic equations, and other partial differential equations from application areas. Topics include convergence, stability and implementation issues.

Math 519. Methods of Applied Mathematics I. (3-0) Cr. 3. F. *Prereq: 414 or 465 or 501.* Techniques of classical and functional analysis with applications to partial differential equations, integral equations. Vector spaces, metric spaces, Hilbert and Banach spaces, Sobolev spaces and other function spaces, contraction mapping theorem, distributions, Fourier series and Fourier transform, linear operators, spectral theory of differential and integral operators, Green s functions and boundary value problems, weak solutions of partial differential equations and variational methods, calculus in Banach spaces and applications.

Math 520. Methods of Applied Mathematics II. (3-0) Cr. 3. S. *Prereq: 519.* Continuation of Math 519.

Math 525. Numerical Analysis of High Performance Computing. (Cross-listed with Com S, Cpr E). (3-0) Cr. 3. S. *Prereq: Cpr E 308, or one of Math 471, 481; experience in scientific programming; knowledge of FORTRAN or C.* Development, analysis, and testing of efficient numerical methods for use on current state-of-the-art high performance computers. Applications of the methods to the students' areas of research.

Math 533. Cryptography. (Cross-listed with Cpr E, InfAs). (3-0) Cr. 3. S. *Prereq: Math 301 or Cpr E 310 or Com S 330.* Basic concepts of secure communication, DES and AES, public-key cryptosystems, elliptic curves, hash algorithms, digital signatures, applications. Relevant material on number theory and finite fields.

Math 535. Steganography and Watermarking. (Cross-listed with Cpr E, InfAs). (3-0) Cr. 3. S. *Prereq: Cpr E 531 or E E 524 or Math 533/Cpr E 533/InfAs 533.* Basic principles of steganography and watermarking. Algorithms based on spatial domain approaches, transformations of data, statistical approaches. Techniques for images, video, and audio data. Communications models for data hiding. Analysis, detection and recovery of hidden data. Military, commercial and e-commerce applications. Known theoretical results. Software packages for data hiding. Social and legal issues, case studies, and digital rights management issues that affect technological development of steganography and watermarking. Current developments in the area.

Math 540. Seminar in Mathematics Education. (1-0) Cr. 1. SS. *Prereq: Enrollment in the Master of School Mathematics program or professional studies in education.* Research studies in mathematics learning and teaching, exemplary practices in mathematics education, and current state and national trends in the mathematics curriculum in grades K-12.
A. Assessment, equity, and teaching of statistics.
B. Geometry and discrete mathematics, and problem solving.
C. Teaching of analysis, algebra, and the use of technology.

Math 542. Investigating the Teaching and Learning of Secondary Mathematics. (1-0) Cr. 1. Repeatable. Alt. F., offered 2010. *Prereq: Enrollment in master of school mathematics program, professional studies in education or by permission for secondary mathematics education majors.* Research, discussion and evaluation of efforts to improve instruction in the mathematics classroom.

Math 543. Topics in Mathematics Education. (1-0) Cr. 1. F. *Prereq: Teaching a mathematics course.* Selected topics in collegiate mathematics education including cooperative learning, instructional use of technology, writing in mathematics, and cognitive learning theories. Research studies, exemplar practices, and trends in mathematics education.

Math 545. Intermediate Calculus. (4-0) Cr. 4. *Prereq: 3 semesters of calculus and enrollment in the master of school mathematics program.* Offered on a 3-year cycle, offered SS. 2010. Further development of the fundamental concepts of calculus and their applications with an emphasis on a constructivist approach to learning, cooperative groups, problem solving, the use of technology.

Math 546. Algorithms in Analysis and Their Computer Implementation. (2-2) Cr. 3. *Prereq: 3 semesters in calculus or concurrent enrollment in 545 and enrollment in the master of school mathematics program.* Offered on a 3- year cycle, offered SS. 2010. The use of technology in secondary mathematics with an emphasis on the exploration and implementation of algorithms.

Math 547. Discrete Mathematics and Applications. (4-0) Cr. 4. *Prereq: Enrollment in the master of school mathematics program.* Offered on a 3-year cycle, offered SS. 2009. Applications of graph theory, game theory, linear programming, recursion, combinatorics and algebraic structures. Issues in integrating discrete topics into the secondary curriculum. Use of the computer to explore discrete mathematics.

Math 549. Intermediate Geometry. (3-0) Cr. 3. *Prereq: 435 or equivalent and enrollment in the master of school mathematics program.* Offered on a 3-year cycle, offered SS. 2009. A study of geometry with emphasis on metrics, the group of isometries, the group of similarities, and the affine group. Specific spaces studied normally include the Euclidean plane, the 2-sphere, and projective 2-space. Emphasis on analytical methods.

Math 554. Introduction to Stochastic Processes. (Cross-listed with Stat). (3-0) Cr. 3. F. *Prereq: Stat 542.* Markov chains on discrete spaces in discrete and continuous time (random walks, Poisson processes, birth and death processes) and their long-term behavior. Optional topics may include branching processes, renewal theory, introduction to Brownian motion.

Math 557. Ordinary Differential Equations I. (3-0) Cr. 3. F. *Prereq: 415 or 465 or 501.* The initial-value problem, existence and uniqueness theorems, continuous dependence on parameters, linear systems, stability and asymptotic behavior of solutions, linearization, topics from dynamical systems and two-point boundary-value problems.

Math 561. Numerical Analysis I. (3-0) Cr. 3. S. *Prereq: 414 or 501.* Approximation theory, including polynomial spline interpolation and best approximation; numerical differentiation and integration; numerical methods for ordinary differential equations.

Math 562. Numerical Analysis II. (3-0) Cr. 3. F. *Prereq: 414 or 501.* Numerical linear algebra including eigenvalue problems; numerical solution of nonlinear equations and optimization problems.

Math 569. Bioinformatics III (Structural Genome Informatics). (Cross-listed with BCB, Com S, BBMB, Cpr E). (3-0) Cr. 3. F. *Prereq: BCB 567, Gen 411, Stat 430.* Algorithmic and statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

Math 573. Random Signal Analysis and Kalman Filtering. (Cross-listed with Aer E, E E, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 370 or M E 411 or Math 341 or 395.* Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

Math 574. Optimal Control. (Cross-listed with Aer E, E E, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* The optimal control problem. Variational approach. Pontryagin's principle. Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

Math 575. Introduction to Robust Control. (Cross-listed with E E, M E, Aer E). (3-0) Cr. 3. *Prereq: E E 577.* Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H2, Hoo, and l1 control problems. Tools for robustness analysis and synthesis.

Math 576. Digital Feedback Control Systems. (Cross-listed with Aer E, E E, M E). (3-0) Cr. 3. F. *Prereq: E E 475 or Aer E 432 or M E 411 or 414 or Math 415; and Math 267.* Sampled-data, discrete data, and the z-transform. Design of digital control systems using transform methods: root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

Math 577. Linear Systems. (Cross-listed with Aer E, E E, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 414 or Math 415; and Math 307.* State variable and input-output descriptions of linear continuous-time and discrete-time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by state feedback. Design of feedback systems. Stability of linear dynamical systems.

Math 578. Nonlinear Systems. (Cross-listed with Aer E, E E, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* Classification of nonlinear control systems. Existence and uniqueness of solutions. Approximate analysis methods. Periodic orbits. Concept of stability and Lyapunove stability theory. Absolute stability of feedback systems. Input-and output stability. Passivity.

Math 590. Special Topics. Cr. arr. Repeatable.

Math 597. Introductory Computational Structural Biology. (Cross-listed with BCB). (3-0) Cr. 3. S. *Prereq: 561 and 562.* Mathematical and computational approaches to protein structure prediction and determination. Topics include molecular distance geometry, potential energy minimization, and molecular dynamics simulation.

Math 599. Creative Component. Cr. arr.

Courses for graduate students

Math 601. Mathematical Logic I. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 504.* First semester of full-year course. Completeness and compactness of propositional and predicate logic, incompleteness and undecidability of set theory and arithmetic, Goedel's theorems, recursive functions, computability, models, ultraproducts, and ultralimits.

Math 602. Mathematical Logic II. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 601.* Continuation of Math 601.

Math 605. Design Theory and Association Schemes. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 504.* Combinatorial designs and Latin squares. Construction methods including finite fields. Error-correcting codes. Adjacency matrices and algebraic combinatorics.

Math 606. Enumerative Combinatorics and Ordered Sets. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 504 or permission of instructor.* Ordered sets and lattices. Generating functions. Moebius inversion and other enumeration methods.

Math 607. Modern (Structural) Graph Theory. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 504 or permission of instructor.* Structural and extremal theory of graphs. Topics include basic structures (trees, paths and cycles), networks, colorings, connectivity, topological graph theory, Ramsey theory, forbidden graphs and minors, introduction to random graphs, applications.

Math 610. Seminar. Cr. arr.

Math 615. General Theory of Algebraic Structures I. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 504.* First semester of full-year course. Subalgebras, homomorphisms, congruence relations, and direct products. Lattices and closure operators. Varieties and quasivarieties of algebras, free algebras, Birkhoff's theorems, clones, Mal'cev conditions. Advanced topics.

Math 616. General Theory of Algebraic Structures II. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 615.* Continuation of Math 615.

Math 617. Category Theory. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 504.* Categories and functors and their applications.

Math 618. Representation Theory. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 504.* Representations of algebraic structures. Content varies by semester.

Math 621. Topology. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Permission of instructor.* Introduction to general topology. Topological spaces, continuous functions, connectedness, compactness. Topics selected from countability and separation axioms, metrization, and complete metric spaces.

Math 622. Algebraic Topology. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 504.* Foundations of algebraic topology. The fundamental group, simplicial homology groups, and singular homology groups.

Math 624. Manifolds, Tensors and Differential Geometry. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 501 or 515.* Topics selected from: Geometry of curves and surfaces. Manifolds, coordinate systems. Tensors, differential forms, Riemannian metrics. Connections, covariant differentiation, curvature tensors.

Math 633. Functional Analysis I. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Permission of instructor.* Fundamental theory of normed linear spaces and algebras emphasizing aspects that provide a framework for the study of boundary-value problems, eigenvalue problems, harmonic analysis, analytic function theory, and modern operator theory.

Math 634. Functional Analysis II. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 633.* Continuation of Math 633.

Math 642. Advanced Probability Theory. (Cross-listed with Stat). (4-0) Cr. 4. F. *Prereq: Stat 542.* Measure spaces, extension theorem and construction of Lebesgue-Stieljes measures on Euclidean spaces, Lebesgue integration and the basic convergence theorems, Lp-spaces, absolute continuity of measures and the Radon Nikodym theorem, absolute continuity of functions on R and the fundamental theorem of Lebesgue integration, product spaces and Fubini-Tonelli Theorems, convolutions. Fourier series and transforms, probability spaces; Kolmogorov's existence theorem for stochastic processes; expectation; Jensen's inequality and applications, independence, Borel-Cantelli lemmas; weak and strong laws of large numbers and applications, renewal theory.

Math 645. Advanced Stochastic Processes. (Cross-listed with Stat). (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Weak convergence. Random walks and Brownian motion. Martingales. Stochastic integration and Ito's Formula. Stochastic differential equations and applications.

Math 646. Mathematical Modeling of Complex Physical Systems. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Modeling of the dynamics of complex systems on multiple scales: Classical and dissipative molecular dynamics, stochastic modeling and Monte-Carlo simulation; macroscale non-linear dynamics and pattern formation.

Math 655. Partial Differential Equations I. (3-0) Cr. 3. F. *Prereq: 515 or 519.* First order equations and systems, conservation laws, general theory of linear partial differential equations of elliptic, parabolic and hyperbolic types, maximum principles, fundamental solutions, Sobolev spaces, variational and Hilbert space methods.

Math 656. Partial Differential Equations II. (3-0) Cr. 3. S. *Prereq: 655.* Continuation of Math 655.

Math 658. Dynamical Systems. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 501 or 515.* Smooth mappings and flows. Fixed points, stable, unstable and center manifolds, normal forms. Structural stability, bifurcations. Horseshoe maps, introduction to chaotic behavior.

Math 666. Finite Element Methods. (3-0) Cr. 3. F. *Prereq: 503 or 516 or 520 or 656.* Elements of functional analysis; Sobolev spaces; variational principles and weak formulations; approximation theory in finite element spaces; analysis of finite element methods; implementation issues; applications.

Math 690. Advanced Topics. Cr. 3. Repeatable.
A. Algebra
B. Functional Analysis
C. Control Theory
D. Approximation Theory
E. Linear Algebra
G. Number Theory
H. Harmonic Analysis
I. Combinatorics and Graph Theory
J. Mathematical Biology and Bioinformatics
K. Mathematics Education
L. Logic and Foundations
M. Complex Analysis
N. Numerical Analysis
O. Ordinary Differential Equations
P. Partial Differential Equations
Q. Group Theory
R. Applied Mathematics
S. Set Theory
T. Topology
U. Automata Theory
V. Optimization Theory
W. Probability and Stochastic Processes
Y. Special Functions
Z. Ring Theory

Math 699. Research. Cr. arr. Repeatable.

Mechanical Engineering

Jonathan Wickert, Chair of Department

Distinguished Professors: Bernard, R. Brown

Distinguished Professor (Emeritus): Serovy

University Professor (Emeritus): Bahadur

Professors: Chandra, Heindel, Kelkar, Levitas, Molian, Nelson, Oliver, Vance, Wickert

Professors (Emeritus): Bathie, Baumgarten, Colver, Cook, Danofsky, Dejong, Eide, Hall, Hendrickson, Henkin, Junkhan, Kavanagh, Mischke, Okiishi, Pate, Peters, Pletcher, Roberts, Shapiro, Spinrad, Wechsle

Associate Professors: Anex, Bastawros, Bryden, Luecke, Mann, Maxwell, Olsen, Subramaniam, Sundararajan, Wang

Associate Professors (Emeritus): Joensen, Vanmeter

Associate Professor (Adjunct): Gray

Assistant Professors: Bigelow, Faidley, Ganapathysubramanian, Kim, Kong, Meyer, Shrotriya, Stone, Winer, Zhang, Zou

Senior Lecturer: Starns

Lecturer: Feve, Heise

Undergraduate Study

For the undergraduate curriculum in mechanical engineering leading to the degree bachelor of science, see College of Engineering, Curricula. This curriculum is accredited by the Engineering Accreditation Commission of ABET.

Mechanical engineers are typically involved with such activities as

•generation, distribution, and use of energy

•development and application of manufacturing systems and processes

•automation and control of mechanical and thermal systems

•design of various products for consumer and commercial markets

About one-fifth of all engineers practicing today have been educated as mechanical engineers. Their activities include research, development, design, testing, production, technical sales, and technical management.

Mechanical engineers are characterized by personal creativity, breadth of knowledge, and versatility. For these reasons they are found to function and thrive as valuable members and leaders of multidisciplinary teams. Through clever use of analysis, modeling, design, synthesis, and interpersonal skills they solve important problems to improve our world.

To ensure the success of students completing the curriculum in mechanical engineering, the department has established the following educational objectives:
1. The department provides a sound foundation for graduates to pursue a variety of careers. Most graduates will find immediate employment in industry, government laboratories or consulting, but some will pursue graduate or professional studies in such fields as engineering, business, law or medicine.
2. Graduates will apply the problem solving skills they have learned at Iowa State University to meet the challenging demands and increasing responsibilities of a successful career.
3. Graduates will continue to learn as they grow in their profession, using modern technology and communication skills to contribute as team members or leaders in solving important problems for their employers and for society.

The mechanical engineering curriculum is organized to provide students with a broad foundation in mathematics and the sciences of physics and chemistry.

•Through courses in these subjects, students will attain the basic knowledge required to understand and analyze mechanical engineering systems. This background is extended and organized through studies in mechanics, dynamics, thermo-fluids, materials, manufacturing, and design.

•Upon completion of courses in these areas of the curriculum, students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives. A major focus throughout the mechanical engineering curriculum is a series of experiences that emphasize engineering design.

•Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.

In addition, a sequence of courses emphasizing engineering design begins in the first year and culminates with a capstone design experience.

•Students will not only be able to apply their engineering knowledge to real-life design problems but also to critically evaluate the solutions.

Development of skills needed to be independent, creative thinkers, effective communicators, and contributing team members is emphasized throughout the curriculum.

•Students will learn to effectively work in multidisciplinary teams to solve engineering problems subject to technical and business constraints through critical thinking that crosses content boundaries.

•Students will develop an understanding of the societal context in which they will practice engineering. They will include ethical, legal, and

aesthetic considerations in design of engineering components and systems. The curriculum provides flexibility to allow students to broaden their perspectives or to focus in more depth in areas of particular interest. Organized sequences of technical electives can be chosen from areas which represent major concentrations in the field of mechanical engineering. Optional areas of specialization include energy conversion and utilization, thermal system design, mechanical system design, materials and manufacturing, nuclear engineering, thermal and environmental engineering, and vehicle propulsion.

•Elective courses provide additional emphasis in terms of the student's unique educational goals, whether they include immediate entry into industry or further study at the graduate level. In addition, students elect courses in the humanities, social sciences, U.S. diversity and international perspectives.

•Through these courses, students develop an understanding of the societal context in which they will practice engineering, including environmental, legal, aesthetic, and human aspects. Students in mechanical engineering are encouraged to participate in the cooperative education program or to obtain engineering internships, both domestically and abroad. Study abroad is encouraged, and the department has exchange programs with several universities around the world. These experiences help students to round out their education and to better prepare for careers in the increasingly global practice of engineering.

Nuclear Engineering Minor

The nuclear engineering minor is multidisciplinary and open to undergraduates in the College of Engineering. The minor may be earned by completing 15 credits from a list of courses available through the Mechanical Engineering Advising Center.

The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

Graduate Study

The department offers work for the degrees of master of science and doctor of philosophy with a major in mechanical engineering. The master of science degree may be earned with or without a thesis. Although co-major and formal minor programs are not offered in mechanical engineering, courses may be used for minor work by students taking major work in other departments.

The graduate program offers advanced study in a variety of thrust areas, including biological and nanoscale sciences, clean energy technologies, complex fluid systems, design and manufacturing innovation, and simulation and visualization.

The department offers students the opportunity to broaden their education by participating in minor programs in established departments, interdepartmental programs, or other experiences as approved by their program of study committees.

The requirements for advanced degrees are established by the student's program of study committee within established guidelines of the Graduate College. Graduate students who have not completed an undergraduate program of study substantially equivalent to that required of undergraduate students in the department can expect that additional supporting coursework will be required. A foreign language requirement exists for the degree of doctor of philosophy only if the student's program of study committee deems it appropriate to a specific program of study.

Courses primarily for undergraduate students

M E 102. Mechanical Engineering Orientation. Cr. R. F.S. (1-0) Information concerning university, college, and departmental policies and procedures. Information on cooperative, intern, summer and career placement. Review of degree audit and registration.

M E 190. Learning Communities. (1-0) Cr. 1. Repeatable. F.S. Enrollment in M E learning communities.

M E 202. Mechanical Engineering - Professional Planning. (1-0) Cr. R. F.S. *Prereq: Sophomore classification.* Preparation for a career in mechanical engineering; discussion of opportunities for leadership, undergraduate research, experiential learning.

M E 231. Engineering Thermodynamics I. (3-0) Cr. 3. F.S. *Prereq: Math 265, Chem 167, Phys 222.* Fundamental concepts based on zeroth, first and second laws of thermodynamics. Properties and processes for ideal gases and solid-liquid-vapor phases of pure substances. Applications to vapor power cycles. Credit for either M E 231 or 330, but not both, may be applied toward graduation.

M E 270. Introduction to Mechanical Engineering Design. (1-6) Cr. 3. F.S. *Prereq: Engr 170, Phys 221.* Introduction to fundamentals of mechanical engineering design with applications to thermal and mechanical systems. Examination of existing machines and systems. Team-based projects, open-ended problems and prototyping. Application of engineering tools. Oral and written reports required.

M E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

M E 324. Manufacturing Engineering. (3-2) Cr. 4. F.S. *Prereq: 270, E M 324, Mat E 272.* Plastic deformation and work hardening. Manufacturing processes including forming, machining, casting and welding with emphasis on manufacturing considerations in design. Modern manufacturing practices. Laboratory exercises will be an integral component of the course. Nonmajor graduate credit.

M E 325. Machine Design. (3-0) Cr. 3. F.S. *Prereq: Engr 170, E M 324, Stat 305.* Philosophy of design and design methodology. Consideration of stresses and failure models useful for static and fatigue loading. Analysis, selection and synthesis of machine elements. Nonmajor graduate credit.

M E 330. Thermodynamics. (3-0) Cr. 3. F.S. *Prereq: Phys 222.* For students electing one course in engineering thermodynamics. First and second laws of thermodynamics. Properties and processes for pure substances. Selected applications including cycles for power and refrigeration. Psychrometrics. Credit for either M E 231 or 330, but not both, may be applied toward graduation. Majors in mechanical engineering may not apply M E 330 toward a degree in mechanical engineering.

M E 332. Engineering Thermodynamics II. (3-0) Cr. 3. F.S. *Prereq: 231.* Gas power cycles. Fundamentals of gas mixtures, psychrometry, and thermochemistry. Applications to one-dimensional compressible flow, refrigeration, air conditioning and combustion processes. Nonmajor graduate credit.

M E 335. Fluid Flow. (3-2) Cr. 4. F.S. *Prereq: Credit or enrollment in 332 and 370, E M 345, Math 266 or 267.* Incompressible and compressible fluid flow fundamentals. Dimensional analysis and similitude. Internal and external flow applications. Lab experiments emphasizing concepts in thermodynamics and fluid flow. Written reports are required. Nonmajor graduate credit.

M E 370. Engineering Measurements and Instrumentation. (2-3) Cr. 3. F.S. *Prereq: E E 442, Stat 305.* Fundamentals of design, selection, and operation of components of measuring systems. Measurement processes, data acquisition systems, analysis of data, and propagation of measurement uncertainty. Nonmajor graduate credit.

M E 388. Sustainable Engineering and International Development. (Cross-listed with A E, C E, E E, Mat E). (2-2) Cr. 3. F. *Prereq: Junior classification in engineering.* Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as non-government organizations (NGOs). Course readings, final project/design report.

M E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period.

M E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* Professional work period, one semester maximum per academic year.

M E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

M E 410. Mechanical Engineering Applications of Mechatronics. (2-2) Cr. 3. S. *Prereq: E E 442, 448, credit or enrollment in 421.* Fundamentals of sensor characterization, signal conditioning and motion control, coupled with concepts of embedded computer control. Digital and analog components used for interfacing with computer controlled systems. Mechanical system analysis combined with various control approaches. Focus on automation of hydraulic actuation processes. Laboratory experiences provide hands-on development of mechanical systems. Nonmajor graduate credit.

M E 411. Automatic Controls. (2-2) Cr. 3. F. *Prereq: 421.* Methods and principles of automatic control. Pneumatic, hydraulic, and electrical systems. Representative applications of automatic control systems. Mathematical analysis of control systems. Nonmajor graduate credit.

M E 412. Ethical Responsibilities of a Practicing Engineer. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 325, senior classification in engineering.* Failure modes associated with product environment. Interaction between the legal profession, legislative bodies, standards and the design engineer, using a case study approach in design applications. Litigation involving designs, standards, and laws applicable to specific designs surveyed. The influence of laws and standards upon design. Nonmajor graduate credit.

M E 413. Fluid Power Engineering. (Cross-listed with A E). (2-2) Cr. 3. F. *Prereq: Credit or enrollment in 335 or E M 378, A E 216 or M E 270.* Properties of hydraulic fluids. Performance parameters of fixed and variable displacement pumps and motors. Hydraulic circuits and systems. Hydrostatic transmissions. Characteristics of control valves. Analysis and design of hydraulic systems for power and control functions. Nonmajor graduate credit.

M E 414. Hydraulic Systems and Control. (3-0) Cr. 3. F. *Prereq: 421, 335.* Characteristics of hydraulic motors and pumps, system components, system analysis, feedback control and stability, control circuits, computer simulation. Nonmajor graduate credit.

M E 415. Mechanical Systems Design. (0-6) Cr. 3. F.S. *Prereq: 324, 325.* Solution of a total design problem involving a mechanical system, documenting decisions concerning form and function, material specification, manufacturing methods, safety, cost, and conformance with codes and standards. Solution description includes oral and written reports. Nonmajor graduate credit.

M E 417. Advanced Machine Design. (Dual-listed with 517). (3-0) Cr. 3. S. *Prereq: 325, Mat E 272.* Stress life, strain life, and linear elastic fracture mechanics approaches to fatigue life and design. Material processing to mitigate crack growth in the initiation and propagation stages of the fatigue process. Variable amplitude and multi-axial loadings, stress-strain response to cyclical loadings, and notch effects. Software development required for graduate credit. Nonmajor graduate credit.

M E 418. Mechanical Considerations in Robotics. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 421.* Three dimensional kinematics, dynamics, and control of robot manipulators, hardware elements and sensors. Laboratory experiments using industrial robots. Nonmajor graduate credit.

M E 419. Computer-Aided Design. (3-0) Cr. 3. F. *Prereq: 325.* Theory and applications of computer-aided design. Design theory, solid modeling and finite element modeling in CAD. Assembly modeling, rapid prototyping and mechanism analysis. Curves and surfaces and CAD/CAM data exchange. Nonmajor graduate credit.

M E 421. Mechanical Systems and Control. (3-2) Cr. 4. F.S. *Prereq: E E 442, E E 448, E M 345, Math 267.* Modeling and simulation of mechanical systems. Development of equations of motion and dynamic response characteristics. Fundamentals of classical control applications, including mathematical analysis and design for closed loop control systems. Introduction to computer interfacing for data acquisition and control. Laboratory exercises for hands-on motion and control implementation. Nonmajor graduate credit.

M E 423. Creativity and Imagination for Engineering and Design. (3-0) Cr. 3. *Prereq: Junior classification in mechanical engineering.* Historical examples of technical innovations based on creativity and imagination. Introduction to the psychology and theory of creativity and imagination. Background and simplified exercises in the creative arts, including poetry (both free verse and prose) and the visual arts (both two and three dimensional), for skill strengthening. Additional exercises in creative and imaginative thinking. Application of creative and imaginative skills for formulating conceptual design solutions. Additional applications related to technology including problem solving and inventing.

M E 425. Optimization Methods for Complex Designs. (Dual-listed with 525). (3-0) Cr. 3. S. *Prereq: Engr 160, Math 265.* Optimization techniques including unconstrained and constrained minimization, linear programming, and particle swarm optimization. Both the theory and methods and the application to complex designs will be presented. Nonmajor graduate credit.

M E 433. Alternative Energy Conversion. (3-0) Cr. 3. F. *Prereq: Phys 221/222 and Chem 167.* Basic principles, thermodynamics, and performance of alternative energy conversion technologies such as direct energy conversion (fuel cells, photovoltaics, magnetohydrodynamics), wind energy, biomass energy, non-combustion thermal sources (ocean gradients, geothermal and nuclear fusion), non-conventional environmental energy sources (ocean tides and currents), and finally other alternative approaches (molecular motors, cryo-engines, and solar sailing). Performance analysis and operating principles of systems and components, economic analysis for system design and operation. Nonmajor graduate credit.

M E 436. Heat Transfer. (3-2) Cr. 4. F.S. *Prereq: 335.* Heat transfer by conduction, convection, and radiation. Similarity concepts in heat, mass, and momentum transfer. Methods for determination of heat transfer coefficients. Combined modes of heat transfer. Heat exchangers. Lab experiments emphasizing concepts in thermodynamics and heat transfer. Written reports are required. Nonmajor graduate credit.

M E 441. Fundamentals of Heating, Ventilating, and Air Conditioning. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 436.* Space conditioning and moist air processes. Application of thermodynamics, heat transfer, and fluid flow principles to the analysis of heating, ventilating, and air conditioning components and systems. Performance and specification of components and systems. Nonmajor graduate credit.

M E 442. Heating and Air Conditioning Design. (1-5) Cr. 3. S. *Prereq: 441.* Design criteria and assessment of building environment and energy requirements. Design of heating, ventilating, and air conditioning systems. System control and economic analysis. Oral and written reports required. Nonmajor graduate credit.

M E 444. Elements and Performance of Power Plants. (3-0) Cr. 3. S. *Prereq: 332, credit or enrollment in 335.* Basic principles, thermodynamics, engineering analysis of power plant systems. Topics include existing power plant technologies, the advanced energyplex systems of the future, societal impacts of power production, and environmental and regulatory concerns. Nonmajor graduate credit.

M E 446. Power Plant Design. (2-2) Cr. 3. F. *Prereq: 332, credit or enrollment in 335.* Design of a power plant to meet regulatory, cost, fuel, and output needs. Selection and synthesis of principal components. Oral and written reports required. Nonmajor graduate credit.

M E 448. Fluid Dynamics of Turbomachinery. (Cross-listed with Aer E). (3-0) Cr. 3. *Prereq: M E 335 or equivalent.* Applications of principles of fluid mechanics and thermodynamics in performance analysis and design of turbomachines and related fluid system components. Nonmajor graduate credit.

M E 449. Internal Combustion Engine Design. (3-1) Cr. 3. F. *Prereq: 335.* Basic principles, thermodynamics, combustion, and exhaust emissions of spark-ignition and compression-ignition engines. Laboratory determination of fuel properties and engine performance. Thermodynamic and mechanical design of engine components to meet specified performance, fuel economy, and air pollution requirements. Oral and written reports required. Nonmajor graduate credit.

M E 450. Engineering Vibrations. (Cross-listed with E M). (3-0) Cr. 3. F. *Prereq: E M 324 and 345.* Elementary vibration analysis, single and multiple degrees of freedom, energy methods, free and forced vibrations, viscous and other forms of damping transform methods and response to periodic and random force inputs, numerical methods of solution, eigenvalues and modal analysis, energy methods, vibration isolation and suppression, string or cable dynamics, beam bending dynamics, application problems in aerospace and mechanical engineering (as relevant). Nonmajor graduate credit.

M E 451. Engineering Acoustics. (Cross-listed with E M). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: Phys 221 and Math 266 or 267.* Sound sources and propagation. Noise standards and effects of noise on people. Principles of noise and vibration control used in architectural and engineering design. Characteristics of basic noise measurement equipment. Experience in use of noise measuring equipment, sound power measurements, techniques for performing noise surveys, evaluation of various noise abatement techniques applied to common noise sources. Selected laboratory experiments. Nonmajor graduate credit.

M E 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Aer E, Cpr E, E E, Engr, I E, Mat E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

M E 475. Modeling and Simulation. (3-0) Cr. 3. S. *Prereq: 421, credit or enrollment in 436.* Introduction to computer solution techniques required to simulate flow, thermal, and mechanical systems. Methods of solving ordinary and partial differential equations and systems of algebraic equations; interpolation, numerical integration; finite difference and finite element methods. Nonmajor graduate credit.

M E 484. Technology, Globalization and Culture. (Dual-listed with 584). (Cross-listed with WLC). (3-0) Cr. 3. F. *Prereq: senior classification for 484; graduate classification for 584.* Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

M E 486. Appropriate Technology Design. (3-0) Cr. 3. F. *Prereq: 231, current enrollment in 335.* Hands-on design experience utilizing knowledge acquired in core mechanical engineering courses. Emphasis with engineering problem formulation and solution, oral and written communication, team decision-making and ethical conduct. Design projects include engineering considerations in appropriate technology which have multidisciplinary components in economics and sociology.

M E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Senior classification.* Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.
C. Engineering Measurements and Instrumentation
D. Heat Transfer
E. Fluid Power and Controls
F. Machines and Systems
G. Materials and Manufacturing Processes
H. Honors
J. Thermodynamics and Energy Utilization
K. Fluid Mechanics
L. Turbomachinery
M. Nuclear Engineering
N. CAD/CAM

M E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduate students

M E 511. Advanced Control Design. (3-0) Cr. 3. S. *Prereq: 411.* Application of control design methods using continuous, discrete, and frequency-based models. Approaches include classical, pole assignment, model reference, internal model, and adaptive control methods. Mechanical design projects.

M E 517. Advanced Machine Design. (Dual-listed with 417). (3-0) Cr. 3. S. *Prereq: 325, Mat E 272.* Stress life, strain life, and linear elastic fracture mechanics approaches to fatigue life and design. Material processing to mitigate crack growth in the initiation and propagation stages of the fatigue process. Variable amplitude and multi-axial loadings, stress-strain response to cyclical loadings, and notch effects. Software development required for graduate credit.

M E 520. Material and Manufacturing Considerations in Design. (3-0) Cr. 3. F. *Prereq: 324, 325.* Advanced treatment of materials and manufacturing. Applications to design. Design and redesign to facilitate cost-effective manufacturing. Qualitative and quantitative comparisons of designs. Economic considerations.

M E 521. Mechanical Behavior and Manufacturing of Polymers and Composites. (Cross-listed with M S E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 324 or Mat E 272 and E M 324.* Effect of chemical structure and morphology on properties. Linear viscoelasticity, damping and stress relaxation phenomena. Structure

and mechanics of filler and fiber reinforced composites. Mechanical properties and failure mechanisms. Material selection and designing with polymers. Processing of polymer and composite parts.

M E 525. Optimization Methods for Complex Designs. (Dual-listed with 425). (Cross-listed with HCI). (3-0) Cr. 3. S. *Prereq: Engr 160, Math 265.* Optimization techniques including unconstrained and constrained minimization, linear programming, and particle swarm optimization. Both the theory and methods and the application to complex designs will be presented.

M E 527. Mechanics of Machining and Finishing Processes. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 324.* Mechanics of material removal for ductile materials. Shear zone theory. Oblique cutting. Heat transfer in machining. Milling and grinding. Mechanics of material removal for brittle materials. Optimal selection and design of cutting parameters. Control of machining processes. Principles of precision finishing. Design considerations for machining and finishing processes.

M E 528. Micro/Nanomanufacturing. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 324.* Introduction and scaling laws; SEM/SPM/AFM microscopes; top-down-beam machining; top-down-mechanical and electrical machining; synthesis of powders, tubes, and wires; bottom-up molecular manufacturing; applications of molecular manufacturing.

M E 530. Advanced Thermodynamics. (3-0) Cr. 3. F. *Prereq: 332.* Fundamentals of thermodynamics from the classical viewpoint with emphasis on the use of the first and second laws for analysis of thermal systems. Generalized thermodynamic relationships. Computer applications of thermodynamic properties and system analysis. Selected topics.

M E 532. Compressible Fluid Flow. (Cross-listed with Aer E). (3-0) Cr. 3. S. *Prereq: M E 335 or Aer E 541.* Thermodynamics of compressible flow. Viscous and inviscid compressible flow equations. One dimensional steady flow; isentropic flow, normal shock waves oblique and curved shocks, constant area flow with friction and heat transfer. Linear theory and Prandtl-Glauert similarity. Method of characteristics. Subsonic, transonic, supersonic and hypersonic flows.

M E 535. Thermochemical Processing of Biomass. (Cross-listed with BRT). (3-0) Cr. 3. S. *Prereq: Undergraduate course work in thermodynamics and transport phenomena..* Introduction to thermal and catalytic processes for the conversion of biomass to biofuels and other biobased products. Topics include gasification, fast pyrolysis, hydrothermal processing, syngas to synfuels, and bio-oil upgrading. Application of thermodynamics, heat transfer, and fluid dynamics to bioenergy and biofuels.

M E 536. Advanced Heat Transfer. (3-0) Cr. 3. S. *Prereq: 436.* Advanced treatment of heat transmission by conduction, convection, and radiation.

M E 538. Advanced Fluid Flow. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 436.* Detailed analysis of incompressible/compressible, viscous/inviscid, laminar/turbulent, and developing fluid flows on a particle/point control volume basis.

M E 540. Solar Energy Systems. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 436.* Application of heat transfer, thermodynamics and photovoltaics to the design and analysis of solar energy collectors and systems.

M E 542. Advanced Combustion. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 332 or Ch E 381.* Thermochemistry and transport theory applied to combustion. Gas phase equilibrium. Energy balances. Reaction kinetics. Flame temperatures, speed, ignition, and extinction. Premixed and diffusion flames. Combustion aerodynamics. Mechanisms of air pollution.

M E 543. Introduction to Random Vibrations and Nonlinear Dynamics. (Cross-listed with E M). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: E M 444.* Vibrations of continuous systems. Nonlinear vibration phenomena, perturbation expansions; methods of multiple time scales and slowly-varying amplitude and phase. Characteristics of random vibrations; random processes, probability distributions, spectral density and its significance, the normal or Gaussian random process. Transmission of random vibration, response of simple single and two-degree-of-freedom systems to stationary random excitation. Fatigue failure due to random excitation.

M E 545. Thermal Systems Design. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 436.* Integrating thermodynamics, fluid mechanics, and heat transfer to model thermal equipment and to simulate thermal systems. Second law and parametric analysis; cost estimation, life cycle analysis and optimization.

M E 546. Computational Fluid Mechanics and Heat Transfer I. (Cross-listed with Aer E). (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 538 or Aer E 541.* Introduction to finite difference and finite volume methods used in modern engineering. Basic concepts of discretization, consistency, and stability. Applications of numerical methods to selected model partial differential equations.

M E 547. Computational Fluid Mechanics and Heat Transfer II. (Cross-listed with Aer E). (3-0) Cr. 3. S. *Prereq: M E 546.* Application of computational methods to current problems in fluid mechanics and heat transfer. Methods for solving the Navier-Stokes and reduced equation sets such as the Euler, boundary layer, and parabolized forms of the conservation equations. Introduction to relevant aspects of grid generation and turbulence modeling.

M E 549. Vehicle Dynamics. (3-0) Cr. 3. F. *Prereq: E M 345, Math 266 or 267.* Analysis and evaluation of the performance of cars and trucks. Computer simulation of ride, braking, and directional response.

M E 552. Advanced Acoustics. (Cross-listed with E M). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 451.* Theoretical acoustics: wave propagation in fluids; acoustic radiation, diffraction and scattering; and architectural acoustics. Applications of basic acoustic theory in noise control and acoustic radiation. Introduction to selected numerical methods in acoustics.

M E 557. Computer Graphics and Geometric Modeling. (Cross-listed with Cpr E, Com S). (3-0) Cr. 3. F.S. *Prereq: 421, programming experience in C.* Fundamentals of computer graphics technology. Data structures. Parametric curve and surface modeling. Solid model representations. Applications in engineering design, analysis, and manufacturing.

M E 561. Scanning Probe Microscopy. (2-1) Cr. 3. Alt. F., offered 2010. *Prereq: First year physics, chemistry.* Introduction to the scanning probe microscope (SPM, also known as atomic force microscope or AFM) and associated measurement techniques. Overview or instrumentation system, basic principles of operation, probe-sample interaction and various operational modes to obtain micro/nanoscale structure and force spectroscopy of material surfaces. Examples of SPM significance and applications in science and engineering research, nanotechnology and other industries. Laboratory work involving use of a scanning probe microscope system is an integral part of the course.

M E 563. Micro and Nanoscale Mechanics. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: E M 324 and M E 325.* Review of Fundamentals: (Elasticity, Electromagnetism, Mechanical response), Mechanics of thermally, electrostatically and magnetically actuated microsystems, Mechanics and design of nanostructured materials, mechanics of surface stress engineering and its implications to sensors and thin film structures.

M E 564. Fracture and Fatigue. (Cross-listed with E M, M S E). (3-0) Cr. 3. F. *Prereq: E M 324 and either Mat E 216 or 272 or 392. Undergraduates: Permission of instructor.* Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

M E 573. Random Signal Analysis and Kalman Filtering. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 370 or 411 or Math 341 or 395.* Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

M E 574. Optimal Control. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. S. *Prereq: E E 577.* The optimal control problem. Variational approach. Pontryagin's principle. Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

M E 575. Introduction to Robust Control. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. *Prereq: E E 577.* Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H2, Hoo, and I1 control problems. Tools for robustness analysis and synthesis.

M E 576. Digital Feedback Control Systems. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. F. *Prereq: E E 475 or Aer E 432 or M E 411 or 414 or Math 415; and Math 267.* Sampled data, discrete data, and the z-transform. Design of digital control systems using transform methods; root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

M E 577. Linear Systems. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 414 or Math 415; and Math 307.* State variable and input-output descriptions of linear continuous-time and discrete-time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by state feedback. Design of feedback systems. Stability of linear dynamical systems.

M E 578. Nonlinear Systems. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. S. *Prereq: E E 577.* Classification of nonlinear control systems. Existence and uniqueness of solutions. Approximate analysis methods. Periodic orbits. Concept of stability and Lyapunov stability theory. Absolute stability of feedback systems. Input-output stability. Passivity.

M E 584. Technology, Globalization and Culture. (Dual-listed with 484). (Cross-listed with WLC). (3-0) Cr. 3. F. *Prereq: senior classification for 484; graduate classification for 584.* Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

M E 590. Special Topics. Cr. arr. Repeatable.
A. Experimental Gas Dynamics
B. Fluid Mechanics
C. Heat Transfer
D. Thermodynamics and Energy Utilization
E. Turbomachinery
F. Vehicular Propulsion Systems
G. Advanced Machine Design
I. Automatic Controls
J. Operating and Environmental Considerations in Design
K. Mechanical Behavior of Materials
L. Manufacturing Processes
M. Tribology
N. Sensitivity Methods
O. Engineering Computation
P. Engineering Measurements and Instrumentation
Q. Independent Literature Investigation
R. Nuclear Engineering
S. CAD/CAM

M E 599. Creative Component. Cr. arr. Repeatable.

Courses primarily for graduate students

M E 600. Seminar. Cr. R. Repeatable. (1-0)

M E 625. Surface Modeling. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 557, programming experience in C.* Theory and implementation of contemporary parametric sculptured surface modeling technology. Non-uniform rational B-spline (NURBS) curves and surfaces. Fundamental computational algorithms. Construction techniques. Advanced modeling topics. Computer projects.

M E 632. Multiphase Flow. (Cross-listed with Ch E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 538.* Single particle, mutliparticle and two-phase fluid flow phenomena (gas-solid, liquid-solid and gas-liquid mixtures); particle interactions, transport phenomena, wall effects; bubbles, equations of multiphase flow. Dense phase (fluidized and packed beds) and ducted flows; momentum, heat and mass transfer. Computer solutions.

M E 636. Conduction Heat Transfer. (3-0) Cr. 3. Alt. F, offered 2010. *Prereq: 436.* Techniques for analysis of problems involving steady-state and transient heat conduction in solids.

M E 637. Convection Heat Transfer. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 436.* Heat transfer to internal or external forced convection flows under laminar or turbulent conditions. Free convection. Heat exchanger design considerations, including augmentation.

M E 638. Radiation Heat Transfer. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 436.* Techniques for analysis of radiation in enclosures. Radiative properties of surfaces. Radiative transfer in participating media. Combined modes of transfer. Approximate methods of analysis.

M E 639. Two-Phase Flow and Heat Transfer. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 436.* Hydrodynamics of adiabatic two-phase flow. Pool boiling. Forced convection, boiling, and condensation. Dynamic behavior of two-phase systems. Augmentation of boiling and condensing heat transfer. Applications in the power and process industries.

M E 647. Advanced High Speed Computational Fluid Dynamics. (Cross-listed with Aer E). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 547.* An examination of current methods in computational fluid dynamics. Differencing strategies. Advanced solution algorithms. Grid generation. Construction of complex CFD algorithms. Current applications. Use of state of the art CFD codes.

M E 690. Advanced Topics. Cr. arr. Repeatable. Investigation of advanced topics of special interest to graduate students in mechanical engineering.
A. Experimental Gas Dynamics
B. Fluid Mechanics
C. Heat Transfer
D. Thermodynamics and Energy Utilization
E. Turbomachinery
F. Vehicular Propulsion Systems
G. Advanced Machine Design
I. Automatic Controls
J. Operating and Environmental Considerations in Design
K. Mechanical Behavior of Materials
L. Manufacturing Processes
M. Tribology
N. Sensitivity Methods
O. Engineering Computation
P. Engineering Measurements and Instrumentation
Q. Independent Literature Investigation
R. Nuclear Engineering
S. CAD/CAM

M E 697. Engineering Internship. Cr. R. Repeatable. *Prereq: Permission of Director of Graduate Education, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

M E 699. Research. Cr. arr. Repeatable. Satisfactory-fail only.

Microbiology

www.micro.iastate.edu

(Interdepartmental Undergraduate Major)

Supervisory Committee: J. Cunnick, Professor-in-Charge, J. Beetham, N. Boury, J. Dickson, E. Braun, M. Gleason, G. Phillips

(Interdepartmental Graduate Major)

Supervisory Committee: A. Bogdanove, Chair, Halverson, Vice Chair, N. Cornick, L. Bartholamy, B. Brehm-Stecher

Participating faculty: M. Allison, L. Bartholomay, G. Beattie, S. Beattie, J. Beetham, B. Bellaire, J. Blanchong, B. Blitvich, T. Bobik, A. Bogdanove, B. Bonning, T. Boylston, B. Brehm-Stecher, N. Cornick, J. Cunnick, J. Dickson, T. Ellis, M. Gleason, R. Griffith, L. Halverson, T. Harrington, D. H. Harris, J. Hill, K. Hofmockel, T. Loynachan, A. Mendonca, C. Miller, W. A. Miller, F. C. Minion, T. Moorman, G. Munkvold, L. Nolan, F. Nutter, E. Nystrom, S. Ong, T. Opriessnig, T. Parkin, G. Phillips, R. Rosenbusch, J. Roth, A. Scupham, J. Sebranek, V. Sharma, B. Sponseller, T. Stanton, E. Vaughn, D. Voytas, M. Wannemuehler, I. Wesley, S. Whitham, B. Yang, Q. Zhang, C. Ziemer, J. Zimmerman, R. Zuerner

Undergraduate Study

Undergraduate study for the bachelor of science degree with a major in microbiology. For the curriculum in microbiology, see Agriculture, Curricula. In this curriculum, principal emphasis is placed on understanding microorganisms and their interrelationships with other organisms in nature, the application of microbiology in medicine, agriculture and industry, and the study of fundamental life processes as exemplified by microorganisms. Some fields of microbiology, especially advanced research, may require further training. Undergraduate work in the program is designed to provide sound preparation for graduate study, training for bachelors-level employment, and admission to professional programs such as medicine, veterinary medicine and dentistry.

Graduates of the Interdepartmental Undergraduate Microbiology Program will learn about the diversity and complexity of microbial life represented by procaryotes, eucaryotes and viruses. In addition to being able to explain fundamental principles of microbial growth, physiology, genetics, biochemistry, and ecology, students will be able to evaluate the impact that the microbial world has on human, animal and plant health, as well as on environmental quality, industry and biotechnology. Graduates are able to design and implement experimental approaches to address specific questions. In addition, graduates are able to communicate scientifically, using a variety of media.

Students graduating in microbiology find career opportunities in a wide variety of areas including: hospital and clinical laboratories; federal, state, and local government agencies; research and development; dairy and food processing industries; and the pharmaceutical and fermentation industries.

The undergraduate program for the major in microbiology requires the following basic courses: 110, 302, 310, 320, 430 or 477, 450, 451, and labs including 302L, 310L, and 440. In addition, students must take 9 credits of elective microbiology courses from an approved list. Aspects of these courses emphasize communication skills, environmental issues, problem solving, and laboratory techniques. Courses in the following areas are required as supporting work: biology, chemistry, biochemistry, genetics, mathematics and physics. For additional details on the undergraduate curriculum in Microbiology see College of Agriculture, Curricula. Students are encouraged to participate in independent studies, internship opportunities, and international experiences.

Preveterinary preparation may be accomplished through the curriculum major in this program (see College of Veterinary Medicine, Admission Requirements).

The program offers a minor in microbiology which may be earned by accumulating a minimum of 15 credits of microbiology courses.

Graduate Study

The program offers work for the degrees master of science and doctor of philosophy in microbiology and for a minor for students majoring in other programs. The interdepartmental microbiology major is offered through faculty housed in twelve departments, including Agronomy; Animal Science; Biochemistry, Biophysics and Molecular Biology; Civil, Construction and Environmental Engineering; Entomology; Food Science and Human Nutrition; Genetics, Developmental and Cell Biology; Geological and Atmospheric Sciences; Plant Pathology; Veterinary Diagnostic and Production Animal Medicine; Veterinary Microbiology and Preventive Medicine; and Veterinary Pathology. Faculty coordinate graduate education and research in a wide range of topics fundamental to the discipline of microbiology. Specific information about individual faculty and their research areas is available at www.micro.iastate.edu.

Prerequisites to graduate study include a sound undergraduate background in chemistry, mathematics and biology, including microbiology and genetics.

All M.S. and Ph.D. students complete coursework that is comprised of one year of modular courses in microbiology (Micro 551, 552, 553, 554, 555, 556). Students also take at least 3 credits (M.S.) or 9 credits (Ph.D.) of coursework from an approved list of microbiology courses, one year of biochemistry (BBMB 404 and 405, or the equivalent), one course (0.5) credits in ethics (Micro 565A), and 3 credits (M.S.) or 5 credits (Ph.D.) of seminar (Micro 604).

Graduates in the Microbiology Graduate program have a broad-based knowledge in the fundamentals of microbiology as well as advanced knowledge in specific areas as determined by their areas of research focus. Students completing the thesis have the technical, research, critical-thinking, problem-solving, and computer skills to design, implement, and conduct research using a variety of current techniques and equipment. They are also able to communicate research results effectively with scientific peer groups in both oral and written formats.

Courses primarily for undergraduate students

Micro 110. Orientation in Microbiology. (1-0) Cr. 0.5. F. Orientation to the discipline of microbiology, the curriculum in microbiology, and educational research opportunities within the department. Satisfactory-fail only.

Micro 201. Introduction to Microbiology. (2-0) Cr. 2. F.S. *Prereq: One semester of college-level biology.* Selected topics in microbiology with emphasis on the relationship of microorganisms to human and animal health, agricultural technology, and the environment. With written petition to the chair of the supervisory committee, students who obtain a grade of B or better may substitute 201 for 302 in advanced courses.

Micro 201L. Introductory Microbiology Laboratory. (0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in 201 or 302.* Basic microbiology laboratory techniques for non-microbiology majors. Credit for either Micro 201L or 302L, but not both, may be applied toward graduation.

Micro 302. Biology of Microorganisms. (3-0) Cr. 3. F.S. *Prereq: Biol 211, credit or enrollment in Biol 212; 1 semester of chemistry.* Basic cell biology, physiology, metabolism, genetics and ecology of microorganisms, with an emphasis on procaryotes and viruses, as well as the roles of microorganisms in the environment, disease, agriculture, and industry.

Micro 302L. Microbiology Laboratory. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 302.* Basic microbiology laboratory techniques for majors in microbiology, biological sciences and related fields. Credit for either Micro 201L or 302L, but not both, may be applied toward graduation.

Micro 310. Medical Microbiology. (3-0) Cr. 3. F. *Prereq: 302 (or 201 if a B or better was obtained).* Study of infection and immunity by bacterial and viral pathogenic agents of humans. Nonmajor graduate credit.

Micro 310L. Medical Microbiology Laboratory. (0-3) Cr. 1. F. *Prereq: 201 or 302; 201L or 302L, credit or enrollment in 310.* Isolation and identification of human bacterial pathogens using basic staining techniques and biochemical tests. Brief introduction to techniques in cell culture and virology.

Micro 320. Microbial Physiology and Genetics. (4-0) Cr. 4. S. *Prereq: 302, Biol 313, credit or enrollment in Chem 332.* Introductory course in microbial physiology and genetics with special emphasis on prokaryotes. Topics include the structure, function, and assembly of cell components, bioenergetics, metabolic diversity, environmental stress tolerance, regulation of gene expression, genetic adaptation, and growth and cellular differentiation.

Micro 353. Introductory Parasitology. (Cross-listed with Biol). (3-3) Cr. 4. F. *Prereq: Biol 212.* Biology and host-parasite relationships of major groups of animal parasites, and techniques of diagnosing and studying parasites.

Micro 374. Insects and Our Health. (Cross-listed with Ent). (3-0) Cr. 3. S. *Prereq: 3 credits in biological sciences.* Bartholomay. Identification, biology, and significance of insects and arthropods that affect the health of humans and animals, particularly those that are vectors of disease. Nonmajor graduate credit.

Micro 374L. Insects and Our Health Laboratory. (Cross-listed with Ent). (0-3) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in Ent 374.* Bartholomay. Laboratory and field techniques for studying medical or public health entomology, including: collection, identification and maintenance of medically significant arthropods and experimental design and execution related to the biology of arthropods or arthropod-pathogen interactions.

Micro 381. Environmental Systems I: Introduction to Environmental Systems. (Cross-listed with Biol, EnSci, Env S). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including Biology and chemistry.* Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

Micro 402. Microbial Genetics. (Dual-listed with 502). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 302, Biol 313.* The fundamental concepts of bacterial and bacteriophage genetics including mutagenesis, mechanisms of both vertical and horizontal genetic information transfer, gene regulation, and genetic approaches to study complex cellular processes. Review and discussion of research literature to examine experimental design, methodology, and interpretation of both historical and contemporary relevance to microbial genetics.

Micro 407. Microbiological Safety of Foods of Animal Origins. (Dual-listed with 507). (Cross-listed with FS HN). (3-0) Cr. 3. S. *Prereq: 420.* Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

Micro 408. Virology. (Dual-listed with 508). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 313 or BBMB 301, Biol 314 recommended.* The molecular virology and epidemiology of human, animal, plant and insect viruses.

Micro 410. Insect-Virus Interactions: a Molecular Perspective. (Dual-listed with 510). (Cross-listed with Ent). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Permission of an instructor.* Bonning, Bartholomay. Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

Micro 419. Foodborne Hazards. (Cross-listed with FS HN, Tox). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Micro 201 or 302, a course in biochemistry.* Pathogenesis of human microbiological foodborne infections and intoxications, principles of toxicology, major classes of toxicants in the food supply, governmental regulation of foodborne hazards. Nonmajor graduate credit.

Micro 420. Food Microbiology. (Cross-listed with FS HN, Tox). (3-0) Cr. 3. F. *Prereq: 201 or 302.* Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications. Nonmajor graduate credit.

Micro 421. Food Microbiology Laboratory. (Cross-listed with FS HN). (0-6) Cr. 3. F. *Prereq: Micro 201 or 302; 201L. Credit or enrollment in Micro 420, FS HN 203.* Standard techniques used for the microbiological examination of foods. Independent and group projects on student-generated questions in food microbiology. Emphasis on oral and written communication and group interaction. Nonmajor graduate credit.

Micro 430. Procaryotic Diversity and Ecology. (Dual-listed with 530). (Cross-listed with BBMB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 302, 302L.* Survey of the diverse groups of procaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

Micro 440. Laboratory in Microbial Physiology, Diversity, and Genetics. (Cross-listed with BBMB). (1-7) Cr. 3. F. *Prereq: 302, 302L, Chem 332, Biol 313L.* Study of the fundamental techniques and theory of studying the diversity of microbial life. Experimental techniques will include isolation and physiological characterization of bacteria that inhabit different environments. Also included are techniques for the phylogenetic characterization, and genetic manipulation of diverse species of bacteria.

Micro 450. Undergraduate Seminar. Cr. 1. S. *Prereq: Sp Cm 212 and senior standing in Microbiology.* Required of all undergraduate majors in microbiology. Discussion of current papers in microbiology and immunology, issues in scientific conduct, and bioethics in microbiology. Students present current papers in a journal club format.

Micro 451. Senior Survey in Microbiology. Cr. R. F. *Prereq: Junior or Senior standing in Microbiology.* Preparations for graduation. Topics include job search strategies, career information, mock interviews, graduate and professional school application processes and guidelines as well as outcomes assessment activities.

Micro 456. Principles of Mycology. (Cross-listed with Biol). (2-3) Cr. 3. F. *Prereq: 10 credits in biological sciences.* Morphology, diversity, and ecology of fungi; their relation to agriculture, industry, and human health. Nonmajor graduate credit.

Micro 475. Immunology. (Dual-listed with 575). (3-0) Cr. 3. S. *Prereq: 310.* An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either Micro 475 or V MPM 520, but not both, may be applied to graduation.

Micro 475L. Immunology Laboratory. (1-4) Cr. 1. S. *Prereq: Credit or enrollment in 475 or 575.* Techniques in primary culture and tumor cell growth, measures of lymphocyte function, and flow cytometry. Half semester course.

Micro 477. Bacterial-Plant Interactions. (Dual-listed with 577). (Cross-listed with Pl P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interaction with plants; covers symbiotic nitrogen fixation, plant pathogenesis, plant growth promotion, and biological control.

Micro 485. Soil and Environmental Microbiology. (Dual-listed with 585). (Cross-listed with Agron, EnSci). (2-3) Cr. 3. F. *Prereq: Agron 154 or EnSci 402, Micro 201 (Micro 302 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues. Nonmajor graduate credit.

Micro 487. Microbial Ecology. (Dual-listed with 587) (Cross-listed with Biol, EnSci). (3-0) Cr. 3. F. *Prereq: Six credits in biology and 6 credits in chemistry.* Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems. Nonmajor graduate credit.

Micro 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor.* **A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.**
H. Honors

Micro 495. Internship. Cr. arr. F.S. *Prereq: At least 6 credits of 300-level or above coursework in microbiology, approval of academic adviser.* Participation in the Cooperative Extension Intern Program or an equivalent work experience. Written report of activities required. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Micro 502. Microbial Genetics. (Dual-listed with 402). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 302, Biol 313.* The fundamental concepts of bacterial and bacteriophage genetics including mutagenesis, mechanisms of both vertical and horizontal genetic information transfer, gene regulation, and genetic approaches to study complex cellular processes. Review and discussion of research literature to examine experimental design, methodology, and interpretation of both historical and contemporary relevance to microbial genetics.

Micro 507. Microbiological Safety of Foods of Animal Origins. (Dual-listed with 407). (Cross-listed with FS HN). (3-0) Cr. 3. S. *Prereq: 420.* Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

Micro 508. Virology. (Dual-listed with 408). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 313 or BBMB 301, Biol 314 recommended.* The molecular virology and epidemiology of human, animal, plant, and insect viruses.

Micro 509. Plant Virology. (Cross-listed with Pl P). (2-6) Cr. 4. Alt. S., offered 2011. *Prereq: Pl P 408, Biol 454, BBMB 405, Chem 211.* Hill. Plant viruses and the diseases they cause. Emphasis on epidemiology and control. Structure, function, and biochemical-biophysical properties of plant viruses.

Micro 510. Insect-Virus Interactions: a Molecular Perspective. (Dual-listed with 410). (Cross-listed with Ent). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Permission of an instructor.* Bonning, Bartholomay. Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

Micro 530. Procaryotic Diversity and Ecology. (Dual-listed with 430). (Cross-listed with BBMB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 302, 302L.* Survey of the diverse groups of procaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

Micro 540. Livestock Immunogenetics. (Cross-listed with An S, V MPM). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: An S 561 or Micro 575 or V MPM 520.* Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

Micro 551. Microbial Diversity and Phylogeny. (1-0) Cr. 1. F. *Prereq: 302, Biol 313.* Comparisons among the three kingdoms of life (Bacterica, Archaea, and Eukarya). Topics will include metabolism, adaptation, methods of phylogenetic analysis, and comparative genomics.

Micro 552. Bacterial Molecular Genetics and Physiology. (1-0) Cr. 1. F. *Prereq: 302, Biol 313.* Review of the molecular genetics and physiology of model organisms.

Micro 553. Pathogenic Microorganisms. (1-0) Cr. 1. F. *Prereq: 302, Biol 313.* Review and contrast/comparison of common bacterial pathogens of plants and animals and their mechanisms of virulence, including toxins, protein secretion, host invasion and iron acquisition strategies. An overview of eukaryotic cell biology that is relevant to pathogenesis will also be included.

Micro 554. Virology. (1-0) Cr. 1. S. *Prereq: 302, Biol 313.* Review and contrast/comparison of insect, animal and plant viruses and bacteriophage. Growth dynamics, replication of model viruses, and the role of specific viruses in disease will also be included.

Micro 555. Fungal Biology. (1-0) Cr. 1. S. *Prereq: 302, Biol 313.* Review of the biology, reproduction, genetics, physiology, and diversity of yeast and other fungi.

Micro 556. Microbial Ecology and Environmental Monitoring. (1-0) Cr. 1. S. *Prereq: 302, Biol 313.* Examination of microorganisms in their natural habitats, including aquatic, terrestrial and extreme environments, community and biofilm development, microbe-microbe interactions, and current and traditional methods of microbial analysis in natural environments.

Micro 565. Professional Practice in the Life Sciences. (Cross-listed with Pl P, Agron, An S, BCB, Hort, V MPM). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.
A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

Micro 575. Immunology. (Dual-listed with 475). (Cross-listed with V MPM). (3-0) Cr. 3. S. *Prereq: 310.* An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either Micro 575 or V MPM 520, but not both, may be applied toward graduation.

Micro 577. Bacterial-Plant Interactions. (Dual-listed with 477). (Cross-listed with Pl P). (3-1) Cr. 3. Alt. S., offered 2010. *Prereq: 3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interaction with plants; covers symbiotic nitrogen fixation, plant pathogenesis, plant growth and biological control.

Micro 585. Soil and Environmental Microbiology. (Dual-listed with 485). (Cross-listed with Agron, EnSci). (2-3) Cr. 3. F. *Prereq: Agron 154 or 402, Micro 201 (Micro 302 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

Micro 586. Medical Bacteriology. (Cross-listed with V MPM). (4-0) Cr. 4. F. *Prereq: 310.* Bacteria associated with diseases of vertebrates, including virulence factors and interaction of host responses.

Micro 587. Microbial Ecology. (Dual-listed with 487). (Cross-listed with EEOB, EnSci). (3-0) Cr. 3. F. *Prereq: Six credits in biology and 6 credits in chemistry.* Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

Micro 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*

Courses for graduate students

Micro 604. Seminar. (1-0) Cr. 1. Repeatable. F.S. Course will expose students to the breadth of subdisciplines within microbiology, offer opportunities for direct interaction between the students and the faculty members within the Interdepartmental Microbiology Graduate Program, and promote interactions among the students within the program. Satisfactory-fail only.

Micro 608. Molecular Virology. (Cross-listed with V MPM, Pl P). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: BBMB 405 or GDCB 511.* C. Miller, Blitvich, A. Miller. Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

Micro 615. Molecular Immunology. (Cross-listed with BBMB, V MPM). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: BBMB 405 or 502.* Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signalling pathways leading to expression of genes that control and activate immune function.

Micro 625. Mechanisms of Bacterial Pathogenesis. (Cross-listed with V MPM). (4-0) Cr. 4. Alt. S., offered 2011. *Prereq: Credit in Biochemistry and Microbiology.* Review of current concepts in specific areas of microbial pathogenesis including the genetic basis for bacterial disease, genetic regulation and control of virulence factors and their mechanisms of action, and host-pathogen interactions at the cellular and molecular levels. The application of microbial genetics to understanding pathogenesis will be included.

Micro 626. Advanced Food Microbiology. (Cross-listed with FS HN, Tox). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: FS HN 420 or 421 or 504.* Topics of current interest in food microbiology, including new foodborne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials.

Micro 627. Rapid Methods in Food Microbiology. (Cross-listed with FS HN, Tox). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: FS HN 420 or 421 or 504.* Provides an overview of rapid microbial detection methods for use in foods. Topics include historical aspects of rapid microbial detection, basic categories of rapid tests (phenotypic, genotypic, whole cell, etc.), existing commercial test formats and kits, automation in testing, sample preparation and "next generation" testing formats now in development.

Micro 679. Light Microscopy. (Cross-listed with GDCB, EEOB). (2-9) Cr. 5. Alt. F., offered 2010. *Prereq: Permission of instructor.* Current theories encompassing light optics and their applications for specimen preservation, paraffin and resin sectioning, general staining, histochemistry, cytophotometry, immunocytochemistry, autoradiography, image digitization, processing and presentation, and digital macro- and micrography. Limit of 10 students.

Micro 680. Scanning Electron Microscopy. (Cross-listed with GDCB, EEOB). (2-9) Cr. 5. Alt. F., offered 2009. *Prereq: Permission of instructor.* Current theories encompassing scanning electron optics and their applications for high and low vacuum microscopy, specimen chemical and cryopreservation methods, x-ray microanalysis, backscattered and topographic imaging, image digitization, processing and presentation. Limit of 10 students.

Micro 681. Transmission Electron Microscopy. (Cross-listed with GDCB, EEOB). (2-9) Cr. 5. Alt. S., offered 2011. *Prereq: GDCB 679 and permission of instructor.* Current theories encompassing electron optics and their applications for chemical and physical specimen preservation, ultramicrotomy, general staining and cytochemistry, immunocytochemistry, autoradiography, negative staining and shadowing, x-ray microanalysis, image digitization, processing and presentation.

Micro 685. Advanced Soil Biochemistry. (Cross-listed with Agron, EnSci). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Agron 585.* Tabatabai. Chemistry of soil organic matter and biochemical transformations brought about by microorganisms and enzymes in soils.

Micro 690. Current Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Colloquia or advanced study of specific topics in a specialized field.
A. Microbiology
B. Immunology
C. Infectious Diseases

Micro 692. Molecular Biology of Plant-Pathogen Interactions. (Cross-listed with Pl P). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Pl P 506 or BBMB 405 or Gen 411 or Micro 402 or course in molecular biology.* Bogdanove, Whitham. Seminal and current research in molecular and physiological aspects of plant interactions with pathogens, including mechanisms of pathogenesis, host-pathogen recognition and host defense, with an emphasis on critical evaluation of primary literature. Students also complete an interinstitutional research proposal writing and peer review exercise.

Micro 697. Graduate Research Rotation. Cr. arr. Repeatable. F.S. Graduate research projects performed under the supervision of selected faculty members in the Interdepartmental Microbiology major.

Micro 698. Seminar in Molecular, Cellular, and Developmental Biology. (Cross-listed with MCDB, GDCB, BBMB, V MPM). (2-0) Cr. arr. Repeatable. F.S. Student and faculty presentations.

MICRO 699. Research. Cr. arr. Repeatable.

Military Science

www.public.iastate.edu/~armyrotc/

Lt. Col. John Soupene, Chair of Department

Professor: Soupene

Assistant Professor (Adjunct): Meyer

Instructors (Adjunct): Bower, Gledhill, Porter, Scott, Stephenson, Taylor, White

The Military Science Department does not offer an academic degree and is embedded within the College of Liberal Arts and Sciences as an interdisciplinary program. The mission of the department is derived directly from regulations governing Army Reserve Officers' Training Corps (AROTC), which are issued by the Army Cadet Command and Army Training and Doctrine Command and cannot be modifiable by this department.

Freshmen Year Learning Outcomes: The student will have a working knowledge of the following areas: The Role of the Army, Roles and Origins of the Army, Army Customs and Traditions, Branches (Jobs) in the Army and Military Operations and Tactics.

Sophomore Year Learning Outcomes: The student will have a working knowledge of the following areas: The Role of an Officer, Role of the Officer and Noncommissioned Officer, communications, code of conduct, first aid, principles of war and military operations and tactics.

Junior Year Learning Outcomes: The student will have a working knowledge of the following areas: Small Unit Training, Command and Staff Functions, Nuclear, Biological and Chemical Warfare, Law of War, Weapons, Human Behavior, Math Reasoning, Computer Science and Military Operations and Tactics.

Senior Year Learning Outcomes: The student will have a working knowledge of the following areas: Transition to Becoming an Officer, Military Justice, Intelligence and Electronic Warfare, Army Personnel Management, Army Logistics, Post and Installation Support and Military Operations and Tactics.

The mission of the Army Reserve Officers' Training Corps (AROTC) is to commission the future leaders of the United States Army. Since ROTC produces over 65 percent of the Army's Officer Corps, our task is one of the most important undertakings in the Army and our country today. We seek top quality college students. We train these potential leaders, assess their abilities, and challenge them with the highest standards of profession/professionalism. Those who successfully complete the program, receive a commission as a second lieutenant in the U.S. Army. A commission as an Army officer affords the opportunity to pursue a profession in one or several of the 300 different jobs held by Army officers. Students may request to serve as an officer in either the active army, or part time in the Army Reserve or National Guard. Regardless of the method of service, officers in today's Army can be proud to know that they are doing their share in the defense of the United States of America.

The ISU Military Science program is divided into two segments, the basic program and the advanced program. The basic program (courses numbered 101-290) is designed primarily for freshmen and sophomores. No military obligation is incurred by a person participating in the basic program. The basic program is designed to be informative and to acquaint students with the military as a profession. The basic program or an allowed substitute is a prerequisite for the advanced program. Financial assistance is available on a competitive basis.

Persons interested in Military Science should visit the department located on the second floor of the Armory (east side).

Basic Program

These courses are primarily for freshmen and sophomore students and, except for persons with prior military service and basic training graduates, are required for entry into the advanced program. No more than 10 credits in 100- and 200-level courses may be applied toward graduation. Each scholarship cadet in the Basic Program receives a monthly allowance (freshmen $300; sophomore $350) for up to 10 months. The curriculum is designed to train freshmen and sophomores in individual and team skills. It also helps the Professor of Military Science identify individual leader developmental needs.

Advanced Program

These courses are for students who have completed the basic program (or received equivalent credit) and are mandatory for potential commissioning upon contracting at the beginning of their junior year. Each cadet receives a monthly allowance (junior $450; senior $500) for up to 10 months. This stipend is given during the junior and senior years. These courses are primarily taught to academic juniors and seniors.

Successful completion normally obligates the student to military service on active or reserve duty. In addition to the advanced program of study, a student (cadet) will be expected to pass the Army Physical Fitness Test (precondition for commissioning) each semester and continually maintain military appearance standards in both personal grooming and uniform. Physical fitness training is regularly conducted outside of class and laboratory hours in a separate course, M S 150 "Army Physical Readiness". Students are encouraged to attend and participate in this class.

Professional Military Science Education (PME) coursework outside of the military science curriculum is also a precondition to commissioning. The PME component consists of Basic Academic proficiency standards. These standards are explained to prospective students as they consider enrollment in the advanced program. Army Uniforms will be worn at least once a week. The 300-level courses are designed to prepare cadets for the Leader Development and Assessment Course, which is a 32 day summer internship/training program where cadets are trained to Army standards, develop leadership skills, and have their officer potential evaluated. The 400-level courses are the final preparation for commissioning as a second lieutenant in the United States Army. Students must meet academic alignment criteria and receive basic program credit before entering the advanced program.

The College of Liberal Arts and Science offers a minor in Military Studies. Requirements for the minor include taking a minimum of 15 credits of ROTC instruction, which may be taken from one or a number of the ROTC programs. At least 6 credits must be in courses numbered 300 or above.

Courses primarily for undergraduate students

Basic Program

M S 101. Introduction to Military Science. (1-0) Cr. 1. F. *Prereq: Concurrent enrollment in M S 101L required.* Examines the role of a Cadet in the Army Reserve Officer Training Corps and a Lieutenant in the United States Army. The course explores a military culture whose ultimate success is determined by the character and proficiency of its' leaders. Instruction introduces students to the cultural heritage and history of the U.S. Army. Students will begin to understand the structure of the U.S. Army and how it functions as an organization and institution. The curriculum promotes the development of students' communication skills to enhance their ability to transmit ideas. The class examines how the Army's cultural values drive the development of leadership in the Officer Corps. Hands-on activities enable students to gain insight on the skills and abilities required of cadets and officers interacting with civilians and soldiers.

M S 101L. Basic Leadership Laboratory I. (0-2) Cr. 1. F. *Prereq: Concurrent enrollment in M S 101 required.* Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Students observe and participate in the rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. This concept provides a constant learning environment as they learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Marching, rifle firing, and tactical patrolling; students gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 102. Structure and Function of the U.S. Army. (1-0) Cr. 1. S. *Prereq: Concurrent enrollment in M S 102L required.* Instructs students on the fundamental skills and proficiencies required of Cadets in the Army Reserve Officer Training Corps and Officers in the United States Army. Allows students to explore the Army culture whose ultimate success is determined by the character and proficiency of its' leaders. Students will gain an insight to the effects of human behavior and communication on the function of the Army's basic unit structures. Special focus is given to the emphasis the Army puts on the development and character of the leader and how that affects the culture and operation of the Army as an institution. Students will develop an understanding of the role that morals and ethics play in becoming an Army Officer and leading American Soldiers. Introduction to basic officer/soldier skills will elucidate the complex role of the Officer in the modern Army.

M S 102L. Basic Leadership Laboratory II. (0-2) Cr. 1. S. *Prereq: Concurrent enrollment in M S 102 required.* Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. Provides a constant learning environment as they learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Students also learn various military tasks such as marching, rifle firing, and tactical patrolling; gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 150. Army Physical Readiness. (0-3) Cr. 1. Repeatable. F.S. *Prereq: None.* This lab is designed to use basic military skills and instruction to develop confidence, leadership, and physical fitness. The team approach is utilized in the instruction and application of Army physical fitness requirements. Students will learn various Army physical fitness techniques as well as how to conduct physical fitness sessions. Teaching locations include Lied Recreation Center, Beyer Hall, State Gym as well as around campus. Full participation in all events will be determined based on

students physical and medical eligibility. No more than 10 credits in MS 100 and 200- level courses may be applied toward graduation. Satisfactory-fail only.

M S 201. Principles of Leadership and Communication Skills. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in M S 201L required.* Explores the development of leadership and communication skills by understanding and studying the principles, traits, and dynamics of leadership and effective communication techniques. These include; leadership dimensions, human behavior, time management skills, stress management, values and ethics, decision making process, problem solving skills, team building exercises, communication techniques, briefing skills, delegating, nutrition, fitness, and counseling. Leadership assessment programs, role playing, active class participation, speeches, country briefs, and video clips are used to enhance and reinforce the instruction.

M S 201L. Basic Leadership Laboratory III. (0-2) Cr. 1. F. *Prereq: Concurrent enrollment in M S 201 required.* Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Students observe and participate in the rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. Learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Students also learn various military tasks such as marching, rifle firing, and tactical patrolling; gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 202. Map Reading and Land Navigation. (2-0) Cr. 2. S. *Prereq: Concurrent enrollment in M S 202L required.* Class focuses on the characteristics and features of the earth's land mass and how to apply different methods of conducting navigation on land. These methods include; by use of topographical maps, compasses, aerial photographs, military maps, symbols, and all their practical application. These navigation techniques are used in class in conjunction with patrolling techniques and squad movement exercises. Students will utilize verbal and non-verbal communication, communication techniques, and briefing techniques during this class. Students are also assigned to read one professional book from the Army Reading List and complete a written review of the book in the Army writing style.

M S 202L. Basic Leadership Laboratory IV. (0-2) Cr. 1. S. *Prereq: Concurrent enrollment in M S 202 required.* Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Students observe and participate in the rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. Learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Students also learn various military tasks such as marching, rifle firing, and tactical patrolling; gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 290. Independent Study: Basic Military Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the Chair of Military Science Department.* Investigation of an approved topic. Must result in a professional journal-worthy paper on ethics, current military issues, interpersonal communications, or leadership development. No more than 10 credits in MS 100- and 200-level courses may be applied toward graduation.

M S 301. Methods of Instructing Military Skills. (3-0) Cr. 3. F. *Prereq: Completion of the basic Military Science program, concurrent enrollment in MS 301L, and permission of the Chair of the Military Science Department.* Develops student's proficiency in analyzing, planning, and executing complex operations within a military organizational structure. Students are given situational opportunities and then measured on their leadership abilities through systematic feedback. Student's evaluations are based on sixteen leadership dimensions within the realms of values, attributes, skills, and actions. Students develop an understanding of human cultural heritage and history, as it pertains to the armed forces.

M S 301L. Advanced Leadership Laboratory I. (0-4) Cr. 1. F. *Prereq: Completion of the basic program, concurrent enrollment in MS 301 and permission of the Chair of the Military Science Department.* The lab compliments M S 301 by providing opportunities to practice the lessons from class. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs. Participating in the Water Survival test, Army Physical Fitness test and the Land Navigation test are required.

M S 302. Applied Leadership. (3-0) Cr. 3. S. *Prereq: Completion of the basic Military Science program, concurrent enrollment in MS 302L and permission of the Chair of the Military Science Department.* Prepares students to attend the Leadership Develop and Assessment Course at Fort Lewis, Washington in which they will be assigned specific and situational tasks to accomplish by providing purpose, motivation, and direction to fellow students across the nation. Students will learn how to identify sixteen leadership dimensions in the under classmen and provide specific feedback on their leadership behaviors. Students will develop their oral communication skills about the plans developed by the class, through small group presentation settings. Students will develop methods of studying human behavior.

M S 302L. Advanced Leadership Laboratory II. (0-4) Cr. 1. S. *Prereq: Completion of the basic program, concurrent enrollment in MS 302 and permission of the Chair of the Military Science Department.* The lab compliments M S 302 by providing opportunities to practice the lessons from class. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs. Participating in the Water Survial Test, Army Physical Fitness Test and the Land Navigation test required.

M S 310. Practicum: Advanced Military Skills. (0-3) Cr. 1. Repeatable. S. *Prereq: Permission of the Chair of the Military Science Department.* An annual 72-hour military field training exercise that requires weeks of planning, participation, plus senior ROTC cadet evaluation. Designed to prepare basic cadets for military field training and MS III cadets for the Leadership Development and Assessment Course, held during the summer at Fort Lewis, Washington. Actual military conditions are simulated; detailed instruction in weapons training and execution of a simulated Operation Order in accomplishing a specific military mission. Conducted as a weekend exercise at Camp Dodge (National Guard Facility). Satisfactory-fail only.

M S 401. Seminar: The Military Team. (3-0) Cr. 3. F. *Prereq: Completion of the basic program, concurrent enrollment in MS 401L and permission of the Chair of the Military Science Department.* Develops student proficiency in analyzing and evaluating leadership behaviors, such as values, attributes, skills, and actions. Students are given situational opportunities to assess leadership and provide feedback to other students placed in leadership roles. Students will be measured by their ability to both give and receive systematic and specific feedback on leadership behaviors. Students will develop their ability to communicate thoughts and ideas orally through small group presentations and group discussions. Students will supervise and evaluate the planning and execution of complex operations within a military organizational structure.

M S 401L. Advanced Leadership Laboratory III. (0-4) Cr. 1. F. *Prereq: Completion of the basic program, concurrent enrollment in MS 401 and permission of the Chair of the Military Science Department.* The lab compliments the instruction from class by demonstrating the indelible link between personal values and successful leadership. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs.

M S 402. Seminar: The Professional Military Officer. (3-0) Cr. 3. S. *Prereq: Completion of the basic program, concurrent enrollment in M S 402L and permission of the Chair of the Military Science Department.* Explores the dynamics of leading in the complex situations of current military operations in a contemporary world. Students will examine the differences in customs, courtesies and operational principles in the face of international terrorism. Students will also explore aspects of interaction with nongovernmental organizations, civilians and media in a war zone and foreign national governments. The course uses case studies, scenarios, and practical exercises, which prepare the student to face complex ethical and practical demands of leading soldiers within a multifaceted military organizational structure.

M S 402L. Advanced Leadership Laboratory IV. (0-4) Cr. 1. S. *Prereq: Completion of the basic program, concurrent enrollment in MS 402 and permission of the Chair of the Military Science Department.* The lab compliments the instruction from class by demonstrating the indelible link between personal values and successful leadership. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs.

M S 410. Practicum: Military Skills Leadership. (0-3) Cr. 1. S. *Prereq: Permission of the Chair of the Military Science Department.* An annual 72-hour military field training exercise that requires weeks of planning, participation, and ROTC cadre evaluation. Designed for the advanced ROTC cadet in preparation for being commissioned as officers in the U.S. Army. Actual military conditions are simulated; detailed instruction in weapons training and execution of a simulated operation order in accomplishing a specific military mission. Conducted as a weekend exercise at Camp Dodge (National Guard Facility). Satisfactory-fail only.

M S 490. Independent Study: Advanced Military Study. (1-0) Cr. 1. Repeatable. F.S.SS. *Prereq: M S 301, 302, 401 and 402 and permission of the Chair of the Military Science Department.* Investigation of an approved topic. Must result in a professional journal-worthy paper on ethics, current military issues, interpersonal communications, or leadership development.

Military Studies

(Interdepartmental Minor)

Advisory Committee: Lieutenant Colonel Soupene, Captain Waring, Colonel Cramp

The Military Studies program is designed for students interested in learning about military skills and careers. The mission of the Reserve Officers' Training Corps (ROTC) programs is threefold. First, students are developed mentally, morally, and physically in order to make them strong leaders. Second, a desire for development in mind and character is instilled in students so they may assume the highest responsibilities of command, citizenship, and government. Finally, students are imbued with the highest ideals of duty, honor, and

loyalty in order to graduate with a basic professional background and motivation toward their careers.

The Military Science, Naval Science and Air Force Aerospace departments accomplish this mission through detailed courses of instruction occurring throughout a typical student's college career. All academic courses offered by these departments focus on the development of professional military skills and their application. Each department offers courses unique to its branch of the military. Students in Army ROTC classes gain an appreciation for ground warfare and doctrine, while the Naval Science program develops basic seamanship skills such as navigation and marine propulsion. The Air Force Aerospace Studies curriculum familiarizes students with Air Force structure and doctrine. On a broader scale, all three departments offer courses promoting leadership and sound management practices that investigate the military's role in American domestic and foreign policy, and can be employed in any career path.

Military Science, Naval Science and Air Force Aerospace courses are offered in the interdepartmental Military Studies program in the following participating departments: Military Science, Naval Science and Air Force Aerospace.

Undergraduate Study

Undergraduate study in this program provides the student with an opportunity to develop a minor in Military Studies. The three Iowa State University ROTC programs offer over 64 credits of specialized coursework. The minor in Military Studies is open to any Iowa State University student.

Undergraduate students may minor in Military Studies by taking 15 credits of coursework from a combination of any of the three ROTC programs - regardless of whether or not a commission in the Armed Forces is tendered. At least 6 of the 15 credits must be in courses numbered 300 or above.

Courses primarily for undergraduate students

Air Force Aerospace Studies - See Air Force Aerospace Studies.

AFAS 141. Foundations of the United States Air Force.
AFAS 142. Foundations of the United States Air Force.
AFAS 241. The Evolution of Air and Space Power.
AFAS 242. The Evolution of Air and Space Power.
AFAS 341. Air Force Leadership Studies.
AFAS 342. Air Force Leadership Studies.
AFAS 441. National Security Affairs and Preparation for Active Duty.
AFAS 442. National Security Affairs and Preparation for Active Duty.

Military Science - See Military Science.

M S 101. Introduction to Military Science
M S 102. Structure and Function of the U.S. Army
M S 201. Principles of Leadership and Communication Skills
M S 202. Map Reading and Land Navigation
M S 301. Methods of Instructing Military Skills
M S 302. Applied Leadership
M S 401. Seminar: The Military Team.
M S 290. Independent Study: Basic Military Study
M S 490. Independent Study: Advanced Military Study

Naval Science - See Naval Science.

N S 111. Introduction to Naval Science
N S 212. Seapower and Maritime Affairs
N S 220. Leadership and Management
N S 230. Navigation
N S 320. Naval Ship Systems I
N S 321. Evolution of Warfare
N S 330. Naval Ship Systems II
N S 410. Naval Operations and Seamanship
N S 412. Leadership and Ethics
N S 421. Evolution of Amphibious Warfare

Molecular, Cellular, and Developmental Biology

www.mcdb.iastate.edu

(Interdepartmental Graduate Major)

Program Executive Committee: Jeff Beetham, Chair; F. C. Minion Associate Chair; W. A. Miller, and James Reecy

Participating Faculty: J. Beetham, Chair; Ambrosio, Linda Anderson, Lloyd Andreotti, Amy Bartholomay, Lyric Bassham, Diane Bhattacharyya, Madan Baum, Thomas Beattie, Gwyn Becraft, Phil Beitz, Donald Bellaire, Bryan Birt, Diane Blitvich, Bradley Bogdanove, Adam Bonning, Bryony Brehm-Stecher, Byron Coffman, Clark Dobbs, Drena Ellinwood, Matthew Essner, Jeffrey Ford, Clark Hannapel, David Henderson, Eric Huiatt, Ted Johansen, Jorgen Johansen, Kristen Jones, Doug Jurenka, Russell Kanthasamy, Anumantha Lee, Michael Link, Charles Macintosh, Gustavo Martin, Richard McGrail, Maura Miller, Cathy Miller, W. Allen Minion, F. Chris Myers, Alan Nikolau, Basil Nilsen-Hamilton, Marit Nolan, Lisa K. Ourednik, Jitka Ourednik, Vaclav Peters, Reuben Petersen, Christine Phillips, Greg Powell-Coffman, Jo Anne Reecy, Jim Robson, Richard Ross, Jason Rowling, Matthew Sakaguchi, Donald Selsby, Joshua Schalinske, Kevin Schnable, Patrick Shin, Yeon-Kyun Shogren-Knaak, Michael Singh, Ravindra Spalding, Martin Tabatabai, Louisa Thornburg, Robert Tuggle, Christopher Vollbrecht, Erik Wang, Kan Whitham, Steve Wurtele, Eve Yang, Bing Yin, Yanhai Yu, Edward Zabotina, Olga Zhang, Qijing

Undergraduate Study

A special program in molecular, cellular, and developmental biology is not offered for the baccalaureate. Undergraduates wishing to prepare for graduate study in molecular, cellular, and developmental biology should elect courses in biochemistry, biology, genetics, microbiology; and mathematics through calculus; chemistry through organic; and one year of physics. Biol 313, 313L, 314, and 314L are recommended to undergraduates desiring an introduction to this area.

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in molecular, cellular, and developmental biology in several cooperating departments: Agronomy; Animal Science; Biochemistry, Biophysics & Molecular Biology; Biomedical Sciences; Entomology; Food Science and Human Nutrition; Genetics, Development and Cell Biology; Horticulture; Physics & Astronomy; Plant Pathology; Veterinary Microbiology & Preventive Medicine; Veterinary Pathology. Facilities and qualified faculty are available in these departments for conducting fundamental research in the various aspects of molecular, cellular, and developmental biology. Ongoing research projects include molecular and cellular studies of viral, prokaryotic, plant, and animal systems.

Students may enter the MCDB major in one of two ways: they may apply to and be accepted into the major directly or they may formally apply to the major after being accepted by a participating department. Students admitted into MCDB will take MCDB 697 (Graduate Research Rotations) in their first two semesters and choose a major professor from the participating faculty by the end of their second semester. Students admitted by a department will choose a major professor from the participating faculty in that department. All Ph.D. students take a core curriculum consisting of the following courses: Molecular biology (MCDB 511, 520, or 545 or Micro 502 or MCDB 676 or V MPM 608). In seminar, students will make journal and research presentations and attend MCDB seminars. M.S. students take the above core but may delete either the molecular genetics, cell biology, or developmental biology component. Additional coursework is selected to meet departmental requirements and to satisfy individual student research interests. All graduate students are required to teach as part of their training for an advanced degree.

Students minoring in molecular, cellular, and developmental biology at the Ph.D. level must meet the following requirements: one year of biochemistry (BBMB 404, 405, or BBMB 501, 502; one course in each of two of the above three areas molecular biology (MCDB 511, 520, or 545 or Micro 502 or MCDB 676 or V MPM 608).

Courses primarily for graduate students

MCDB 511. Molecular Genetics. (Cross-listed with GDCB). (3-0) Cr. 3. S. *Prereq: Biol 313 and BBMB 405.* The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes.

MCDB 512. Plant Growth and Development. (Cross-listed with GDCB, PlBio). (2-0) Cr. 2. S. *Prereq: Biol 330 or a course in developmental biology; GDCB 545 or BBMB 404, 405 or GDCB 520.* Plant growth and development and its molecular genetic regulation. Hormone biosynthesis, metabolism, and action. Signal transduction in plants.

MCDB 520. Genetic Engineering. (Cross-listed with GDCB, BBMB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Gen 411 or BBMB 405.* Strategies and methods of gene cloning, restriction endonuclease mapping, southern hybridization, isolation and manipulation of plasmid DNA, and detection of specific genes in bacteria.

MCDB 528. Cellular Growth and Regulation. (Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Courses in cell biology and BBMB 404, 405.* Cell cycle, regulation of cell growth, cell division, membranes, transport processes, and regulation of cellular activities.

MCDB 529. Plant Cell Biology. (Cross-listed with GDCB). (2-0) Cr. 2. F. *Prereq: Biol 313, 314, 330 or BBMB 405.* Organization, function, and development of plant cells and subcellular structures.

MCDB 533. Principles of Developmental Biology. (Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 314.* Fundamental principles in multicellular development. Emphasis on cellular and molecular regulation of developmental processes, and experimental approaches as illustrated in classical studies and current literature.

MCDB 545. Plant Molecular Biology. (Cross-listed with GDCB, PlBio). (3-0) Cr. 3. F. *Prereq: Biol 314, 330.* Organization and function of plant nuclear and organelle DNA; regulation of gene expression. Methods of generating novel genetic variation. Impact of plant biotechnology on agriculture.

MCDB 590. Special Topics. Cr. arr. Repeatable.

MCDB 640. Signal Transduction. (Cross-listed with GDCB, BBMB). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: GDCB 528, BBMB 404.* Mechanisms and components of cellular signal transduction including receptors, G-proteins, second messengers, protein phosphorylation, other post-translational protein modifications, and transcriptional regulation.

MCDB 676. Biochemistry of Gene Expression in Eucaryotes. (Cross-listed with BBMB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: BBMB 404 or 501, 405 or 502 or GDCB 511.* Analysis of the biochemical processes involved in expression of eucaryotic genes and the regulation thereof, including RNA polymerase, transcriptional regulatory proteins, enhancers and silencers, chromosome structure, termination, RNA processing, RNA transport, RNA turnover, translational regulation, protein turnover.

MCDB 697. Graduate Research Rotation. Cr. arr. Repeatable. F.S. Graduate research projects performed under the supervision of selected faculty members in the molecular, cellular, and developmental biology program.

MCDB 698. Seminar in Molecular, Cellular, and Developmental Biology. (Cross-listed with BBMB, GDCB, Micro, V MPM). (2-0) Cr. arr. Repeatable. F.S. Student and faculty presentations.

MCDB 699. Research. Cr. arr. Repeatable.

Music

www.music.iastate.edu

Michael Golemo, Chair of Department

Distinguished Professor (Emeritus): White

University Professor: David

Professors: Cox, Darlington, Prater, Rodde, Simonson, Stuart, Work, Zeigler

Professors (Emeritus): Bleyle, Brandt, Burkhalter, Drexler, Haug, Messenger, Molison, Swift, Vongrabow

Professor (Adjunct): Estes

Associate Professors: Bovinette, Creswell, Golemo, Larkin, Munsen, Schilling, Sturm, Sunderman, Tam

Associate Professors (Emeritus): Alcorn, Bjurstrom

Assistant Professors: Baker, Giles, Hopkins, Oakes

Assistant Professor (Emeritus): Waggoner

Assistant Professors (Adjunct): Bryden, Trenberth

Instructor (Collaborator): Foss

Senior Lecturers: Rodde, Smith, Tener

Lecturers: Conklin, Dell, Duckett, Foss, Giles, Grunmann, Heffernan, Kortenkamp, Lin, Schumacher, Steele, Zwick-Tapley

Undergraduate Study

The Department of Music offers a strong undergraduate music program, where students study with full-time faculty professionals in a supportive environment that encourages students to become their best.

The curriculum of the music department provides:

1. A comprehensive program of professional studies for students who wish to prepare for careers in music, including teaching, performance, and composition, and for students who plan to pursue graduate studies in music.

2. Courses in music literature, theory and areas of performance for all students, regardless of major.

The department embodies the land-grant philosophy of service to the people of the state with a faculty of active scholars, teachers, and artists committed to excellence in teaching, creative/scholarly work, and arts outreach. The department is an accredited institutional member of the National Association of Schools of Music (NASM).

The Theatre Program is administered by the Department of Music (see *Index, Theatre Courses*.)

Minor in Music. Candidates for the minor in music will complete 19 credits in music including:
a. 221 and 231
b. two of the following: 102, 120 or 302, 304, 383
c. four credits chosen from the following ensembles and applied music: 111, 113, 115, 141, 151, 161, 181, 321, 118, 318, 290F

At least 6 of the 19 credits must be in courses numbered 300 and above taken at ISU with a grade of C or better. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

Students pursuing a music minor must meet the audition requirements and/or prerequisites for all courses they wish to take.

Minor in Music Technology. Candidates for the minor in music technology will complete 15 credits including:
a. eight credits: Music Technology Core—Music 246 (2 cr.), 346 (3 cr.), 446 (3 cr.)
b. seven credits from the following technology and music electives: Com S 107, 207, 208, 227, 228, 229, 309; Cpr E 329; E E 201, 224, 324, 424; M E 451; Phys 198; S E 319; Music 101 or 105, 102, 118, 120 or 302, 221, 222, 231, 232, 304, 318, 331, 332, 337, 338, 383, 384, 472, 490I, 593I.

Music majors may use the following music courses toward the music technology minor: 246, 346, 446, 490I, 590I.

Bachelor of Music students may not count Phys 198 in the Music Technology minor.

At least six of the fifteen credits must be taken at Iowa State University in courses numbered 300 or above with a grade of C or higher. The minor must include at least nine credits not used to meet any other department, college, or university requirement. Students pursuing a minor in music technology must meet the audition requirements and/or prerequisites for all music courses they wish to take.

Curricula Available to Music Majors

Students interested in pursuing an emphasis in music theater should see Index, Theater and Performing Arts.

Bachelor of Music

This curriculum leads to the degree bachelor of music. This degree is more specialized and contains fewer general education requirements than the bachelor of arts degree with a major in music. Students in this curriculum choose between options in education, performance, and composition. To obtain a bachelor of music degree, a student must earn a minimum of 124.5-146 credits (depending on the option chosen) including a minimum of 32 credits in residence at Iowa State University and a minimum of 45 advanced credits in courses numbered 300 or above and must meet all of the requirements specified below.

Courses taken on a pass/not pass basis may be counted toward the required total credits, and may be used to meet the advanced credit requirement, if appropriate, but may not be used to satisfy any other graduation requirement.

Cr. Degree Requirements

32 General Education Requirements
(Students choosing the music education option should consult their advisers regarding general education requirements)
- 6 Social sciences
- 6 Humanities
- 6 Music 383, 384
- 3 Phys 198
- 6 Mathematical, physical, and biological sciences
- 5 Electives

6.5-14.5 Other Requirements
- 6 Engl 150, 250 (average grade C- or better required)
- 0.5 Library 160
- 0-8 World language (one)

47 Music core
- 22 Music 120, 221, 222, 231, 232, 331, 332, 337, 338, 361
- 12 Music 119, 219, 319, 419
- 3 One of the following: Music 471, 472, 473, 475, 476
- 3 One of the following: Music 440, 446
- 7 Ensembles
- R 420

31-52.5 Area of concentration
(select one of the following options)

51.5-52.5 Music education - See Teacher Education Section of this catalog.

52.5 Vocal K-12 option
Music 248, 266, 327, 358A, 360, 362A, 366, 367, 417K, 417L, 465, 466, 480K (3.5 cr.); one of the following: Music 301 (3 cr.), Thtre 354, 355, 359; C I 204, 406, 426; Sp Ed 450

51.5-52.5 Instrumental K-12 option
Music 248, 266, 350, 351, 352, 353, 354, 355, 358B, 362B, 366, 368 or 490A (String pedagogy), 464, 466, 417K, 417L, 480K (3.5 cr.); C I 204, 406, 426; Sp Ed 450

31 Voice
- 2 Music 327
- 2 Music 119B, 119C, or 119K
- 8 Music 319A, 419A
- 6 Music 324, 325, 360
- 3 Music 440, or 446
- 2 Music 415A
- 8 Second world language

31 Piano
- 12 Music 119, 219, 319, 419
- 5 Music 321
- 5 Music 415B
- 2 Music 327
- 3 Music 440 or 446
- 4 Electives

31 Organ
- 4 Music 119B, 219B
- 8 Music 319C, 419C
- 5 Music 415C
- 3 Music 471, 472, 473, 475, or 476
- 3 Music 440, or 446
- 8 Second world language

31 String instruments
- 12 Music 119, 219, 319, 419
- 6 Music 181, 321
- 3 Music 440 or 446
- 4 Music 415D
- 6 Electives

31 Wind or percussion instrument
- 12 Music 119, 219, 319, 419
- 1-3 Music 351-352 or 353-354 or 355
- 3 Music 321
- 3 Music 440 or 446
- 4 Music 415
- 6-8 Electives

31 Composition
- 4 Music 290C
- 12 Music 490C
- 2 Music 246
- 4 Music 362A, 362B
- 6 From: Music 346, 440, 446, 490B, 490I
- 3 Electives

124.5-146 Total credits

Bachelor of Arts—Music Major

A more general degree than the bachelor of music, the bachelor of arts degree requires no formal specialization. It includes more general education requirements and provides a broader course of academic study.

For the undergraduate curriculum in Liberal Arts and Sciences, major in music, leading to the degree bachelor of arts, see Liberal Arts and Sciences, Curriculum.

Candidates for the degree bachelor of arts with a music major will normally complete 48 credits of music including the following required courses: 119, 120, 219, 221, 222, 231, 232, 319, 331, 332, 337, 338, 383, 384, 4 credits from: 111, 113, 115, 141, 151, 161, 181, 321.

Bachelor of arts students whose chief professional interest lies in research are encouraged to minor in world languages and cultures, history, literature, or philosophy.

General Requirements

Prior to being accepted as a music major, students are required to audition for applied faculty in their performance area (piano, organ, woodwinds, strings, percussion, brass, or voice), and must successfully demonstrate performance skills appropriate for college level instruction. Once accepted, a student must complete a placement examination in keyboard skills. This examination will be given by members of the departmental faculty during summer orientation, the week preceding the opening of classes for fall semester, or by appointment.

Seminars and Recitals. All music majors enrolled for applied music courses will attend a weekly 1-hour seminar in their areas and departmental recitals each semester.

Ensemble Requirement. All bachelor of music students must register for an ensemble course (111, 115, 141, 151, 161, 181, 113, 301, 321) each semester of full-time enrollment (except during student teaching). Students in a music education option must register for six semesters of large ensemble (111, 115, 141, 151, 161, 181) and one semester of chamber music ensemble (113, 161, 301, 321). Instrumental music education students may count one semester of 114A as a large ensemble. All full-time Bachelor of Music students in options other than music education must include among their ensembles at least two semesters of large ensemble (111, 115, 141, 151, 161, 181) and one semester of chamber ensemble (113, 161, 301, 321).

Continuation Examination. To be approved for continuation as a music major on the junior level, a student must pass a continuation examination taken normally at the end of the fourth semester. Before taking this examination, the student must fill out the requisite forms as well as write an essay including: (1) his/her personal goals, (2) a self-assessment of his/her progress thus far, and (3) an assessment of what he/she expects to accomplish before graduation.

The student taking the Continuation Examination performs for a Continuation Examination Committee. Requirements include the performance of three works representing different periods or styles selected by and studied with the applied teacher, a self-prepared piece, and sight reading. The student must display acceptable solo ability and performance techniques in at least one of the applied areas. A written evaluation will be given each student following his/her performance. This evaluation will include a candid assessment of the student's potential to achieve his/her goals.

In addition, the student may arrange to meet with members of the Continuation Examination Committee at a later date to discuss the results of his/her Continuation Examination.

All music majors must demonstrate proficiency in piano as a part of the continuation examination. Proficiency will normally be demonstrated by completing Music 228 or, for keyboard majors, by completing Music 327. The student must pass all parts of the continuation examination in order to enroll in Music 319 or 419, Applied Music. Details and forms available at: www.music.iastate.edu.

Graduation Proficiency. To be recommended for graduation, a music student should demonstrate to the music faculty mature acquaintance with performance styles, technique, and repertoire. All music majors will participate in departmental recitals to the satisfaction of the department. Candidates for the bachelor of music degree will present a graduation recital.

Communication Proficiency requirement: The department requires a grade of C– or better in each of Engl 150 and 250 (or 250H). In addition the Communication Proficiency must be certified through one of the following options:

1. Certification of writing skills, by the instructor, after completion of Music 120, 383, 384, 472, 473, or 475. (Passing one of these courses does not automatically satisfy the requirements for Communication Proficiency.)

2. Satisfactory completion of an advanced writing course (e.g., English 302, 305, or 314.)

Learning Outcomes and Assessment
Music graduates will understand and demonstrate: (1) Knowledge of music cultural heritage and history, (2) Appreciation for musical creativity, reasoning, and the aesthetic value of music, (3) Knowledge of organization and structures of music, (4) Analytical skills necessary for listening, performing, and teaching, (5) Skills necessary to perform music from a variety of periods, styles, and genres, (6) Necessary abilities to communicate ideas musically, verbally, and in writing, (7) Awareness of the diversity of musical ideas throughout the world's cultures, and (8) For Music Education students: success in meeting the ISU Teaching Standards as outlined by the University Teacher Education Program. Assessment measures include the continuation examination, graduating senior surveys and exit interviews, public performances, senior projects, course grades, teacher certification (for music education students), and the National Association of Schools of Music accreditation review.

Courses primarily for undergraduate students

Music 101. Fundamentals of Music. (1-2) Cr. 2. F.S. *Prereq: Ability to read elementary musical notation.* Notation, recognition, execution and analysis of scales, intervals, triads, and rhythm; key signatures; time signatures; transposition. Open to non-majors only.

Music 102. Introduction to Music Listening. (3-0) Cr. 3. F.S.SS. Expansion of the music listening experiences for the general student through greater awareness of differences in techniques of listening, performance media, and materials of the art. The course focuses on the elements of music: rhythm, melody, harmony, form, and style, and how these elements are used in musics of different cultures and time periods. Ability to read or perform music not required.

Music 105. Basic Musicianship. (1-4) Cr. 3. S. *Prereq: Performing arts major classification.* Beginning keyboard techniques, sight-reading, and ear training. Basic materials of music: notation, scales, intervals, key signatures, time signatures, rhythm, and harmony.

Music 111. Wind Ensemble. (0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Emphasis on significant extended compositions for wind and percussion instruments. Performances include formal concerts on campus and the annual tour.

Music 112. Concert Band. (0-2) Cr. 1. Repeatable. F.S. *Prereq: Open to all students who have performed on a wind or percussion instrument in high school band or orchestra.* Repertoire includes the broad spectrum of band music. Two concerts are presented each semester.

Music 113. Jazz Ensemble. (0-2) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Designed to explore various styles and trends in contemporary jazz.

Music 114. Marching and Pep Bands. (0-5) Cr. 1. Repeatable.
A. Marching Band.
F. Membership determined by audition and band application. Auditions held for woodwind, brass, percussion, flag, and twirler positions. Presentation of pre-game and half time shows at each home football game; additional performances are also scheduled on and off campus. Audition information is listed on the band website (www.music.iastate.edu/org/marching).
B. Pep Band.
S. Prereq: Students selected by audition from current members of 114A. Performances at basketball games.

Music 115. Symphonic Band. (0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Stresses high quality wind literature. Performances include formal concerts on campus.

Music 118. Applied Music: Non-majors. (0.5-0) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor.* (.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 119. Applied Music: Majors. (0.5-2) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor; restricted to music majors.* (.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 120. Introduction to Music Literature and Styles. (3-0) Cr. 3. S. *Prereq: 221.* Directed studies via aural analysis for music majors with emphasis on the materials of music, form and aesthetic issues. Introduction to style and literature of the major performance media in context of historical chronology. Fundamentals of score reading and performance terminology. Only one of Music 120 and 302 can count toward graduation.

Music 127. Class Study in Piano I. (0-2) Cr. 1. F.S. *Prereq: 101 or audition, and permission of instructor.* Beginning keyboard technique, transposition, harmonization, ensemble and solo repertory, and sight-reading skills.

Music 128. Class Study in Piano II. (0-2) Cr. 1. F.S. *Prereq: 127 or audition, and permission of instructor.* Continuation of beginning keyboard technique, transposition, harmonization, ensemble and solo repertory, and sight-reading skills.

Music 131. Vocal Jazz Ensemble: "Off the Record". (0-2) Cr. 1. Repeatable. *Prereq: Open by audition and permission of instructor; concurrent enrollment in one of the following: 141, 151, 161.* Small mixed chorus specializing in advanced vocal jazz techniques. Performances on and off campus.

Music 133. Basic Voice Techniques. (0-2) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.* Class study in voice. Techniques of vocal production: respiration, phonation, resonation, articulation, and performance.

Music 141. Lyrica Women's Choir. (0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all female students by audition.* Large chorus; emphasis on fundamental vocal and choral skills, wide variety of literature. Campus concerts each semester.

Music 151. Oratorio Chorus. (0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Advanced skills required, high quality literature. Campus concerts each semester, some concerts in conjunction with orchestras. Men's and women's choirs separately and in combination.
A. Cantamus Women's Choir
B. Statesmen Men's Choir

Music 161. Iowa State Singers. (0-5) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Concert choir specializing in performance of advanced music literature, Renaissance through contemporary. Campus concerts, annual spring tour.

Music 181. Symphony Orchestra. (0-4) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Reading, preparation, and performance of standard repertoire. Five or six concerts annually plus occasional off-campus appearances.

Music 219. Applied Music: Majors. (0.5-2) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor; restricted to music majors.* (.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 221. Introduction to Music Theory. (3-0) Cr. 3. F. *Prereq: Music major status or permission of instructor; concurrent enrollment in 222 recommended.* Fluent identification and application of the elements of music and music notation. The study of two-voice species counterpoint as an introduction to voice-leading principles in common practice period music.

Music 222. Introduction to Aural Theory and Music Technology. (0-4) Cr. 2. F. *Prereq: Music major status or permission of instructor; concurrent enrollment in 221 recommended.* Aural discrimination of musical elements and patterns as demonstrated by proficiency in ear training, sight singing, and related musicianship skills. Introduction to technological equipment and software used in the study of music.

Music 227. Class Study in Piano III. (0-2) Cr. 1. F.S. *Prereq: 128 or audition and permission of instructor.* Intermediate keyboard technique, transposition, harmonization, improvisation, repertory, and sight-reading skills. Introduction to score reading, hymn playing, and accompanying at the piano.

Music 228. Class Study in Piano IV. (0-2) Cr. 1. F.S. *Prereq: 227 or audition and permission of instructor.* Continuation of intermediate keyboard technique, transposition, harmonization, improvisation, repertory, score reading, hymn playing, and accompanying at the piano.

Music 231. Materials of Music I. (3-0) Cr. 3. S. *Prereq: 221.* Harmonic, melodic, and rhythmic materials of the common practice period. Application of these materials in analysis and writing. Techniques of melodic construction, formal design, and harmonization.

Music 232. Aural Theory I. (0-3) Cr. 1. S. *Prereq: 222.* Development of sight singing, ear training, and related musical skills with emphasis on melodic, harmonic and rhythmic materials from the common practice period.

Music 246. Introduction to Music Technology. (2-0) Cr. 2. F.S. *Prereq: 101, 105, or 221, or permission of instructor.* Introduction to audio and MIDI in music and media applications, fundamentals of digital audio editing and mixing, software-based musical arrangements and composition.

Music 248. Technology in Music Instruction. (2-0) Cr. 2. S. *Prereq: 221 and 222.* Introduction to computer software applications used in musical arrangements and presentations, practical introduction to audio and MIDI technologies in lab-based music instruction, basic recording/sound reinforcement and music website management. Intended for Music Education Majors

Music 265. Music in Elementary Education. (3-0) Cr. 3. F.S. *Prereq: HD FS 226 or Psych 230.* Experiencing and understanding the fundamentals of music through singing, playing classroom instruments, body movement, reading notation, listening, and creative activities. Developing lesson plan strategies and sequence, exploring multicultural musics, integrating music with other subjects in the elementary classroom, and evaluating aspects of musical learning.

Music 266. Introduction to Music Education. (1-2) Cr. 2. F. *Prereq: Concurrent enrollment (.5 cr.) in 480K.* Required for second-year majors in music education. Historical, philosophical, and social foundations of music education; music curricula overview including goals of the music program, and contemporary and international curriculum development; psychology of teaching music including discipline techniques. Preparation for required observations in area schools.

Music 290. Special Problems. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor; 12 credits in music, approval of department head.*
A. Education
B. Theory
C. Composition
D. History
E. Literature
F. Applied Music
G. Conducting
H. Honors

Music 301. Opera Studio. Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Study of selected opera scenes, chamber operas, and works from contemporary and classical music theater. Basic stagecraft, role interpretation, production.
A. Opera/Operetta
B. Music Theater

Music 302. The History of Music in Western Culture. (3-0) Cr. 3. S. *Prereq: 102.* Study of the evolution of music styles through history with emphasis on listening. Primarily European music with some non-Western music providing a global perspective. Individual composer's unique approaches to timbre, texture, rhythm and melody. General trends in the progress of style and form. Concert reports and papers in addition to examinations. Ability to read music recommended, but not required. Open to non-majors only. Only one of Music 120 and 302 can count toward graduation.

Music 304. History of Rock 'n' Roll. (3-0) Cr. 3. S. *Prereq: 101, 102, 221, or 222.* Rock 'n' Roll from the mid 1950s through the 1990s, focusing on the development of rock styles from its roots in blues, folk, country, and pop. Expansion of listening experience through study of song forms, musical instruments of rock, and the socio-political significance of song lyrics. Examinations, research paper or in class presentation required. Ability to read or perform music not required.

Music 318. Applied Music: Non-majors. (0.5-0) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor.* (.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 319. Applied Music: Majors. (0.5-2) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor; restricted to music majors.* (.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 321. Advanced Ensemble. (0-3) Cr. 1. Repeatable. F.S. *Prereq: Advanced proficiency and performing ability, permission of instructor.* Performance in ensembles that demand high proficiency. Open to a limited number of undergraduate and graduate students.
A. Voice
B. Piano
C. Organ
D. Strings
E. Musica Antiqua
F. Woodwinds
G. Brass
I. Percussion
J. Mixed

Music 324. English and Italian Diction for Singing. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: Credit or enrollment in 118A or 119A.* The international phonetic alphabet and its application to correct pronunciation of English and Italian in singing.

Music 325. French and German Diction for Singing. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Credit or enrollment in 118A or 119A.* The international phonetic alphabet and its application to correct pronunciation of French and German in singing.

Music 327. Functional Piano. (0-3) Cr. 2. S. *Prereq: 228 or audition and permission of instructor.* Emphasis on sight reading, three and four-part score reading, improvisation, accompanying, and advanced harmonization.
A. Keyboard majors.
B. Vocal/choral majors.

Music 331. Materials of Music II. (3-0) Cr. 3. F. *Prereq: 231.* Harmonic, melodic, and rhythmic materials of the common practice period. Application of these materials in analysis and writing. Techniques of melodic construction, formal design, and harmonization.

Music 332. Aural Theory II. (0-2) Cr. 1. F. *Prereq: 232.* Development of sight singing, ear training, and related musical skills with emphasis on melodic, harmonic and rhythmic materials from the eighteenth and nineteenth centuries.

Music 337. Materials of Music III. (3-0) Cr. 3. S. *Prereq: 331.* Writing and analysis based on musical styles since 1900.

Music 338. Aural Theory III. (0-2) Cr. 1. S. *Prereq: 332.* Development of sight singing, ear training, and related musical skills with emphasis on melodic, harmonic and rhythmic materials from the nineteenth and twentieth centuries.

Music 346. MIDI and Digital Audio Techniques. (3-0) Cr. 3. S. *Prereq: 246 or permission of instructor.* MIDI theory and programming applications, sampling/synthesis control, digital signal processing techniques. Composition projects using integrated audio/MIDI sequencing applications. Nonmajor graduate credit.

Music 350. Instrumental Techniques: Strings. (0-2) Cr. 1. F. *Prereq: Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

Music 351. Instrumental Techniques: Clarinet, Flute, Saxophone. (1-2) Cr. 2. S. *Prereq: Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

Music 352. Instrumental Techniques: Oboe, Bassoon. (0-2) Cr. 1. F. *Prereq: 351 or permission of instructor. Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

Music 353. Instrumental Techniques: Trumpet, Horn. (0-2) Cr. 1. S. *Prereq: Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

Music 354. Instrumental Techniques: Trombone, Baritone, Tuba. (0-2) Cr. 1. F. *Prereq: 353 or permission of instructor. Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

Music 355. Instrumental Techniques: Percussion. (0-2) Cr. 1. S. *Prereq: Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required to teach percussion instruments in the schools. Techniques for performing and teaching snare drum, keyboard percussion instruments, timpani, band and orchestral hand instruments, drum set, and Latin percussion. Intended for instrumental music education students.

Music 356. Instrument Maintenance and Repair. (0-2) Cr. 1. *Prereq: Permission of instructor. Limited to music majors.* Techniques and skills required for basic maintenance and repair of wind and percussion instruments. Examination of commercial repair methods and facilities. Intended for instrumental music education students.

Music 358. Lab Ensemble. Cr. R. Repeatable. Review and selection of appropriate literature for ensembles of differing levels and abilities; conducting and rehearsal experience.
A. Choral. F., Alt. S., offered 2009. Sight singing, conducting, and accompanying experience in conjunction with 362
A. Required of all vocal music education majors in every semester offered.
B. Instrumental. F. S. Performance on secondary instruments. Includes experiences with singing and vocal techniques. Required of all instrumental music education majors in those semesters when enrolled in 350, 351, 352, 353, 354, 355, or 362B.

Music 360. Voice Pedagogy. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 319A or vocal proficiency examination.* Physical, acoustical, and musical properties of the vocal instrument, including a survey of important texts and articles on singing and voice production.

Music 361. Conducting I. (1-2) Cr. 2. F. *Prereq: 231, 232.* Introduction to conducting; score reading and analysis. Conveying musical ideas through appropriate gestures. Leadership role of the conductor.

Music 362. Conducting II. (1-2) Cr. 2.
A. Choral techniques. Alt. S., offered 2011. Prereq: Concurrent enrollment in 358A and 141, 151, or 161. Advanced baton technique, score preparation and interpretation of choral repertoire.
B. Instrumental techniques. S. Prereq: Concurrent enrollment in 358B. Advanced baton technique. Score preparation. Specific problems of large instrumental ensembles.

Music 366. Methods of Music Education. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 480K and Sp Ed 450; 266 and admission into teacher education..* Music education strategies and materials including development of appropriate objectives and plans for general music classes utilizing traditional and multicultural musics, evaluating musical learning; overview of Orff Schulwerk, Kodaly, and Dalcroze approaches; music in special education; required teaching in lab settings and observations in area schools.

Music 367. Choral Literature. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 361 recommended.* Overview of choral repertoire from the sixteenth century to the present, including accessible works for the young conductor.

Music 368. Marching Band and Jazz Ensemble Techniques. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Credit or enrollment in 362B recommended.* Techniques and materials for teaching marching band in the high school; philosophy, computer assisted drill design, music analysis, band set up, and other related skills. Jazz style, articulation, phrasing, materials and teaching techniques for secondary school jazz ensembles.

Music 383. History of Music I. (3-0) Cr. 3. F. *Prereq: 120.* History of the stylistic and cultural development of music: Middle Ages through Baroque.

Music 384. History of Music II. (3-0) Cr. 3. S. *Prereq: 383.* History of the stylistic and cultural development of music: Classical through contemporary music.

Music 415. Literature and Pedagogy in Applied Music. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Includes experience in technology relative to the particular discipline.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
J. Jazz Pedagogy and Performance

Music 417. Student Teaching. (Cross-listed with C I). Cr. arr. F.S. *Prereq: Admission to teacher education, approval of coordinator during semester before student teaching.* Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.
K. Music - Secondary
L. Music - Elementary

Music 419. Applied Music: Majors. (0.5-2) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor; restricted to music majors.* (.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 420. Junior/Senior Recital. Cr. R. Repeatable. F.S.SS. *Prereq: Advanced performing ability, permission of instructor, concurrent registration in Music 319 or 419..* Performance of advanced repertory in a public concert. Preparation of program notes. Satisfactory-fail only.

Music 440. Seminar in Music Theory. (3-0) Cr. 3. Repeatable. S. *Prereq: 337, 338.* Various topics in music theory including analysis, counterpoint, arranging, pedagogy, and psychology of music. Content will vary. Contact the Department of Music for the current year offering. Nonmajor graduate credit.

Music 446. Electronic Music Synthesis. (3-0) Cr. 3. F. *Prereq: 246 or permission of instructor.* Techniques of digital sound synthesis, software synthesizer design, and electronic music composition. Nonmajor graduate credit.

Music 464. Instrumental Administration, Materials, and Methods. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Credit or enrollment in 362B recommended.* Instructional materials and methods appropriate for teaching instrumental music in elementary, middle school, and high school music programs. Required observations in area schools. Intended for instrumental music education students.

Music 465. Choral Materials and Methods. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 358A and 141, 151, or 161.* Instructional materials and methods appropriate for teaching choral music in the secondary school. Emphasis on pedagogy and rehearsal techniques. Required observations in area schools. Intended for vocal music education students.

Music 466. Program Development and Evaluation in Music Education. (2-1) Cr. 2. F. *Prereq: Continuation Examination passed; 362, 366, concurrent enrollment (1 cr.) in 480K..* Developing a rationale for music education; music program development; evaluation of music curricula, programs and facilities; professional growth of the teacher; preparation for student teaching and the job market. Required observations in area schools.

Music 471. The Tones of Florence - A Study of Humanism. Cr. 3. SS. *Prereq: Application through the Study Abroad Program; interview with instructor; sophomore classification.* A survey of the masterpieces of music, literature, painting, sculpture, architecture, mathematics and theology that made Florence the major European center of humanism in the Renaissance.

Music 472. History of American Music. (3-0) Cr. 3. *Prereq: Ability to read music; 9 credits from music, American literature, American history, art history.* Offered F. 2010. History and development of the sacred and secular music in North America from approximately 1600 to the present, exploring the diverse cultural backgrounds that have contributed to the variety of contemporary musical styles. Nonmajor graduate credit.

Music 473. Music of the Baroque and Classical Eras. (3-0) Cr. 3. *Prereq: 383, 384.* Detailed survey of instrumental, vocal, choral, and keyboard music from 1600 to 1825. Nonmajor graduate credit.

Music 475. Music of the Romantic Era. (3-0) Cr. 3. *Prereq: 383, 384.* Offered F. 2009. Detailed survey of instrumental, vocal, choral, and keyboard music from 1825 to 1910. Nonmajor graduate credit.

Music 476. Music of the Twentieth Century. (3-0) Cr. 3. *Prereq: 383, 384.* Offered S. 2010. Detailed survey of instrumental, vocal, choral, and keyboard music from 1900 to the present. Nonmajor graduate credit.

Music 480. Field Experience for Secondary Teaching Preparation. (Cross-listed with C I). Cr. arr. Repeatable. F.S. *Prereq: Permission of area coordinator required prior to enrollment.* Observation and participation in a variety of school settings after admission to the teacher preparation program. (S/F grading may be used in some offerings of some sections.)
K. Music

Music 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor; 12 credits in music, approval of department head.*
A. Education (Same as C I 490A)
B. Theory
C. Composition
D. History
E. Literature
F. Applied Music
G. Conducting
H. Honors
I. Electronic Music

Courses primarily for graduate students, open to qualified undergraduate students

Music 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor, approval of department head.*
A. Education
B. Theory
C. Composition
D. History
E. Literature
F. Applied Music
G. Conducting
I. Electronic Music

Music 593. Workshops. Cr. arr. Repeatable.
A. Foundations of Music Learning
B. Music in Early Childhood
C. Junior High School Music Programs
D. Instrumental Teaching Techniques
E. Research in Music Education
F. Vocal/Choral Teaching Techniques
G. General & Contemporary Music Methodologies
I. Music and Technology

Natural Resource Ecology and Management

Richard Hall, Interim Chair of Department

University Professors (Emeritus): Atchison, Hinz, McNabb

Professors: Colletti, Hall, Harrington, Jungst, Payne, Schultz

Professors (Emeritus): M. Bachmann, R. Bachmann, Best, Countryman, J. Dinsmore, Hart, Klaas, Manwiller, Menzel, Moorman, Prestemon, Summerfelt, Wray

Professors (Collaborators): Brandle, Burger, Engle, Isebrands, Otis

Associate Professors: Asbjornsen, S. Dinsmore, Fairbanks, Isenhart, Kuo, Morris, Rule, Thompson

Associate Professors (Emeritus): Pease

Associate Professors (Collaborators): Deutsch, Guntenspergen, Manson, Palik, Rickenbach, Tomer

Assistant Professors: Blanchong, Kim, Quist, Randall, Schulte, Stewart, Tyndall

Assistant Professors (Adjunct): Harris, McMullen, Merrick, Pritchard, Roe

Assistant Professors (Collaborators): Koford, Kolka, Miller, Negreros-Castillo, Pierce, Thogmartin, Westphal

Senior Lecturer: Stokke, Wiersema

Lecturer: O'Brien

The department addresses a broad spectrum of natural resource and environmental issues in a holistic approach to learning, discovery and engagement. Our vision of natural resources is that informed protection and management of natural resources involves an integration of biological, economic, and social considerations. Such an integrated and comprehensive approach to the education of future generations of natural resource managers and scientists is needed in order to sustain viable landscapes, facilitate strong communities, and produce desired goods, services, and functions from our natural resources.

Our educational mission for the undergraduate and graduate programs is to provide those learning experiences and opportunities that will ensure students can learn to function effectively in their chosen fields.

Central to that effective functioning are the abilities to:

Identify, explain and critically evaluate their own beliefs, values and actions in relation to professional and societal standards of ethics.

Anticipate, analyze and evaluate natural resource issues and opportunities, explaining the ecological, economic, and social consequences of natural resource actions at various scales and over time.

Actively seek the input and perspectives of diverse stakeholders regarding natural resource problems and issues.

Assess, analyze, synthesize, and evaluate information fairly and objectively.

Work effectively, both individually and with others, on complex, value-laden natural resource problems that require holistic problem solving approaches.

Formulate and evaluate alternative solutions to complex problems and recommend and defend best alternatives.

Communicate clearly and effectively with all audiences using appropriate oral, visual, electronic, and written techniques.

Recognize and interpret resource problems and opportunities across spatial scales from local to global.

Appreciate cultural diversity and understand the impact of the global distribution of people and wealth on natural resource use and valuation.

Exercise leadership skills as professionals and engaged citizens.

Demonstrate creativity and innovation in identifying and pursuing opportunities that produce environmental, social, or economic value.

Exercise life-long learning skills developed before graduation.

Undergraduate Study

The Department of Natural Resource Ecology and Management offers work for the bachelor of science degree with majors in animal ecology or forestry (see College of Agriculture and Life Sciences, Curricula). The department participates in interdisciplinary programs in biology, environmental studies, international studies, and pest management. By proper selection of free and restricted elective courses, students can obtain a minor or a second major in these programs or other disciplines.

The Department provides numerous scholarships; application information is available in the departmental Student Services Center.

Animal Ecology (A Ecl)

The animal ecology curriculum provides its majors with an understanding of ecological principles and processes and their applications to natural resource management. It is oriented toward students desiring a general and flexible program in environmental biology and for those planning graduate study. Students may select from five options: Aquatic Sciences, Fisheries, Interpretation of Natural Resources, Preveterinary and Wildlife Care, or Wildlife. Graduates find employment as aquaculturists, aquatic ecologists, wildlife biologists, fisheries biologists, resource managers, and ecologists for industry, environmental consulting firms, natural resource and environmental agencies and organizations, zoos, and as educators.

Graduates of the Animal Ecology major understand the basic principles of animal biology, ecology and management, and relevant aspects of scientific communication, basic mathematics and sciences, computing applications, and personal and professional development. Five specific options prepare students for careers in aquatic sciences, fisheries, wildlife, interpretation of natural resources, wildlife care and veterinary sciences. Each option has specific outcomes expectations that include (1) the scope of the specialization and its relationships to broader aspects of animal ecology, biotic resource management, and other allied scientific disciplines and professions, (2) career opportunities and requirements, and (3) knowledge and skills appropriate for employment at technical and practitioner levels in each discipline. Graduates are able to communicate and work effectively in the multidisciplinary arena of ecology and natural resource management.

All options require three months of relevant work experience or study at a biological station prior to graduation. The latter may be accomplished at the university's affiliate field stations: Iowa Lakeside Laboratory at West Lake Okoboji, and Gulf Coast Research Laboratory at Ocean Springs, Mississippi. Information on these laboratories is available from the department's Student Services Center.

Preveterinary medicine preparation may be achieved while satisfying degree requirements in animal ecology.

Additional education and training can lead to other opportunities in such areas as research and management, natural resources planning and administration, teaching, and environmental consulting, among others. Graduate training is necessary for many specialized positions within the fields of animal ecology. Majors preparing for graduate study should consult with their academic adviser concerning appropriate coursework.

Students seeking certification to teach biology in secondary schools must meet requirements of the College of Human Sciences as well as those of the Animal Ecology curriculum. In addition, they must apply formally for admission to the teacher education program (see Index, Teacher Education Program). Students with an interest in careers in outdoor writing are encouraged to obtain a minor or a second major in journalism (see Index, Journalism and Communication, Courses and Programs). Students who wish to pursue a job as a conservation officer may wish to minor in criminal justice (see Index, Criminal Justice Studies).

The department offers a minor in animal ecology that may be earned by taking 15 credits in the department including 312, 365, NREM 120, plus four additional credits of Animal Ecology courses at the 300 level or above.

Forestry (For)

The forestry curriculum offers courses dealing with the management of forest ecosystems for multiple benefits including wood and fiber products, biodiversity, recreation, water, wilderness, and wildlife. Conservation and preservation of natural resources are emphasized. The department offers work for the bachelor of science degree with a major in forestry and options in forest ecosystem management, interpretation of natural resources, urban and community forestry, natural resource conservation and restoration, or sustainable materials science and technology. All options lead to a professional degree in

forestry (Bachelor of Science). The forestry major has been accredited by the Society of American Foresters (SAF) since 1935. The Council for Higher Education Accreditation recognizes SAF as the specialized accrediting body for forestry education in the United States. The primary goal of the undergraduate curriculum in forestry is to educate foresters to be capable of scientifically managing the nation's forest lands and related ecosystems - private and public.

Graduates understand and can apply scientific principles associated with forests, forest ecosystem management, and wood and non-wood products. Graduates are able to communicate effectively and work well in teams. They are capable of preparing and delivering effective oral and written communication of scientific and technical decisions to professional and lay audiences. They are proficient in technical skills such as measurements, computer usage, inventory, economic analysis, data and situation analysis, and ecosystem assessment. They recognize the importance of ethics in forestry and are sensitive to cultural diversity and broad environmental concerns.

Graduates of the forest ecosystem management option are skilled at understanding how forests function and how forests can be managed to produce desired goods (wood, fiber, recreation, wildlife habitat) and services (clean water, carbon sequestration, wilderness) in the long-run. They are skilled at interpretation of interactions and effects of abiotic and biotic factors in forests and quantification of bio-physical, social, and economic outputs from forest ecosystems. They are skilled at complex decision-making involving private and public forest resources where ethical, legal, social, economic, and ecological dimensions are explicitly considered.

Graduates of the interpretation of natural resources option are skilled at communicating with the public about the values associated with forest ecosystems and providing educational programs for all ages.

Graduates of the urban and community forestry option are able to combine biological, social, legal, and economic expertise to effectively manage trees or forests in an urban setting. They are skilled at decision-making related to site assessment, and long-term management of urban trees and forests to achieve multiple goals.

Graduates of the natural resource conservation and restoration option are skilled at assessing the natural functions of the environment and human impacts. They are skilled at interpretation of forest and other natural environments and making decisions relating to their conservation and preservation.

Graduates of the sustainable materials science and technology option understand the anatomical, physical, and chemical properties of wood and other bio-renewable materials and know wood processing operations involved in drying, composite materials manufacturing, and chemical treatment.

Elective courses related to the forest ecosystem management option can be selected to emphasize forest ecology; wildlife, wilderness, and recreation management; water quality and erosion protection; quantitative-analytical techniques; business and marketing; and other areas related to natural resource management. Elective courses in the urban and community forestry option can be selected to emphasize plant health, policy and planning, ecology, hydrology, sociology, business administration, or horticulture/design. Elective courses related to the natural resource conservation and restoration option can be selected to emphasize, ecology, wildlife, recreation, nature interpretation, landscape design, sociology and ethics of conservation and preservation. Similarly, elective courses in the sustainable materials science and technology option can be selected to emphasize wood production, bio-renewable materials, wood fiber, business and marketing, and quality assurance. Elective courses in the interpretation of natural resources option can be selected to emphasize natural history, animal ecology, and environmental education.

Many private firms as well as national, regional, state, and local agencies seek forestry graduates to fill positions in management of natural resources for commodity and non-commodity multiple benefits. Graduates in forestry are prepared to be involved with evolving forestry systems, such as agroforestry and urban forestry. Wood processing industries, such as composite products, plywood, particle board, lumber, and pulp and paper offer professional opportunities in production, product development, quality control, and marketing.

With advanced graduate study, the range of professional job opportunities for a person with a B.S. in forestry is expanded. Opportunities include research and education as well as more specialized managerial and administrative positions with private firms and public agencies.

During fall semester of the second year of study (sophomore year, typically), forestry students are required to enroll in the department's integrated forestry modules consisting of 201, 202, 203, 204, 205, and 206. That semester, consisting entirely of forestry coursework, is designed to give students an early understanding of the many aspects of forestry and how they are interrelated. In addition to work in the classroom, students will spend time in laboratory and field work each week. A 3-week off-campus fall camp during the semester will reinforce concepts learned both in the classroom and during laboratory/field sessions. Transfer students should check with the department for counsel on timing their completion of the integrated forestry modules.

The department offers a minor in forestry which can be earned by completion of a minimum of 15 credits in forestry courses. Students wishing to emphasize management and environmental aspects of forestry must select at least 15 credits from the following courses: 302, 356, 451, NREM 120, 301, 345, 390, 407, and 472. Students wishing to emphasize wood products and wood utilization must complete 280 and an additional 12 credits from the following courses: 480, 481, 483, 485, 486, 487, and 490B.

Graduate Study

The Department of Natural Resource Ecology and Management offers work for the degrees master of science and doctor of philosophy with majors in fisheries biology, forestry, and wildlife ecology. A non-thesis masters degree is available for students desiring a general degree program without thesis research. Students may also major in interdepartmental graduate majors in biorenewable resources technology, ecology and evolutionary biology, environmental science, genetics, plant physiology, sustainable agriculture, or toxicology (see Index). All students are required to teach and conduct research as part of their training for the Ph.D. degree.

Fisheries Biology and Wildlife Ecology

Graduates have a broad understanding of the basic principles of animal biology, ecology and management, and relevant aspects of basic mathematics and natural sciences, computing applications, and personal and professional development. They are able to execute rigorous independent research, have developed problem-solving and critical-thinking skills, and can communicate effectively with scientific colleagues and the general public in both formal and informal settings.

Personnel of the U.S. Geological Survey's Iowa Cooperative Fish and Wildlife Research Unit contribute significantly to the graduate program of the department through teaching and research. Governmental agencies such as the U.S. Fish and Wildlife Service, Natural Resources Conservation Service and the Iowa Department of Natural Resources, and non-governmental agencies such as The Nature Conservancy and the Iowa Natural Heritage Foundation also contribute to the graduate program by funding research, providing in-kind support, and providing numerous formal and informal mentoring relationships.

No more than two dual-listed animal ecology courses may be applied for major graduate credit. Additional work is expected of students taking a dual-listed course for credit at the 500 level.

Forestry

The department offers programs leading to the degrees of master of science and doctor of philosophy with a major in forestry and minor work to students taking major work in other departments.

Graduates are skilled at defining a research problem in forestry, applying scientific principles and appropriate methods, and analyzing the results. They are capable of understanding the many facets of forest and wood science and are very knowledgeable in specific areas in forestry. They are able to deal with complex forestry problems, and where appropriate, they are capable of blending ecological, social, ethical, legal, and economic factors in the research process. They are very skilled at communicating, both in written and oral form, research results to professional and lay audiences. They are sensitive to cultural diversity and work effectively with peers, natural resource professionals, and the public.

The graduate program is open to, and suitable for, students who have majored in forestry or related natural resource fields. A non-thesis master's option is available.

The department participates in the Masters in Business Administration (M.B.A.), with specialization in the agriculture program administered by the College of Business, providing an opportunity to obtain an M.B.A. degree while taking advanced courses in forestry and maintaining contact with the profession of forestry.

Animal Ecology (A Ecl)

Courses primarily for undergraduate students

A Ecl 312. Ecology. (Cross-listed with Biol, EnSci). (3-3) Cr. 4. F.SS. *Prereq: Biol 211L and 212L.* Fundamental concepts and principles of ecology dealing with organisms, populations, communities and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats.

A Ecl 312l. Ecology. (Cross-listed with Ia LL, EnSci). Cr. 4. SS. An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

A Ecl 321. Fish Biology. (2-3) Cr. 3. S. *Prereq: 365.* Biology, ecology, and evolution of fishes. Emphasis on structure, physiology, and behavior, including a focus on the conservation and management of fishes and their habitats. Laboratory focus on fish morphology, survey methods, identification, distribution, habits, and habitats of fishes.

A Ecl 326l. Ornithology. (Cross-listed with Ia LL). Cr. 4. SS. The biology, ecology, and behavior of birds with emphasis on field studies of local avifauna. Group projects stress techniques of population analysis and methodology for population studies.

A Ecl 365. Vertebrate Biology. (Cross-listed with Biol). (3-2) Cr. 4. F. *Prereq: Biol 212, 212L.* Evolution, biology, and classification of fish, amphibians, reptiles, birds, and mammals. Emphasis on a comparative analysis of the structure and function of organ systems. Laboratory exercises concentrate on morphology and identification of orders of vertebrates.

A Ecl 366. Natural History of Iowa Vertebrates. (2-3) Cr. 3. S. *Prereq: Biol 211, 211L, 212, 212L.* Vertebrate fauna of Iowa, including fishes, amphibians, reptiles, birds, and mammals. Species identification, habitat requirements, community structure and assessment, conservation issues that include historical population changes and value of wild animals to the region's ecological and economic health.

A Ecl 371. Ecological Methods. (Cross-listed with Biol). (2-2) Cr. 3. F. *Prereq: 312; Stat 101 or 104.* Quantitative techniques used in management of natural resources with emphasis on inventory and manipulation of habitat and animal populations. Nonmajor graduate credit.

A Ecl 401. Introductory Aquatic Animal Health and Medicine. (Cross-listed with B M S). (1-2) Cr. 1. S. 8 weeks. Introductory course with focus on fin fish production, health and medicine. Course content will help define future roles for veterinarians, producers, and service providers. Emphasis will be placed on anatomy, pathology, infectious diseases, nutrition, regulatory constraints in production, food safety, and current research. Field trip to aquaculture facility.

A Ecl 404l. Behavioral Ecology. (Cross-listed with Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: Two semesters of biology.* Animal coloniality, courtship, territoriality, predator defense, habitat selection, foraging, mating systems, and parental care will be examined in the field in order to evaluate various ecological and evolutionary theories of animal behavior.

A Ecl 418. Stream Ecology. (Dual-listed with 518). (Cross-listed with EnSci). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 486.* Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

A Ecl 419l. Vertebrate Ecology and Evolution. (Cross-listed with Ia LL). Cr. 4. SS. Field and laboratory study of representative vertebrates of northwestern Iowa. Observations and experimentation emphasize ecological histories by integrating concepts of functional morphology, behavioral ecology, and evolutionary biology. Nonmajor graduate credit.

A Ecl 420l. Amphibians and Reptiles. (Cross-listed with Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: Two semesters of biology.* Ecology, behavior, and conservation biology of amphibians and reptiles with emphasis on their anatomy and morphology; temperature and water regulation; locomotion; life history; reproduction; population and community ecology; and conservation.

A Ecl 425. Aquatic Insects. (Dual-listed with 525). (Cross-listed with Ent). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312 or equivalent.* Courtney. Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

A Ecl 440. Fishery Management. (Dual-listed with 540). (2-3) Cr. 3. F. *Prereq: 312, 321, Stat 101 or 104; credit or enrollment in 441 and 486.* Biological basis of fishery management, fishery problems, and management practices for freshwater, anadromous, and marine fisheries.

A Ecl 441. Fisheries Techniques. (Dual-listed with 541). (2-3) Cr. 3. F. *Prereq: 321 and Stat 104.* Overview of field, laboratory, and analytical techniques associated with managing fisheries and aquatic resources. Specific topics include sampling design, fish and habitat sampling techniques, structural indices, age and growth, and biotelemetry.

A Ecl 442. Aquaculture. (Dual-listed with 542). (2-3) Cr. 3. Alt. S., offered 2010. *Prereq: 486, credit or enrollment in 321.* Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetics, diseases, and marketing.

A Ecl 451. Wildlife Ecology and Management. (2-3) Cr. 3. F. *Prereq: 371.* Ecological theory and practice of wildlife management, including, population ecology, habitat management, and current issues in the field. Course involves a series of case studies addressing actual wildlife issues using field and quantitative methods. Nonmajor graduate credit.

A Ecl 455. International Wildlife Issues. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 365, 312 or graduate standing; NREM 120.* Biological, political, social, and economic factors affecting the management of international wildlife resources. Nonmajor graduate credit.

A Ecl 457. Herpetology. (Dual-listed with 557). (Cross-listed with Biol). (2-3) Cr. 3. F. *Prereq: A Ecl 365 or Biol 351.* Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodilians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

A Ecl 458. Ornithology. (Dual-listed with 558). (Cross-listed with Biol). (2-3) Cr. 3. S. *Prereq: A Ecl 365 or Biol 351.* Biology, evolution, ecology and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation. Laboratory exercises complement lecture topics, emphasize identification and distribution of Midwest birds, and include field trips.

A Ecl 459. Mammalogy. (Dual-listed with 559). (Cross-listed with Biol). (2-3) Cr. 3. S. *Prereq: Biol 351 or A Ecl 365.* Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. Laboratory focus on identification, distribution, habits, and habitats of mammals.

A Ecl 480. Studies in Marine Biology. Cr. arr. Repeatable. SS. Courses taken at Gulf Coast Research Laboratory and other marine biological stations are transferred to Iowa State University under this number.

A Ecl 486. Aquatic Ecology. (Cross-listed with Biol, EnSci). (3-0) Cr. 3. F. *Prereq: Biol 312 or EnSci 381 or EnSci 402 or NREM 301.* Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology. Nonmajor graduate credit.

A Ecl 486L. Aquatic Ecology Laboratory. (Cross-listed with Biol, EnSci). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in 486.* Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

A Ecl 515. Ecology of Freshwater Invertebrates, Plants, and Algae. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 312.* Identification, biology, and ecological requirements of freshwater invertebrates, plants and algae. Additional emphases on community sampling methods and analysis, and use of organisms as tools for aquatic ecosystem health assessment.

A Ecl 516. Avian Ecology. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 365, 312, or graduate standing.* Current topics and theories including avian breeding and foraging ecology, population biology, community structure, habitat selection, field methodologies, and data interpretation.

A Ecl 518. Stream Ecology. (Dual-listed with 418). (Cross-listed with EnSci). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 486.* Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

A Ecl 520. Fisheries Science. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 312, 321.* Concepts, approaches, and techniques for assessment of recreational and commercial fisheries. Scope will range from individual fish to entire ecosystems, both freshwater and marine.

A Ecl 523l. Fish Ecology. (Cross-listed with Ia LL). Cr. 4. Alt. SS., offered 2010. Basic principles of fish interaction with the biotic and abiotic environment. Field methods, taxonomy, and biology of fish with emphasis on the fish fauna of northwestern Iowa.

A Ecl 525. Aquatic Insects. (Dual-listed with 425). (Cross-listed with Ent). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312 or equivalent.* Courtney. Morphology, ecology, diversity and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

A Ecl 526l. Advanced Field Ornithology. (Cross-listed with Ia LL). Cr. 2. SS. *Prereq: Concurrent registration in Ia LL 326l.* Field study of birds of the upper Midwest; extended field trip to Minnesota and Wisconsin; individual or group project.

A Ecl 531. Conservation Biology. (Cross-listed with EEOB). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 312; Biol 313 or graduate standing.* Examination of conservation issues from a population and a community perspective. Population-level analysis will focus on the role of genetics, demography, and environment in determining population viability. Community perspectives will focus on topics such as habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology.

A Ecl 531l. Conservation Biology. (Cross-listed with Ia LL, EEOB). Cr. 4. Alt. SS., offered 2010. *Prereq: Ia LL 312l.* Population-and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

A Ecl 535l. Restoration Ecology. (Cross-listed with Ia LL, EEOB, EnSci). Cr. 4. Alt. SS., offered 2010. *Prereq: A course in ecology.* Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

A Ecl 540. Fishery Management. (Dual-listed with 440). (2-3) Cr. 3. F. *Prereq: 312, 321; credit or enrollment in 541 and Biol 586; Stat 401.* Biological basis of fishery management, fishery problems, and practices for management of freshwater, anadromous, and marine fisheries.

A Ecl 541. Fisheries Techniques. (Dual-listed with 441). (2-3) Cr. 3. F. *Prereq: 321 and Stat 104.* Overview of field, laboratory, and analytical techniques associated with managing fisheries and aquatic resources. Specific topics include sampling design, fish and habitat sampling techniques, structural indices, age and growth, and biotelemetry.

A Ecl 542. Aquaculture. (Dual-listed with 442). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 485, credit or enrollment in 321.* Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetic, diseases, and marketing.

A Ecl 551. Wildlife Behavioral Ecology. (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: a course in ecology or animal behavior.* The study of how an animal's behavior affects its ability to survive and reproduce in its environment. Topics represent the interface of ecology, evolution, and behavior. Wildlife defined broadly.

A Ecl 557. Herpetology. (Dual-listed with 457). (Cross-listed with EEOB). (2-3) Cr. 3. F. *Prereq: A Ecl 365 or Biol 351.* Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodilians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

A Ecl 558. Ornithology. (Dual-listed with 458). (Cross-listed with EEOB). (2-3) Cr. 3. S. *Prereq: A Ecl 365 or Biol 351.* Biology, evolution, ecology and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation. Laboratory exercises complement lecture topics, emphasize identification and distribution of Midwest birds, and include field trips.

A Ecl 559. Mammalogy. (Dual-listed with 459). (Cross-listed with EEOB). (2-3) Cr. 3. S. *Prereq: Biol 351 or A Ecl 365.* Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. Laboratory focus on identification, distribution, habits, and habitats of mammals.

A Ecl 570. Landscape Ecology. (Cross-listed with EEOB). (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: Permission of instructor; EEOB 588; a course in calculus.* The study of ecological and evolutionary processes within a spatial context with emphasis on behavior, population, and community dynamics.

A Ecl 573. Techniques for Biology Teaching. (Cross-listed with Ia LL, EEOB). Cr. arr. Repeatable. SS. The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.
A. Animal Biology (Same as Ia LL 573A)
G. Limnology (Same as Ia LL 573G)
H. Animal Behavior (Same as Ia LL 573H)
W. Project WET (Same as Ia LL 573W)

A Ecl 589. Population Ecology. (Cross-listed with EEOB). (2-2) Cr. 3. F. *Prereq: Biol 312, Stat 101 or 104, a course in calculus, or graduate standing.* Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

A Ecl 590I. Graduate Independent Study. (Cross-listed with Ia LL, EEOB, Anthr). Cr. arr. Repeatable. SS. *Prereq: Graduate classification and permission of instructor.*

A Ecl 599. Creative Component. Cr. arr. *Prereq: Nonthesis M.S. option only.*

Courses primarily for graduate students

A Ecl 600. Seminar. (2-0) Cr. 1. Repeatable. F.S. Current topics in ecological research, fish and wildlife management, and environmental problems related to fish or wildlife resources.

A Ecl 611. Analysis of Populations. (Cross-listed with EEOB). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: Biol 312; Stat 401; a course in calculus.* Quantitative techniques for analyzing vertebrate population data to estimate parameters such as density and survival. Emphasis on statistical inference and computing.

A Ecl 698. Animal Ecology Teaching Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification in animal ecology and permission of instructor.* Graduate student experience in the animal ecology teaching program. Satisfactory-fail only.

A Ecl 699. Research. Cr. arr. Repeatable.

A Ecl 699I. Research. (Cross-listed with Ia LL, Anthr, GDCB, EEOB). Cr. arr. Repeatable.

Forestry (For)

Courses primarily for undergraduate students

For 201. Forest Biology. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 202, 203, 204, 205, and 206.* Discussion of ecological concepts, individual tree structure and growth, variation and diversity in tree populations. Physical environment of trees and forests, ecological processes in forest communities, and introduction to different regional forest communities.

For 202. Wood Utilization. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 201, 203, 204, 205, and 206.* Processing of sustainable materials including wood into products and general properties and proper use of these products.

For 203. Resource Measurements/Evaluation. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 201, 202, 204, 205, and 206; Math 140.* Survey techniques involved in quantification, valuation, and evaluation of tree and stand growth and other variables in the forest environment (e.g., recreational use, wildlife habitat value, biomass, and solid wood).

For 204. Forest Ecosystem Decision-Making. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 201, 202, 203, 205, and 206.* Methods of decision-making related to forest ecosystems including communications, teams and conflict resolution. Current issues relating to public, private, and urban forests; quantification of processes, services, and goods produced by the forest and expected by the public such as wildlife, water, range, recreation, wilderness, biodiversity, as well as wood and fiber products.

For 205. Integrated Forestry Laboratory. (0-8) Cr. 3. F. *Prereq: Concurrent enrollment in 201, 202, 203, 204, and 206.* Field and laboratory exercises integrating the evaluation and management of forest goods, services, and the processing of wood products.

For 206. Fall Forestry Camp. Cr. 4. F. *Prereq: Concurrent enrollment in 201, 202, 203, 204, and 205.* Three-week field camp to address topics and issues covered in 201, 202, 203, 204, and 205.

For 280. Wood Properties and Identification. (3-3) Cr. 4. S. Properties of wood and how they relate to its successful use. Comparative anatomical characteristics, scientific nomenclature, and hand lens identification of commercially important North American woods.

For 283. Pesticide Application Certification. (Cross-listed with Ent, Agron, Hort). (2-0) Cr. 2. S. Holscher. Core background and specialty topics in agricultural, and horticultural pesticide applicator certification. Students can select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

For 290. Special Problems. Cr. arr. Repeatable. *Prereq: Freshman or Sophomore classification, permission of instructor.*
A. Leadership in Forestry Teams (LIFT) Learning Community
B. Forest Ecosystem Management
C. Natural Resource Conservation
D. Urban and Community Forestry
E. Wood Science and Technology

For 302. Silviculture. (2-3) Cr. 3. S. *Prereq: 201.* Manipulation of forest vegetation based on ecological principles for the production of goods and services. Nonmajor graduate credit.

For 342. Dynamics of Forest Stands. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 203, Stat 101.* Change in forest species composition and structure at the stand and landscape scales resulting from site quality, tree growth, competition, succession, and disturbance. Methods for assessing tree growth and reconstructing past stand development. Applications to forest and savanna management. Nonmajor graduate credit.

For 356. Dendrology. (Cross-listed with Biol). (2-4) Cr. 4. F. *Prereq: Biol 211.* Identification and ecology of North American woody plant species. Importance of woody plants in timber production and wildlife habitat. Natural disturbances, human impacts, management and restoration concerns for major North American forest regions will be addressed. Nonmajor graduate credit.

For 416. Forest Insect and Disease Ecology. (Cross-listed with Pl P). (3-3) Cr. 4. S. *Prereq: 8 credits in biological sciences, including Biol 211.* Harrington. Nature of insects and pathogens of forest and shade trees; their role in the dynamics of natural and managed forest ecosystems; and the management of indigenous and exotic pests. Nonmajor graduate credit.

For 451. Forest Resource Economics and Quantitative Methods. (3-3) Cr. 4. S. *Prereq: 203, Econ 101, Math 150.* Application of economic principles to forest resource management considering both market and non-market goods and services. Methods of identifying and specifying problems in the management and use of forest resources. Application of mathematical and statistical models to the solution of managerial problems. Nonmajor graduate credit.

For 452. Ecosystem Management. (Cross-listed with NREM). (2-3) Cr. 3. F. *Prereq: Junior classification, and NREM 301 or A Ecl 312.* Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints. Nonmajor graduate credit.

For 453. Forest Resource Policy and Administration. (3-0) Cr. 3. S. *Prereq: junior or senior classification.* Forest and related natural resource policies and contemporary policy issues. Integration of elements of policy development processes, various participants in these processes, and resulting programs. Ethics in professional forestry and natural resource conservation, and conflict resolution. Participation in the policy process involving communication with policy makers and natural resource professionals, study of current issues, promotion of issues with students as issue educators. Participation in policy meetings to identify/determine various elements and applications of strategies associated with the policy development process. Nonmajor graduate credit.

For 454. Forestry Practicum. (1-4) Cr. 3. S. *Prereq: 20 credits in student's major at 300 level or above.* Integrated decision-making related to the conservation, management, and preservation of private and public forests, wildlands, urban/community forests, and/or the production and utilization of wood products. Student teams work with a client and develop management plans that incorporate ecological, social, economic, ethical, and institutional/political factors. Effective teamwork, written/oral/visual communication, and problem-solving stressed. Multiple trips to project site and client. Nonmajor graduate credit.

For 475. Urban Forestry. (Cross-listed with Hort). (2-3) Cr. 3. F. *Prereq: Junior or senior classification, 3 credits in biology.* Discussion of establishment and management of woody perennials in community-owned urban greenspaces, consideration of urban site and soil characteristics, plant physiology, plant culture, urban forest valuation, inventory methods, species selection, and urban forest maintenance (health care and pest management). Nonmajor graduate credit.

For 480. Wood Anatomy and Fiber Analysis. (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 280 or permission of instructor.* Microscopic anatomy and ultrastructure of wood and other industrial lignocellulosic materials. Microscopy techniques for fiber analysis. Comparison of fiber properties. Nonmajor graduate credit.

For 481. Conversion of Lignocellulosic Materials. (Cross-listed with TSM). (2-3) Cr. 3. F. *Prereq: 280 or TSM 210 or A E 216 or equivalent.* Chemical properties of lignocellulosic materials. Wood chemistry. Various conversion processes. Pulp and paper technology. Biobased products. Other fiber products. Cellulose derivatives. Term paper and/or student project required for graduate level. Nonmajor graduate credit.

For 483. Wood Deterioration and Preservation. (Cross-listed with Pl P). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: For 280.* Deterioration of wood in use by biological and physical agents. Wood preservation and fire retardant treatments. Environmental impact of wood treating. Nonmajor graduate credit.

For 485. Lignocellulosic Composite Materials. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 280 or permission of instructor.* Consolidation behavior of lignocellulosic materials. Principles of adhesion. Manufacturing processes for wood and lignocellulose composites such as plywood, oriented strand products, laminated lumber, particleboard, and medium density fiberboard. Extrusion processing of natural fiber/plastic composites. Nonmajor graduate credit.

For 486. Moisture Interactions of Lignocellulosic Materials. (2-3) Cr. 3. Alt. S., offered 2010. *Prereq: 280 or permission of instructor.* Principles of moisture relations in hygroscopic materials; adsorption, desorption, equilibrium moisture content. Transport processes in natural materials such as wood. Drying processes for wood and other lignocellulosic materials. Influence of moisture on dimensional stability and durability of lignocellulosics and composites. Nonmajor graduate credit.

For 487. Physical Properties of Wood. (3-3) Cr. 4. Alt. S., offered 2010. *Prereq: 280.* Mechanical, thermal, electrical, and acoustical properties of wood. Lumber grading and stress rating, nondestructive evaluation of wood and wood composite products. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

For 599. Creative Component. Cr. arr. Repeatable.
A. Forest Biology
B. Forest Biometry
C. Forest and Recreation Economics
D. Forest Management and Administration
E. Wood Science

Courses for graduate students

For 603. Plant Physiological Ecology. (4-0) Cr. 4. Alt. F., offered 2010. *Prereq: NREM 301 or a course in plant physiology.* Structural and functional adaptations in woody and herbaceous plant species to environmental variables, with and emphasis on understanding relationships between physiological processes at the whole plant scale with ecosystem processes related to nutrient, water, and carbon cycling. Plant physiological responses to natural disturbances, management practices, global climate change, and other forces of environmental change.

For 696. Research Seminar. (Cross-listed with GDCB, Agron, BBMB, Hort, PlBio). Cr. 1. Repeatable. Research seminars by faculty and graduate students. Satisfactory-fail only.

For 699. Research. Cr. arr. Repeatable.
A. Forest Biology - Wood Science
B. Forest Biometry
C. Forest Economics
D. Forest Management and Administration
E. Wood Science
F. Plant Physiology

Natural Resource Ecology and Management (NREM)

Courses primarily for undergraduate students

NREM 104. Practical Work Experience. Cr. R. Three months of relevant work experience in natural resources, animal ecology, or forestry. Study at a summer biological station may be applicable. See adviser for specific requirements and approval process.

NREM 110. Orientation in Natural Resource Ecology and Management. Cr. R. F. Orientation to the University and to the Department of Natural Resource Ecology and Management. Discussion of departmental learning outcomes, strategies for academic success and academic planning. Satisfactory-fail only.

NREM 111. NREM Transitions Learning Community Seminar. (1-0) Cr. 1. F.S. Enrollment limited to members of the NREM Transitions Learning Community. Designed to assist new transfer students and continuing sophomore students with their transition to the academic expectations and professional development aspects of the natural resource program. Satisfactory-fail only.

NREM 112. Orientation to Learning and Productive Team Membership. (Cross-listed with Aer E, FS HN, Hort, TSM). (2-0) Cr. 2. F. Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

NREM 114. Developing Responsible Learners and Effective Leaders. (Cross-listed with FS HN, Hort, TSM). (2-0) Cr. 2. S. Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

NREM 120. Introduction to Renewable Resources. (Cross-listed with Agron, Env S). (3-0) Cr. 3. F.S. Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

NREM 130. Natural Resources and Agriculture. (Cross-listed with Env S). (3-0) Cr. 3. S. Survey of the ecology and management of fish, forest, and wildlife resources in areas of intensive agriculture, with emphasis on Iowa. Conservation and management practices for private agricultural lands. Designed for nonmajors.

NREM 211. Careers in Natural Resources. Cr. 1. F.S. *Prereq: Sophomore classification.* Career planning exploration in natural resources. Discussion of the job application process, including techniques for successful interviewing and development of an effective resume. Satisfactory-fail only.

NREM 256. Midwestern Prairie Plants. (1-2) Cr. 1. F. Offered 1st half semester only. Survey of the major plant families, genera, and representative species of Midwestern prairies with emphasis on plant identification and use of keys. Prairie restoration, conservation, and management issues will also be considered.

NREM 285. The National Parks: Culture and Nature. (Cross-listed with L A). (2-0) Cr. 2. Alt. F., offered 2010. Reviews cultural setting for park establishment and management, ideas about wilderness, and philosophy of parks as types of land use. History of landscape architecture in the National Park Service, the development of American parks, the history of park wildlife management and nature interpretation. Recent initiatives in ecosystem management, community conservation, and international points of comparison. Readings, discussion, exercises.

NREM 301. Natural Resource Ecology and Soils. (Cross-listed with EnSci). (3-3) Cr. 4. F. *Prereq: Biol 211, 211L; For 201 or a second course in biology.* Effects of environmental factors on ecosystem structure and function using forest, prairie and agricultural ecosystems as models. Special emphasis is given to soil-forming factors and the role of soil in nutrient and water cycling and ecosystem dynamics. Additional emphasis is given to human influences on natural ecosystems and the role of perennial plant communities in agricultural landscapes. Nonmajor graduate credit.

NREM 303. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor and sophomore standing.* Placement with county conservation boards, camps, zoos, parks, etc., for experience as interpreters, rangers, and technicians.

NREM 303I. Undergraduate Internship. (Cross-listed with Ia LL). Cr. arr. Repeatable. SS. *Prereq: Permission of instructor and sophomore standing.* Placement with county conservation boards, camps, parks, etc. For experience as interpreters, rangers, and technicians.

NREM 305. Seminar. (2-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.* Current topics in natural resources or related issues.

NREM 330. Interpretation of Natural Resources. (2-3) Cr. 3. S. *Prereq: 6 credits in biological sciences.* History, objectives, forms, and techniques of natural resources interpretation in the settings of county, state, national parks, and zoos.

NREM 345. Natural Resource Photogrammetry and Geographic Information Systems. (Cross-listed with EnSci). (2-3) Cr. 3. F. *Prereq: Junior classification.* Measurement and interpretation of aerial photos in resource management. Introduction to Geographic Information Systems (GIS) using ArcGIS including digitizing, development and query of attribute tables, georeferencing, and use of multiple GIS layers in simple spatial analyses. Nonmajor graduate credit.

NREM 385. Natural Resource Policy. (Dual-listed with 585). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Junior standing.* History, theory, and practice of natural resource policy. Integrative approach with topical studies in wildlife, forest, water, and other natural resources, mainly in North America. Examine roles and relationships in policy formulation between major policy actors, including legislative bodies, government agencies, and non-profits. The role of science and scientists in policy.

NREM 390. Fire Ecology and Management. (3-0) Cr. 3. F. Characteristics and role of fire in forest ecosystems. Major topics covered include fuels, fire weather, fire behavior, fire danger rating systems, fire control, prescribed burning, and fire dynamics in major ecosystem types. Nonmajor graduate credit.

NREM 402. Watershed Hydrology. (Cross-listed with Agron, EnSci, Geol, Mteor). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

NREM 407. Watershed Management. (Dual-listed with 507). (Cross-listed with EnSci, Env S). (3-3) Cr. 4. S. *Prereq: A course in general biology.* Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

NREM 430. Media Techniques in Natural Resources Interpretation. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 330.* Media techniques used by interpreters for teaching the public about natural resources. Nonmajor graduate credit.

NREM 446. Integrating GPS and GIS for Natural Resource Management. (Dual-listed with 546). (Cross-listed with EnSci). (2-3) Cr. 3. S. *Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS.* Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

NREM 452. Ecosystem Management. (Cross-listed with For). (2-3) Cr. 3. F. *Prereq: Junior classification, and NREM 301 or A Ecl 312.* Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints. Nonmajor graduate credit.

NREM 460. Controversies in Natural Resource Management. (Cross-listed with Env S). (3-0) Cr. 3. F.S. *Prereq: 120, and A Ecl 312 or NREM 301, and Junior classification.* Analysis of controversial natural resource issues using a case approach that considers uncertainty and adequacy of information and scientific understanding. Ecological, social, political, economic, and ethical implications of issues will be analyzed. Nonmajor graduate credit.

NREM 465. Landscape Change and Conservation. (Dual-listed with 565). (Cross-listed with L A). (3-0) Cr. 3. F. *Prereq: L A 202.* Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

NREM 471. Agroforestry Systems; Local and Global Perspectives. (Dual-listed with 571). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in biological science at 300 level or above.* Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry.

NREM 472. Landscape Ecology and Natural Resource Management. (Dual-listed with 572). (2-2) Cr. 3. F. *Prereq: NREM 301 or A Ecl 312 or equivalent and NREM 345 or C R P 451 or equivalent.* Analysis and management of spatial patterns and processes in populations, communities, and ecosystems with emphasis on broad spatial scales. Human influences on natural systems are strongly considered.

NREM 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or senior classification, permission of instructor.*
A. Animal Ecology
B. Forestry
E. Entrepreneurship
H. Honors Program

NREM 490I. Undergraduate Independent Study. (Cross-listed with Ia LL). Cr. arr. Repeatable. *Prereq: Junior or senior classification and permission of the instructor.*

NREM 493. Workshop. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Ecological concepts and management practices for landowners, teachers and others. Not for students majoring in animal ecology or forestry. NREM 493 may be taken more than once for graduation credit.

NREM 496. Travel Course. (Dual-listed with 596). Cr. arr. Repeatable. *Prereq: Permission of instructor.* Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.
A. International
B. Domestic

NREM 498. Cooperative Education. Cr. arr. *Prereq: Permission of departmental chair.* Required of all cooperative education students. Students must register prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

NREM 501. Genecology. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Gen 320 or Biol 313.* Genecology principles as they apply to natural and improved populations of plants and animals. Genetic systems as they interact with long-term natural selection to produce clinal or ecotypic variation. The impact of current environments and genetic modifications of domesticated organisms on short-term selection pressures. Special coverage of species of interest to students enrolled in the course.

NREM 504. Forest Landscapes, Wildlife, and Silviculture. (3-3) Cr. 4. Alt. F., offered 2010. *Prereq: 301.* Detailed analysis of factors and processes underlying forest and stand growth and development. Applications of this knowledge to forest culture to support a diversity of use and protection objectives. Discussions of regional silviculture, tropical forests, and experimentation in forest biology.

NREM 505. Seminar. (2-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor or graduate classification.* Current topics in natural resources research and management.

NREM 507. Watershed Management. (Dual-listed with 407). (Cross-listed with EnSci). (3-3) Cr. 4. S. *Prereq: A course in general biology.* Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

NREM 508I. Aquatic Ecology. (Cross-listed with Ia LL, EnSci). Cr. 4. SS. *Prereq: Courses in ecology, chemistry, and physics.* Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

NREM 529. Publishing in Biological Sciences Journals. (Cross-listed with Agron, Hort). (2-0) Cr. 2. S. *Prereq: Permission of instructor; evidence of a publishable unit of the student's research data.* Process of preparing a manuscript for submission to a refereed journal in the biological sciences. Emphasis on publishing self-generated data from thesis or dissertation research.

NREM 532. Human Dimensions of Natural Resource Management. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: A Ecl 312 or equivalent plus 6 credits of biological sciences; permission of instructor.* Exploration of institutions that help shape natural resource management and policies. Current research on interaction of humans with natural resources. Roles of social forces, politics and economics in natural resource management.

NREM 535. Restoration Ecology. (Cross-listed with EnSci, EEOB). (2-3) Cr. 3. F. *Prereq: Biol 366 or 474 or graduate standing.* Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies.

NREM 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BBMB, BCB, B M S, FS HN, Hort, NutrS, VDPAM, EEOB, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

NREM 546. Integrating GPS and GIS for Natural Resource Management. (Dual-listed with 446). (Cross-listed with EnSci). (2-3) Cr. 3. S. *Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS.* Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

NREM 565. Landscape Change and Conservation. (Dual-listed with 465). (Cross-listed with L A). (3-0) Cr. 3. F. *Prereq: L A 202.* Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

NREM 570. Advanced Decision-making in Natural Resource Allocation. (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: For 451 or two courses in economics.* Analytical approach to economic aspects of forest resource management problems. Theory and application of economic decision-making criteria to traditional and modern forest resource management issues. Current problems in the allocation of forest resources.

NREM 571. Agroforestry Systems. (Dual-listed with 471). (Cross-listed with SusAg). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in biological science at 300 level or above.* Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry.

NREM 572. Landscape Ecology and Natural Resource Management. (Dual-listed with 472). (2-2) Cr. 3. F. *Prereq: NREM 301 or A Ecl 312 or equivalent and NREM 345 or C R P 451 or equivalent.* Analysis and management of spatial patterns and processes in populations, communities, and ecosystems with emphasis on broad spatial scales. Human influences on natural systems are strongly considered.

NREM 580. Research Orientation. (2-0) Cr. 2. F. *Prereq: 20 credits in biological sciences and a course in statistics.* Research design, proposal preparation, and technical writing.

NREM 581. Methods for Presenting Scientific Results. (2-0) Cr. 2. S. *Prereq: Permission of instructor.* Techniques of proper platform presentation. Discussion of effective audio/visual techniques for presentation of research findings. Practice in development of overheads and slides. Use of computer generated and projected visuals. Practice in oral presentation with critical review. Development of effective posters for scientific presentation.

NREM 585. Natural Resource Policy. (Dual-listed with 385). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate standing or permission of instructor. History, theory, and practice of natural resource policy.* Integrative approach with topical studies in wildlife, forest, water, and other natural resources, mainly in North America. Examine roles and relationships in policy

formulation between major policy actors, including legislative bodies, government agencies, and non-profits. The role of science and scientists in policy.

NREM 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
A. Animal Ecology
B. Forestry

NREM 593. Workshop. Cr. arr. Repeatable. *Prereq: Graduate classification.*

NREM 596. Travel Course. (Dual-listed with 496). Cr. arr. Repeatable. *Prereq: Permission of instructor.* Limited enrollment. Extended field trips to study ecological topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.
A. International
B. Domestic

NREM 599. Creative Component. Cr. arr.

Courses for graduate students

NREM 600. Seminar. Cr. 1. Repeatable. F.S. Current topics in natural resources research and management.

NREM 699. Research. Cr. arr. Repeatable.

Naval Science

www.iastate.edu/~navy

Captain Gary Waring, Chair of Department

Professors: Waring

Assistant Professors (Adjunct): Asjes

Instructors (Adjunct): Corbeill, Dienes, Kamp

The Department of Naval Science is embedded within the College of Liberal Arts and Sciences as an interdisciplinary program but does not offer an academic degree. The courses offered by the Department are developed by the Department of the Navy. The Naval Science Department and Naval ROTC (NROTC) Program develop individuals mentally, morally, and physically, and imbue in them the highest ideals of duty and loyalty, in order to commission them upon graduation as Navy and Marine Corps officers. Program graduates possess a basic professional background, are motivated towards careers in the Naval Service, and have a potential for future development in mind and character so as to assume the highest responsibilities of command, citizenship, and government. Emphasis is placed on the core values of courage, honor and commitment.

Naval Science courses are open to any ISU student who has met the course prerequisites. To participate in the Naval ROTC Program, students must apply through one of two programs: the NROTC Scholarship Program (full scholarship; which includes a book stipend, tuition, laboratory fees, uniforms, and a monthly stipend), or the College Program (nonscholarship, with limited financial assistance). Applicants for the Scholarship Program are selected through a comprehensive nationwide competition. Applicants for the College Program are selected by the Professor of Naval Science from among students already in attendance at, or selected for admission by, the university. The College Program involves limited financial assistance for each of the last two academic years. Upon application, students choose between the Navy Option and Marine Corps Option, for the purposes of training focus. NROTC students pursue their studies like other university students except that they must meet certain additional requirements that will prepare them to serve as naval officers upon graduation.

A Scholarship Program student incurs a minimum 4 -year active duty military obligation as a commissioned officer after graduation; a College Program student incurs a 3-year active duty obligation.

Further information is available from the Professor of Naval Science, Iowa State University.

While in the NROTC Program, students will participate (with pay) in summer at-sea training cruises. Students are also exposed to regular and extracurricular activities that teach leadership principles and help them decide which field of the Navy or Marine Corps they wish to enter. These activities also include weekly leadership laboratory periods and opportunities for involvement in several student societies.

Undergraduate Study

Naval science courses are primarily for those students in the NROTC program, however, other university students may also enroll. Students enrolled in the NROTC program must fulfill the following requirements:

1. N S 111, N S 212, N S 220, N S 230, N S 320, N S 330, N S 410, N S 412 and N S 440. Marine option students will complete N S 111, N S 212, N S 220, N S 321, N S 412, N S 421, and N S 440.

2. All NROTC students must complete one course in American military history or national security policy. A course in non-western culture or religion is also required of all Navy-option students.

3. All Navy option scholarship students must successfully complete Math 165 and 166 by the end of the sophomore year and Phys 221 and 222 by the end of the junior year.

4. In addition to the normal Naval Science courses, all NROTC students are required to participate in laboratory periods that supplement the various academic courses. The Leadership Lab emphasizes human relations principles, teaches basic military formations, movements, commands, courtesies, and honors, and provides practice in unit leadership. Non NROTC program students enrolled in Naval Science courses are not required to participate in laboratory periods.

5. Navy option scholarship students are encouraged to major in engineering and physical sciences to meet the technological requirements of the modern Navy, however Navy-option students and Marine Corps-option students may pursue any major leading to a Bachelor's Degree.

6. The College of Liberal Arts and Sciences offers a minor in military studies. Requirements for the minor include taking a minimum of 15 credits of ROTC instruction, which may be taken from any of the three ROTC programs offered on campus. At least 6 credits must be in courses numbered 300 or above.

For basic undergraduate curriculum requirements, see *Liberal Arts and Sciences, Curriculum; or Engineering, Curricula.*

Courses primarily for undergraduate students

N S 111. Introduction to Naval Science. (3-0) Cr. 3. F. Introduction to the organization, regulations, and capabilities of the Navy, with emphasis on mission and principal warfare components.

N S 212. Seapower and Maritime Affairs. (3-0) Cr. 3. S. Requests to waive this prerequisite must be approved by Naval Science Department. Development of concept of seapower including the Merchant Marine; role of various warfare components of the Navy in supporting the Navy's mission; implementation of seapower as an instrument of national policy; evolution and network-centric warfare and review of Cold War naval strategy.

N S 220. Leadership and Management. (3-0) Cr. 3. S. Experiential approach to learning the principles of leadership and management by examining business management theories and their applications. Skills are developed in the areas of communication, counseling, control, direction, management, and leadership through active guided participation.

N S 230. Navigation. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Requests to waive this prerequisite must be approved by Naval Science Department. Study of the fundamentals of marine navigation used by ships at sea; includes practical exercises in piloting using visual and electronic means. In-depth discussion of laws that govern conduct of vessels in national/international waters. Course is supplemented with review/analysis of case studies involving actual navigation incidents.

N S 320. Naval Ship Systems I (Engineering). (3-0) Cr. 3. F. *Prereq: Physics 221, sophomore classification.* Requests to waive these prerequisite must be approved by Naval Science Department. An introduction to naval engineering with emphasis on the equipment and machinery involved in the conversion of energy for propulsion and other purposes aboard the major ship types of the U.S. fleet. Basic concepts of the theory and design of steam, gas turbine, diesel, and nuclear propulsion. Introduction to ship design, stability, hydrodynamic forces, compartmentation, electrical and auxiliary systems.

N S 321. Evolution of Warfare. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Sophomore classification. Requests to waive this prerequisite must be approved by Naval Science Department.* Evolution of warfare from 3500 B.C. to contemporary times; analysis of the impact of historical precedents on modern military thought and action; emphasis on the historical development of military tactics, strategy, and technology.

N S 330. Naval Ship Systems II (Weapons). (3-0) Cr. 3. S. *Prereq: Physics 221, sophomore classification. Requests to waive this prerequisite must be approved by Naval Science Department.* Introduction to the theory and principles of operation of naval weapon systems. Included coverage of types of weapons and fire control systems, capabilities and limitations; theory of target acquisition, identification and tracking; basics of naval ordnance.

N S 410. Naval Operations and Seamanship. (3-0) Cr. 3. F. *Prereq: Senior classification. Requests to waive this prerequisite must be approved by Naval Science Department.* Study of tactical naval operations; employs practical use of maneuvering boards together with shiphandling principles to arrive at tactical shipboard maneuvering solutions for single ship and formation operations. Study also of command and control, leadership, and ethics issues associated with surface naval operations.

N S 412. Leadership and Ethics. (3-0) Cr. 3. S. *Prereq: For NROTC students only - N S 111, N S 212 or Hist 389, N S 220, N S 230, N S 320, N S 330 and N S 410. Requests to waive this prerequisite must be approved by Naval Science Department.* Basic background concerning the duties and responsibilities of the junior naval officer and division officer in the areas of integrity and ethics, human resources management, personnel management, material management, and the administration of discipline. Preparation for responsibilities encountered immediately upon commissioning.

N S 421. Evolution of Amphibious Warfare. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Sophomore classification. Requests to waive this prerequisite must be approved by Naval Science Department.* Defines the concept of amphibious operations, origins, development from 600 B.C.

N S 440. Senior Naval Science Seminar. (1-0) Cr. 1. F.S. *Prereq: Senior classification. Requests to waive this prerequisite must be approved by Naval Science Department.* Current leadership issues in the Navy which will challenge the newly commissioned officer. Opportunities to analyze, provide solutions, and discuss actions related to a variety of real world situations.

N S 490. Independent Study. Cr. arr. Repeatable. *Prereq: Senior classification and prior approval of Naval Science Department Chair, 6 credits in naval science.* No more than 9 credits of N S 490 may be counted toward graduation.

Neuroscience

www/neuroscience.iastate.edu/

(Interdepartmental Graduate Program)

Co-Chairs: D. Sakaguchi, R. Martin

Supervisory Committee: V. Bracha, S. Jeftinija, A. G. Kanthasamy, R. Martin, D. Sakaguchi

Participating Faculty: V. Anantharam, L. Anderson, J. Bloedel, V. Bracha, E Cooper, J. Cunnick, T. Day, N. M. Ellinwood, H. Greenlee, V. Honavar, W. Hsu, S. Jeftinija, A.G. Kanthasamy, A. Kanthasamy, M. Kimber, V.S. Lin, S. Mallapragada, R. J. Martin, M. Nilsen-Hamilton, J. Ourednik, V. Ourednik, A. Robertson, R. Robson, D. Sakaguchi, R. Singh, A. Smiley-Oyen, C. Tuggle, E. Uemura

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in neuroscience. Cooperating departments include Animal Science; Biochemistry, Biophysics and Molecular Biology; Biomedical Sciences; Chemical and Biological Engineering; Chemistry; Ecology, Evolution and Organismal Biology; Genetics, Development and Cell Biology; Kinesiology; and Psychology.

Facilities and faculty are committed to research in the following areas: neuronal membrane functions, signal transduction, neuroanatomy, neurodegenerative diseases, neuroendocrinology, neurotoxicology, neuropathology, developmental neurobiology, neurogenetics, computational neuroscience, neural networks, and behavioral neuroscience.

An undergraduate or advanced degree in the sciences is ordinarily a prerequisite for admission to the program. A student majoring in neuroscience will select a major professor from the faculty participating in the program.

All students take a core curriculum consisting of Neuro 556, 557, 661, 690, 696, BBMB 404, and Stat 401. All students are also expected to take elective neuroscience courses from the following: B M S 537, 575; Com S 474; E E 545; Psych 517, 519; and Tox 501.

Courses for graduate students

Neuro 556. Cellular, Molecular and Developmental Neuroscience. (Cross-listed with GDCB, B M S). Cr. arr. F. *Prereq: Biol 335 or Biol 436; physics recommended.* Fundamental principles of neuroscience including cellular and molecular neuroscience, nervous system development, sensory, motor and regulatory systems.

Neuro 557. Advanced Neuroscience Techniques. (Cross-listed with GDCB). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Neuro 556 or equivalent course.* Research methods and techniques; exercises and/or demonstrations representing individual faculty specialties.

Neuro 661. Current Topics in Neurobiology. (Cross-listed with GDCB, BBMB). Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics may include communication, hormones and behavior, neural integration, membrane biophysics, molecular and cellular neuroscience, developmental neurobiology, neuroanatomy and ultrastructure, sensory biology, social behavior, techniques in neurobiology and behavior.

Neuro 690. Journal Club in Neuroscience. (1-0) Cr. 1. Repeatable. F.S. *Prereq: 556.* Students are required to attend and make at least one presentation at a weekly journal club focusing on current topics.

Neuro 696. Neuroscience Seminar. (1-0) Cr. 1. Repeatable. F.S. *Prereq: 556.* Presentations and discussion of research by students, faculty, and visiting scholars.

Neuro 699. Research. Cr. arr. Repeatable.

Nuclear Engineering

www.iastate.edu/~nuclearengineering

Minor administered by Mechanical Engineering

The nuclear engineering undergraduate minor allows engineering students to acquire a formal background in nuclear engineering topics that will not only benefit them, but also fulfill a societal need for future hiring of engineers. Through this program, students can enroll in a formal minor that enables them to acquire a basic and fundamental knowledge of nuclear sciences and engineering, thus enabling them to pursue employment in any one of a number of fields associated with the construction, operation or regulation of nuclear power generation.

Students completing this minor acquire a body of knowledge in the fundamentals of nuclear science and engineering. The required courses selected ensures that all graduates of the nuclear engineering minor obtain a minimum body of knowledge in nuclear science and engineering that would allow them to apply their specialized field of engineering knowledge to nuclear-related applications, such as nuclear plant and site construction, nuclear power plant operations, nuclear safety and radiation protection.

The supporting courses that are listed in this program provide an opportunity for students to build upon the knowledge gained in the required courses by taking either more advanced courses or more specialized courses dealing with specific areas of nuclear engineering.

Undergraduate Study

Students interested in completing the nuclear engineering minor must be enrolled in the College of Engineering at Iowa State University. They should complete and submit the "Request for Minor" form. The selection process is based on approval by the administering department, Mechanical Engineering.

The course requirements for the undergraduate minor in nuclear engineering are: Required courses (9 credits) – Nuc E 401, 3 cr., Nuc E 402, 3 cr., and Nuc E 405, 3 cr.; Supporting courses (select two for 6 credits) – Nuc E 410, 3 cr., Nuc E 411, 3 cr. Nuc E 490, 3 cr., or M E 433, 3 cr. The minor must include at least nine credits which are beyond the total used to meet curriculum requirements for the bachelors degree in engineering.

Interinstitutional Program:
Contact: Gregory Maxwell

Participating Faculty:
Iowa State University
Gregory Maxwell, gmaxwell@iastate.edu
Carolyn Heising, cheising@iastate.edu

Kansas State University
William Dunn, dunn@ksu.edu
Kenneth Shultis, jks@ksu.edu

University of Missouri Columbia
Mark Prelas, PrelasM@missouri.edu

Texas A&M University
Raymond Juzaitis, rjuzaitis@tamu.edu

University of Texas at Austin
Sheldon Landsberger,
s.landsberger@mail.utexas.edu

Nuclear engineering courses are provided through an inter-institutional distance education program offered through the Web. Some of the courses that comprise this minor are offered at Iowa State University, while others are offered through four of the Big 12 Engineering Consortium universities that have formal nuclear engineering departments or programs. The four universities offering an assortment of nuclear engineering courses via web-based distance education are Texas A & M (TAMU), the University of Missouri Columbia (UMC), Kansas State University (KSU) and the University of Texas at Austin (UTA).

Courses primarily for undergraduate students

Nuc E 401. Nuclear Radiation Theory and Engineering. (3-0) Cr. 3. F. *Prereq: Phys 222, Math 266 or 267.* Atomic and nuclear physics. Radioactivity and reaction rates. Cross sections. Introduction to neutron diffusion theory. Engineering applications of radiation theory. Nonmajor graduate credit.

Nuc E 402. Nuclear Reactor Engineering. (3-0) Cr. 3. S. *Prereq: 401.* WWW only. Fission and chain reactions. Neutron diffusion and moderation. Reactor equations. Fermi Age theory. Multigroup and multiregional analysis.

Nuc E 405. Radiation Protection and Shielding. (3-0) Cr. 3. *Prereq: 401.* WWW only. Basic principles and concepts of radiation protection and design: dosimetric units and response functions, hazards of radiation dose, radiation sources, basic methods for dose evaluation, and shielding design techniques for photons and neurons.

Nuc E 410. Nuclear Reactor Theory. (3-0) Cr. 3. F. *Prereq: 405.* WWW only. An introduction to neutron diffusion theory, neutron moderation, conditions for criticality of nuclear reactors.

Nuc E 411. Nuclear Reactor Analysis. (3-0) Cr. 3. S. *Prereq: 410.* WWW only. Group diffusion method. Multiregion reactors, heterogeneous reactors. Reactor kinetics, changes in reactivity.

Nuc E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior Classification.* Investigation of nuclear engineering topics. Election of course and topic must be approved in advance by supervising faculty.

Nutritional Sciences

(Interdepartmental Graduate Major)

Advisory Committee: K. Schalinske, Chair; D. Beitz, M. Spurlock, M. Reddy, W. White

Participating Faculty: Faculty mainly from Food Science and Human Nutrition and Animal Science and also from other departments such as Kinesiology; Biochemistry, Biophysics, and Molecular Biology; Agronomy; Human Development and Family Studies, Sociology; Agricultural and Biosystems Engineering, and Statistics

Graduate Study

The Interdepartmental Graduate Program in Nutritional Sciences (IGPNS), administered through the Graduate College, under the auspices of the Chairs of Food Science and Human Nutrition (FS HN) and Animal Science, will provide the structure for coordinating and enhancing interdisciplinary nutrition research and graduate education. M.S. and Ph.D. degrees in Nutritional Sciences will be offered with three specializations: Animal Nutrition, Human Nutrition, or Molecular/Biochemical Nutrition.

The following undergraduate course work is recommended of all applicants who are applying to the IGPNS, but may be modified depending upon the student's area of emphasis. Recommended course work includes organic chemistry

with laboratory, physics, analytical chemistry, a nutrition course that requires biochemistry or organic chemistry as a prerequisite, and a course in biology/physiology or anatomy. Under certain circumstances students can be admitted or provisionally admitted with course work deficiencies. Students with an undergraduate degree will be generally admitted into the M.S. program and upon completion, they can then apply for admission into the Ph.D. program. However, exceptional students with experience can apply directly to the Ph.D. program.

The general requirements of the Nutritional Sciences degree at the MS level, in addition to those of Graduate College, are: NutrS 501; NutrS 502; a minimum of 4 additional credits of graduate-level advanced nutrition or nutritional physiology; 3-6 credits of graduate-level biochemistry; 3 credits of graduate-level statistics (STAT 401); graduate student orientation course (FS HN 580 or An S 501); seminar(s) attendance in Food Science and Human Nutrition (FS HN 581) or Animal Science (An S 603); seminar presentation course (FSHN 681 or An S equivalent); one semester credit of seminar pertaining to student's research; Teaching assistant requirement (FS HN 590C or AnS 590L), summer lectureship (NutrS 505) and successful completion of a thesis and defense of the thesis. They are expected to complete the course work established by the Program of Study (POS) committee based on specialization with a minimum of 30 graduate-level semester credits, not less than 22 of which must be earned at Iowa State University.

The general requirements of the Nutritional Sciences degree at the PhD level, in addition to those of the Graduate College, are: completion of all requirements of the MS degree in Nutritional Sciences; 3 additional credits in each of graduate-level biochemistry, graduate-level statistics (Stat 402), and systemic physiology; and one additional graduate-level courses in the field of study as deemed appropriate by the POS Committee and additional teaching assistant requirements (FS HN 590C or An S 690L). Satisfactory completion of a preliminary examination, a written dissertation, seminar presentation of dissertation research, and defense of the dissertation is also required. Overall a minimum of 72 graduate-level semester credits, no less than 36 of which must be earned at Iowa State University.

Courses for graduate students

NutrS 501. Biochemical and Physiological Basis of Nutrition: Macronutrients. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in BBMB 404 or BBMB 420.* Integration of the molecular, cellular, and physiologic aspects of macronutrient and energy metabolism in mammalian systems. Dietary energy, carbohydrates, fiber, lipids, proteins, their interactions, metabolic consequences, and major research methodologies.

NutrS 502. Biochemical and Physiological Basis of Nutrition: Vitamins and Minerals. (3-0) Cr. 3. S. *Prereq: BBMB 404 or BBMB 420, and credit or enrollment in BBMB 405.* Integration of the molecular, cellular, and physiologic aspects of vitamin and mineral metabolism in mammalian systems. Interactions among nutrients, metabolic consequences of deficiencies or excesses, relevant polymorphisms, major research methodologies, and current topics related to micronutrients.

NutrS 503. Biology of Adipose Tissue. (2-0) Cr. 2. S. *Prereq: Undergraduate: consent of instructor; Graduate: NutrS 501.* Principles regarding the development of adipose tissue and its role in energy balance, and will focus considerably on endocrine and immune actions of the adipocyte. Course material will be in lecture format, including handouts and selected journal articles. Students will be asked to lead critical discussions of key research findings as summary material for a given topic. Species differences will be highlighted, particularly as they relate to research models.

NutrS 505. Short Course. Cr. arr. F.S.SS. *Prereq: Permission of instructor.*

NutrS 518. Digestive Physiology and Metabolism of Non Ruminants. (Cross-listed with AN S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: An S 419 or NutrS 501.* Digestion and metabolism of nutrients. Nutritional requirements and current research and feeding programs for poultry and swine.

NutrS 519. Food Toxicology. (Cross-listed with FS HN, Tox). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: A course in biochemistry.* Basic principles of toxicology. Toxicants in the food supply: modes of action, toxicant defense systems, toxicant and nutrient interactions, risk assessment. Only one of NutrS 419 and 519 may count toward graduation.

NutrS 520. Digestive Physiology and Metabolism of Ruminants. (Cross-listed with AN S). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: An S 419 or NutrS 501.* Digestive physiology and nutrient metabolism in ruminant and preruminant animals

NutrS 542. Introduction to Molecular Biology Techniques. (Cross-listed with B M S, BCB, BBMB, EEOB, FS HN, GDCB, Hort, NREM, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

NutrS 552. Advanced Vertebrate Physiology II. (Cross-listed with B M S, Kin, An S). (3-0) Cr. 3. S. *Prereq: Biol 335; credit or enrollment in BBMB 404 or 420.* Cardiovascular, renal, respiratory, and digestive physiology.

NutrS 561. Medical Nutrition and Disease I. (4-0) Cr. arr. F. *Prereq: FS HN 360, 3 credits in physiology at 300 level or above.* (Dual listed with FS HN 461.) Pathophysiology of selected chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state. Recitation section (1 cr.) will focus on refinement of assessment skills, diagnosis of nutritional problems, nutrition care, and documentation. Course must be taken for 4 credits if Didactic Program in Dietetics (DPD) verification statement of completion is desired. Graduate students may take the lecture portion without the recitation section.

NutrS 562. Assessment of Nutritional Status. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: FS HN 461/NutrS 561 or NutrS 501.* Overview and practical applications of methods for assessing nutritional status, including: theoretical framework of nutritional health and disease, dietary intake, biochemical indices, clinical examination, and body composition.

NutrS 563. Community Nutrition. (3-0) Cr. 3. F. *Prereq: FSHN 203, 362.* Dual listed with FS HN 463. Survey of current public health nutrition problems among nutritionally vulnerable individuals and groups. Discussion of the multidimensional nature of those problems and community programs designed to help solve them. The role of community nutritionists in grant writing for project development. Significant emphasis on written and oral communication.

NutrS 564. Medical Nutrition and Disease II. (4-0) Cr. arr. S. *Prereq: FS HN 360, FS HN 461, or NutrS 561. 3 credits in physiology at 300 level or above.* (Dual listed with FS HN 464.) Pathophysiology of selected acute and chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state. Recitation section (1 cr.) will focus on refinement of assessment skills, diagnosis of nutritional problems, nutrition care, and documentation. Course must be taken for 4 credits if Didactic Program in Dietetics (DPD) verification statement of completion is desired. Nutritional science undergraduates and graduate students may take the 3 credit lecture portion without the recitation section.

NutrS 619. Advanced Nutrition and Metabolism - Protein. (Cross-listed with An S). (2-0) Cr. 2. *Prereq: BBMB 405.* Digestion, absorption, and intermediary metabolism of amino acids and protein. Regulation of protein synthesis and degradation. Integration of cellular biochemistry and physiology of mammalian protein metabolism.

NutrS 680. Modern Views of Nutrition. Cr. R. Repeatable. S. Current concepts in nutrition and related fields. Required for all graduate students in nutrition.

NutrS 695. Grant Proposal Writing. (Cross-listed with FS HN). (1-0) Cr. 1. F. *Prereq: 3 credits of graduate course work in food science and/or nutrition.* Grant proposal preparation experiences including writing and critiquing of proposals and budget planning. Formation of grant writing teams in food science and/or nutrition. Satisfactory-fail only.

NutrS 699. Research in Nutritional Sciences. Cr. arr. F.S.SS. Satisfactory-fail only.

Officer Education Programs

Iowa State University offers Reserve Officers Training Corps (ROTC) programs for the professional training of officers for the Army, Air Force, Navy and Marines.

The purpose of these programs is to provide an avenue for interested students to become reserve or regular officers in one of the United States military services, and the university regards this training as the foundation for possible careers in the military. The Air Force and the Navy require a period of active duty service upon completion of the ROTC program. Graduates from Army ROTC serve in either active Army, the Army Reserve, or the National Guard.

All students enrolled in advanced ROTC programs receive financial allowances, which are described under Student Financial Aid. Scholarships are also available for all services as outlined in the section on financial aid.

For specific courses and programs see also Air Force Aerospace Studies, Military Science, and Naval Science.

Operations and Supply Chain Management

(Administered by the Department of Logistics, Operations and Management Information Systems)

Richard Poist, Chair of Department

Distinguished Professor (Emeritus): Baumel

Professors: Crum, Poist, Walter

Professors (Emeritus): Thompson, Voorhees

Associate Professors: Blackhurst, Johnson, Mennecke, Montabon, Nilakanta, Ruben, Suzuki, Tiwana, Townsend, Zhu

Assistant Professors: Jiang, Martens, Scheibe

Instructors (Adjunct): Choobineh

Lecturer: Helmer

Undergraduate Study

For undergraduate curriculum in business, major in Operations and Supply Chain Management, see *College of Business, Curricula.*

Operations and Supply Chain Management is a program of study concerned with the efficient and timely flow of materials, products, and information within and among organizations. Operations management encompasses the planning, control and implementation of the processes used to transform inputs into finished goods and services. Supply chain management involves the integration of business processes across organizations, from material sources and suppliers through manufacturing and processing to the final customer. Operations management is, thus, taught in the context and framework of inter-organizational supply chain systems.

The study of Operations and Supply Chain Management prepares students for professional careers with manufacturers, distributors, logistics service providers and consulting firms. The curriculum provides the required theoretical/conceptual base and analytical methods for making sound operational and strategic business decisions.

The requirements for the Operations and Supply Chain Management major are met by completion of the following courses: OSCM 422, 424, 485, 486, 487, plus one course from an approved list.

The department also offers a minor for non Operations and Supply Chain Management majors in the College of Business. The minor requires 15 credits from an approved list of courses, of which 9 credits must stand alone. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

For graduate study options, including the Ph.D. degree, see the Supply Chain Management listing.

Courses primarily for undergraduate students

OSCM 320. Production/Operations Management. (3-0) Cr. 3. *Prereq: Stat 226.* Introduction and analysis of the basic concepts in production/operations management. Topics include: applied forecasting, aggregate planning, scheduling, shop floor control, total quality management, inventory management, facility layout, and project management.

OSCM 422. Manufacturing Planning and Control. (3-0) Cr. 3. *Prereq: OSCM 320.* Advanced treatment of manufacturing planning and control procedures. Master production scheduling, material requirements planning, enterprise resource planning, capacity planning, shop floor control, just-in-time, and competitive analyses of modern manufacturing systems. Nonmajor graduate credit.

OSCM 424. Process Management, Analysis, and Improvement. (3-0) Cr. 3. *Prereq: OSCM 320.* The design, analysis, and management of production processes to improve performance. Performance measures and their relationships; process design and evaluation; and managerial levers for improving and controlling process performance. Nonmajor graduate credit.

OSCM 428. Special Topics in Operations Management. (3-0) Cr. 3. *Prereq: OSCM 320.* In-depth analysis of current issues, problems, and systems in operations management with emphasis on new theoretical and methodological developments. Topics may include in different semesters, supply chain management, productivity and quality improvement, management of technology and innovation, information technology in operations management, quick response manufacturing, and service operations management. Nonmajor graduate credit.

OSCM 440. Supply Chain Information Systems. (Cross-listed with MIS, LSCM). (3-0) Cr. 3. *Prereq: MIS 330, OSCM 320, LSCM 360.* Internal and inter-organizational information systems necessary for a supply chain to achieve competitive advantage. Topics include: design, development, implementation, and maintenance of supply chain information systems; enterprise resource planning; advanced planning and scheduling, manufacturing execution systems; and the interface between manufacturing planning and control processes, logistics processes, and the information system.

OSCM 485. Demand Planning and Management. (Cross-listed with LSCM). (3-0) Cr. 3. *Prereq: LSCM 360, OSCM 320.* Demand planning process which synchronizes demand with manufacturing and distribution. Addresses linking business plans and demand forecasts both horizontally and vertically within the organization and collaboratively among supply chain partners. Forecasting, customer relationship management, sales and operations planning, customer service, distribution channels, e-fulfillment, and information systems requirements. Nonmajor graduate credit.

OSCM 486. Principles of Purchasing and Supply Management. (Cross-listed with LSCM). (3-0) Cr. 3. *Prereq: LSCM 360, OSCM 320.* Sourcing strategies, concepts, tools and dynamics in the context of the integrated supply chain. Make or buy decision, supplier evaluation and selection, global sourcing, the total cost of ownership, contracts and legal terms, negotiation, purchasing ethics, and information systems requirements. Nonmajor graduate credit.

OSCM 487. Strategic Supply Chain Management. (Cross-listed with LSCM). (3-0) Cr. 3. *Prereq: OSCM 422 or OSCM 424 or LSCM 460; OSCM 485 or OSCM 486.* Capstone course in supply chain management. Integrating and applying the theories, concepts, and methods covered in the prerequisite courses through the use of readings, case studies, projects, and industry speakers. Nonmajor graduate credit.

OSCM 490. Independent Study. Cr. arr. Repeatable. *Prereq: OSCM 320, senior classification, permission of instructor.*

Courses primarily for graduate students, open to qualified undergraduate students

The department offers graduate courses under the heading of Supply Chain Management. These courses include SCM 502, 520, 522, 524, 560, 561, 563, 585, and 590. For descriptions of these courses, see *Supply Chain Management*.

Courses for graduate students

The department offers graduate courses under the heading of Supply Chain Management. These courses include SCM 601, 602, 603, 604, 605, 650, 651, and 699. For descriptions of these courses, see *Supply Chain Management*.

Philosophy and Religious Studies

Tony Smith, Chair of Department

University Professor: Kupfer

Professors: Avalos, Hollinger, Kirschenmann, Robinson, Sawyer, Smith, Wilson

Professors (Emeritus): Hollenbach, Vaniten

Associate Professors: Bado-Fralick, T. Butler, Clifford, De Laplante, Fehr, Geirsson, Holmgren, Wolf

Assistant Professors: Alexander, A. Butler, Kelley, Padgett-Walsh, Qu

Senior Lecturer: Northway

Lecturer: Bevin, Wirth

Philosophy

Undergraduate Study

Philosophy tries to make sense of human experience and reality through critical reflection and argument. The questions it treats engage and provoke all of us, and they occupy an important place in our intellectual tradition: Are there objective standards for deciding what is right and wrong, or is morality merely a subjective matter? Is capitalism morally acceptable? Do I have a will, and is it free? How do my words and thoughts come to be about the world? Does God exist? Can machines think? How are mind and body related? Students in philosophy classes will be exposed to arguments on both sides of such questions, and they will be encouraged to develop and rationally defend their own positions.

Philosophy is not an isolated discipline. It enjoys mutually beneficial exchanges with many fields of study within the humanities and sciences. Philosophers develop tools that allow them to examine critically the assumptions and implications of the social and natural sciences, religion, and law.

The study of philosophy provides several benefits. It emphasizes rigourous understanding of problems, together with careful analysis of the strengths and weaknesses of the available solutions. It encourages clarity in the presentation of one's own ideas, as well as sensitivity in the consideration of the ideas of others. The study of philosophy therefore encourages one to develop skills and habits that are useful not only in philosophy, but in other areas as well. Philosophy students historically do well, for example, in law and medical schools.

However, one should not think that philosophy is only valuable in academic settings. Philosophical questions arise in many areas of family, business, and civic life. Philosophers strive to face these questions with the kind of intellectual honesty that leads to respect for the views of others, and continual reassessment of their own. In this way, the study of philosophy fosters values and attitudes that are helpful for responding to a lifetime of intellectual challenges.

The degree program in philosophy requires a minimum of 33 credits, plus the zero credit 492 course. The following courses compose the core program of the major from which 15 credits shall be chosen. Additionally, two courses at the 400 level or above (other than 490 and 492) are required.

a. Ethical theory: One course required. Choose from 330 (Ethical Theory), 335 (Social and Political Philosophy), 535 (Contemporary Political Philosophy).

b. History: Two courses required, namely, 310 (Ancient Philosophy) and either 314 (17th Century Philosophy) or 315 (18th Century Philosophy).

c. Metaphysics and Epistemology: One course required. Choose from 364 (Metaphysics: God, Minds, and Matter), 366 (Truth, Belief, and Reason), 380 (Philosophy of Science).

d. Logic: 207 (Introduction to Symbolic Logic) is required.

The department offers a minor in philosophy which may be earned by completing a total of 15 credits in philosophy. At least 9 credits must be in courses numbered 300 or above. Students may want to emphasize specific areas by taking 15 hours of courses chosen from the following:

Philosophy of Science: 201, 206 or 207, 314, 315, 380, 381, 480, 483, 485

History of Philosophy: 201, 310, 314, 315, 316, 317, 318, 460

Law, Social Values and Policy: 230, 235, 331, 332, 333, 335, 336, 338, 343, 430, 535

Communication Proficiency requirement: The department requires a grade of C+ or better in each of Engl 150 and 250 (or 250H), and approval of writing by instructor of any philosophy course 300 level or above, to be designated by the student.

Graduate Study

The department offers work for a graduate minor in philosophy. For those taking the M.A. or M.S., the minor requirement is two courses above 300 (but not 490) each taken in conjunction with 590. For those taking the Ph.D., the requirement is four courses above 300, at least one of which is above 400 (but not 490) each taken in conjunction with 590. Interested students should ask the chair to assign a minor adviser.

The department participates in the interdepartmental program in general graduate studies. (See *Index*.)

Courses primarily for undergraduate students

Phil 201. Introduction to Philosophy. (3-0) Cr. 3. F.S.SS. It has been rumored that the unexamined life is not worth living. Philosophy is an attempt to begin examining life by considering such questions as: What makes us human? What is the world ultimately like? How should we relate to other people? Is there a god? How can we know anything about these questions? Understanding questions of this kind and proposed answers to them is what this course is all about.

Phil 206. Introduction to Logic and Scientific Reasoning. (3-0) Cr. 3. F.S.SS. Basic principles of critical reasoning and argument evaluation. A consideration of basic forms of argumentation in science and everyday life. Application to contemporary issues and controversies.

Phil 207. Introduction to Symbolic Logic. (Cross-listed with Ling). (3-0) Cr. 3. S. Introduction to fundamental logical concepts and logical symbolism. Development of natural deduction through first order predicate logic with identity. Applications to arguments in ordinary English and to philosophical issues. Majors should take Phil 207 as early as possible.

Phil 230. Moral Theory and Practice. (3-0) Cr. 3. F.S.SS. Investigation of moral issues in the context of major ethical theories of value and obligation; e.g., punishment, abortion, economic justice, job discrimination, world hunger, and sexual morality. Emphasis on critical reasoning and argument analysis.

Phil 235. Ethical Issues in A Diverse Society. (3-0) Cr. 3. S. This course will examine a range of arguments on diversity issues. Topics will include: the social status of women, the moral status of sexuality and homosexuality, the nature and role of racism in contemporary society, the relationship between biology, gender roles and social status, and various proposals for change from a variety of political perspectives.

Phil 310. Ancient Philosophy. (Cross-listed with Cl St). (3-0) Cr. 3. F. *Prereq: 201.* Survey of ancient Greek philosophy, focusing on the pre-Socratics, Plato, and Aristotle. Questions concerning being, knowledge, language, and the good life are treated in depth. Nonmajor graduate credit.

Phil 314. 17th Century Philosophy. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 201.* Readings from philosophers such as Hobbes, Descartes, Spinoza, Leibniz, and Locke. Changing conceptions of knowledge, self, and deities in response to Galileo's new science and post-reformation challenge to ecclesiastical authority. Nonmajor graduate credit.

Phil 315. 18th Century Philosophy. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 201.* Readings from philosophers such as Berkeley, Hume, and Kant. Development of Enlightenment thought. Issues include idealism, causation, freedom, and knowledge regarding science, ethics, and deities. Nonmajor graduate credit.

Phil 316. 19th Century Continental Philosophy. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 201.* The thought of Hegel, Marx, Nietzsche, and their contemporaries. Various perspectives on the philosophy of history, the nature of reason and subjectivity, the contrast between dialectical and nondialectical philosophy, and the relationship between philosophy and society. Nonmajor graduate credit.

Phil 317. 20th and 21st Century Continental Philosophy. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 201.* Major movements of 20th and 21st century thought, such as Phenomenology, Critical Theory, Post-structuralism, Postmodernism, and Feminism. Issues include the assumptions and limits of Western metaphysics, the nature of reason, the relationship between language and power. Nonmajor graduate credit.

Phil 318. 20th and 21st Century Anglo-American Philosophy. (3-0) Cr. 3. S. *Prereq: 201.* Major movements in recent and contemporary philosophy such as realism, logical positivism, ordinary language philosophy, and naturalism. Russell, Wittgenstein, Quine and other leading figures. Topics include knowledge of the material world, mind, language, values, and philosophical method. Nonmajor graduate credit.

Phil 320. Existentialism and Its Critics. (3-0) Cr. 3. F. *Prereq: 201.* An investigation of Existentialism and its critics in historical and cultural context. Emphasis on existential phenomenology and French existentialism, and on criticisms. Existential Marxism and Heidegger's later philosophy. Nonmajor graduate credit.

Phil 330. Ethical Theory. (3-0) Cr. 3. F. *Prereq: 201 or 230.* Major theories in normative ethics and metaethics. Includes such views as relativism, emotivism, and absolutism. Comparison of ethics with science and how moral judgments are justified. Nonmajor graduate credit.

Phil 331. Moral Problems in Medicine. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 230 or junior classification.* In-depth study of some of the central moral problems arising in medicine, e.g., abortion, euthanasia, patients' rights, health care professionals' duties and responsibilities, allocation of medical resources. Major moral theories will be examined and applied. Nonmajor graduate credit.

Phil 332. Philosophy of Law. (Cross-listed with CJ St). (3-0) Cr. 3. F.S. *Prereq: 201 or 230.* Extent of our obligation to obey the law; what constitutes just punishment; how much of the immoral should be made illegal? Relation of these questions to major theories of law and the state. Discussion of such concepts as coercion, equality, and responsibility. Nonmajor graduate credit.

Phil 333. Family Ethics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 3 credits in philosophy.* Moral dimensions of marriage and love, parent-child relations, domestic work, and moral education. Can parents and children be friends? What do children "owe" their parents? Is there a feminist mode of moral thinking? Nonmajor graduate credit.

Phil 334. Environmental Ethics. (Cross-listed with Env S). (3-0) Cr. 3. F. *Prereq: 3 credits in philosophy or junior classification.* Thorough study of some of the central moral issues arising in connection with human impact on the environment, e.g., human overpopulation, species extinction, forest and wilderness management, pollution. Several world views of the proper relationship between human beings and nature will be explored. Nonmajor graduate credit.

Phil 335. Social and Political Philosophy. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 201 or 230.* Foundations of social and political life. The basis of political organization, the nature of social and political institutions, rights and authority, justice. Original texts. Nonmajor graduate credit.

Phil 336. Bioethics and Biotechnology. (3-0) Cr. 3. *Prereq: Phil 201 or 230 or 235.* In-depth study of some central moral issues in the life sciences, e.g., genetic screening and testing, genetically engineered plants and animals, risk analysis, biotechnology patents, research ethics, biodiversity, the impact of biotechnology on society and the environment. Major moral theories will be discussed and applied. (Phil 336 contains almost no similarities to Phil 331.) Nonmajor graduate credit.

Phil 338. Feminist Philosophy. (Cross-listed with W S). (3-0) Cr. 3. F. *Prereq: 3 credits in philosophy or women's studies recommended.* A critical, theoretical examination of the oppression of women, especially as it relates to issues of race, class, and sexual orientation. How concepts such as sex and gender, self and other, nature and nurture, complicate our understanding of what it means to be a woman. Historical and contemporary feminist philosophers addressing topics such as violence, sexuality, pornography, political power, family structure and women's paid and unpaid labor. Nonmajor graduate credit.

Phil 340. Aesthetics. (3-0) Cr. 3. F. *Prereq: 201 or 230.* Is liking all there is to appreciating works of art or natural beauty? We will examine our appreciative experiences, talk about such experiences (e.g., art criticism), and what makes them valuable. Do the different arts have common values? How are their differences important? Nonmajor graduate credit.

Phil 343. Philosophy of Technology. (Cross-listed with T SC). (3-0) Cr. 3. F.S. *Prereq: 6 credits of social science or T SC 341 and 3 credits of social science.* Moral and other philosophical problems related to developments in technology. Topics may include conditions under which technological innovations contribute to human emancipation, relationship of technology and democracy, utility and limits of technical rationality, and problems of ensuring that benefits of technological advance are communally shared. Topics discussed with reference to such issues as contemporary developments in microelectronics, technology transfer to the Third World, etc. Nonmajor graduate credit.

Phil 350. Philosophy of Religion. (Cross-listed with Relig). (3-0) Cr. 3. F. *Prereq: 201.* The value and truth of religious life and belief. Mystical experience; religious faith and language; arguments for God's existence; the problem of evil; miracles; and religion and morality. Historical and contemporary readings. Nonmajor graduate credit.

Phil 364. Metaphysics: God, Minds, and Matter. (3-0) Cr. 3. S. *Prereq: 3 credits in philosophy.* A survey of classical and contemporary views on some basic metaphysical issues. Issues discussed include: Does God exist? Do you have a mind and, if so, how does it relate to your body? What is the nature of cause and effect? Do objects have any essential properties? How can we account for properties objects have in common? Nonmajor graduate credit.

Phil 366. Truth, Belief and Reason. (3-0) Cr. 3. F. *Prereq: 201 or permission of instructor.* This course focuses on significant topics in theory of knowledge, including the value of true beliefs, the role of sense experience in supporting our theoretical views, and the place of reason in human nature. Historical and contemporary views will be considered.

Phil 380. Philosophy of Science. (3-0) Cr. 3. F. *Prereq: 201 or 6 credits in a science.* Introduction to the philosophy of science. A variety of basic problems common to the natural and social sciences: the nature of explanation, the structure of theories, the unity of science, and the distinction between science and nonscience. Nonmajor graduate credit.

Phil 381. Philosophy of the social and Behavioral Sciences. (3-0) Cr. 3. S. *Prereq: 201 or 6 credits in the social sciences.* Methodological, ideological, and doctrinal issues about the social and behavioral sciences against the background of influence of the natural sciences. Focus is on the historical and cultural background of 19th and 20th century western thought. Nonmajor graduate credit.

Phil 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period. Nonmajor graduate credit.

Phil 430. Value Theory. (3-0) Cr. 3. Repeatable. S. *Prereq: 230.* Theoretical and normative issues in ethics, aesthetics, religious thought, or political philosophy. Topics vary each time offered. Nonmajor graduate credit.

Phil 450. Persons and Causes. (3-0) Cr. 3. Repeatable. F. *Prereq: 3 credits in philosophy; 207 strongly encouraged.* Personal identity, agency, free will, moral responsibility, causation, future contingents, and time will be discussed. What makes a person the same person over time? Do humans have free will? Are we not morally responsible if our actions are inevitable consequences of the past and the laws of nature? What distinguishes causes from non-causes? Are there facts about the future? Nonmajor graduate credit.

Phil 460. Epistemology and Metaphysics. (3-0) Cr. 3. Repeatable. S. *Prereq: 6 credits in philosophy.* Issues in epistemology and metaphysics. Topics vary each time offered. Nonmajor graduate credit.

Phil 465. Brains, Minds, and Computers. (3-0) Cr. 3. F. *Prereq: 201.* Examination of concepts such as computability, intelligence, programming, and free will; and of arguments about whether any human capacity is forever beyond realization in a machine. Nonmajor graduate credit.

Phil 480. Controversies in Science. (3-0) Cr. 3. Repeatable. S. *Prereq: 3 credits in philosophy or 6 credits in a natural or social science.* Philosophical treatment of a branch of science that has (or has had) significant social, political, religious and/or moral implications. Possible topics include: the IQ debate, implications of Darwinism, the Galileo affair, the role of values in science, critical analysis of current science policy (e.g., the Human Genome Project). Topics will be arranged to meet the needs of interested students. Often team taught by a philosopher and a scientist from the relevant discipline. Nonmajor graduate credit.

Phil 483. Philosophy of Biology. (3-0) Cr. 3. S. *Prereq: 3 credits in philosophy or 3 credits in biology.* Biology is powerful, both as a science and in its effects on our culture. Philosophy of biology evaluates this power. Possible topics include: What makes sciences such as evolutionary theory, ecology or molecular biology so good at explaining things? What is life? Can evolution account for design? What role does chance play in evolution? Has there been progress in the evolution of life on earth? What can sociobiology tell us about human nature, behavior and culture? Nonmajor graduate credit.

Phil 485. Philosophy of Physics. (3-0) Cr. 3. *Prereq: 3 credits in Philosophy or 3 credits in Physics.* S. Conceptual and philosophical issues relating to the interpretation of theories in classical and modern physics. May include one or more of the following topics: the relationship between mathematics and the physical world; Newtonian physics (determinism and predictability); thermodynamics and statistical physics (the nature of probability; entropy and the direction of time); relativistic physics (indeterminism; realism and nonlocality; consciousness and the role of the observer). Nonmajor graduate credit.

Phil 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in philosophy; permission of instructor, approval of chairman.* Guided reading and research on special topics selected to meet needs of advanced students. No more than 9 credits of Phil 490 may be counted toward graduation.
H. Honors

Phil 492. Graduating Senior Survey. Cr. R. F.S. *Prereq: Graduating senior.* Final presentation for graduation and the future. Outcomes assessment activities. Satisfactory-fail only.

Phil 496. Ecology and Society. (Dual-listed with 596). (3-0) Cr. 3. *Prereq: Graduate classification in biological or environmental sciences/studies with at least one course in ecology.* Analysis of conceptual and methodological debates in ecology. Historical development of competing research traditions and philosophies. Topics include i) methodological issues in ecological science, ii) conceptual issues in theoretical ecology, iii) conceptual issues in applied ecology, iv) relation of ecology to environmental and social issues. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Phil 535. Contemporary Political Philosophy. (Cross-listed with Pol S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits of philosophy or political science.* Examination of theories of justice proposed by contemporary political philosophers. Analysis of the philosophical foundations of perspectives such as liberalism, libertarianism, communitarianism, socialism, feminism. Normative assessments of socio-political institutions.

Phil 590. Special Topics in Philosophy. Cr. arr. Repeatable. *Prereq: Permission of instructor, 9 credits in philosophy.*
A. History of Philosophy
B. Epistemology and Metaphysics
C. Value Theory
D. Logic and Philosophy of Science

Phil 596. Ecology and Society. (Dual-listed with 496). (Cross-listed with EEOB). (3-0) Cr. 3. *Prereq: Graduate classification in biological or environmental sciences/studies with at least one course in ecology.* Analysis of conceptual and methodological debates in ecology. Historical development of competing research traditions and philosophies. Topics include i) methodological issues in ecological science, ii) conceptual issues in theoretical ecology, iii) conceptual issues in applied ecology, iv) relation of ecology to environmental and social issues.

Religious Studies (Relig)

Undergraduate Study

Religious studies gives students the opportunity to investigate and reflect on the world's religions in an objective, critical, and appreciative manner. Though there is emphasis in religious studies on the wide variety of religious phenomena as well as on the various methods in the study of religion, the aim is to help students develop their own integrated understanding of the nature of religion and its role in individual and social life.

Graduates of the religious studies program have knowledge of the religious diversity in the United States and the world. They have the ability to interpret religion empathetically and critically and to compare and contrast historical and contemporary differences and similarities of religious systems. They understand ways in which religion influences and is influenced by the historical, social, and cultural contexts in which religious systems function. Graduates often pursue careers in non-profit, community organizations; apply to professional schools or graduate programs; or enter seminaries to prepare for ministry.

The program provides students with the following opportunities: to major or minor in religious studies, to fulfill group requirements, to take religious studies courses that are integrated into another major, to take religious studies courses as electives, and to develop an interdisciplinary studies major. (See the professor in charge of the religious studies program for advice.)

The major in religious studies seeks to provide both breadth and depth. Breadth is provided through the exploration of the world's various religious traditions and through exposure to a variety of theoretical approaches and methodologies in the academic study of religion. Depth is achieved through specialized courses in particular religious traditions and particular issues in the study of religions, culminating in research seminars. The objective is to expose the student to various components of the discipline of Religious Studies and by doing so develop skills that are valuable in a number of careers and that provide the necessary foundation for pursuing graduate studies.

Students pursuing a major in religious studies must complete a minimum of 33 credits, including the following requirements:

1. Either Relig 205, Introduction to World Religions or Relig 210, Religion in America.

2. One course from Judaism or Christianity:
Relig 220, Introduction to the Bible.
Relig 242, History of Christianity.
Relig 280, Introduction to Catholicism.
Relig 321, Old Testament.
Relig 322, New Testament.
Relig 333, Introduction to Judaism.

3. Either 356, African Religions or 358, Introduction to Islam.

4. Either 352, Religious Traditions of India or 353, Buddhism.

5. One course from Religion, Culture, and Society.
Relig 328, American Indian Religions.
Relig 334, African American Religious Experience.
Relig 336, Women and Religion.
Relig 339, Goddess Religions.
Relig 342, Religion and U.S. Lation/a Literature.
Relig 370, Religion and Politics.
Relig 377, Social Dimensions of Religion.
Relig 384, Religion and Ecology.

6. Relig 385, Theory and Methods in the Study of Religion.

7. Three hours of Relig 475, Seminar.

8. A minimum of 12 credits of elective Religious Studies courses.

The program offers a minor which may be earned by completing a total of 15 credits in religious studies including either Relig 205 or 210. Nine hours must be in courses at the 300 level or above (no more than 3 hours of seminar and no more than 3 hours of independent study).

Communication Proficiency requirement: The department requires a grade of C or better in each of English 150 and 250 (or 250H), and requires one 300 level course in religious studies in which writing is evaluated as acceptable.

Students may choose to do a senior thesis under the supervision of a religious studies faculty adviser. This option may earn 3-6 credits toward the completion of the major.

Graduate Study

The program offers courses for nonmajor graduate credit in religious studies as supporting work in other fields. Religious studies may also be one of the three areas used for the interdisciplinary graduate studies master's degree.

Courses primarily for undergraduate students

Relig 205. Introduction to World Religions. (3-0) Cr. 3. F.S.SS. An introduction to the academic study of religions, including myths, beliefs, rituals, values, social forms. Examples chosen from oral cultures and major religions of the world.

Relig 210. Religion in America. (3-0) Cr. 3. F.S.SS. Introductory study of the major beliefs, practices, and institutions of American Judaism, Catholicism, Protestantism, and Islam with emphasis on the diversity of religion in America, and attention to issues of gender, race, and class.

Relig 220. Introduction to the Bible. (3-0) Cr. 3. F.S. Basic overview of the contents of the Old and New Testament in light of their ancient socio-historical background, and with attention to a variety of interpretations and relevance to modern American society.

Relig 242. History of Christianity. (3-0) Cr. 3. F.S.SS. An introduction to Christian thought and practice from an historical point of view, stressing the development of belief, spirituality, and organization, and the continuities and changes involved in these developments.A. The Early Church through the Medieval period. B. The Reformation period to the present time.

Relig 280. Introduction to Catholicism. (3-0) Cr. 3. F. An explanation of the beliefs, spirit, and practices of Roman Catholicism, including its understanding of God, sacramentality, the human person, and community, and its relationship to other forms of Christianity and other world religions.

Relig 321. Old Testament. (3-0) Cr. 3. F. An in-depth study of the literature and religion of ancient Israel in light of recent archaeological discoveries, research about the ancient Near East, and a variety of interpretations. Nonmajor graduate credit.

Relig 322. New Testament. (3-0) Cr. 3. S. A detailed survey of the sacred scriptures of Christianity in light of recent archaeological discoveries and historical research about their Greco-Roman and Jewish background. Nonmajor graduate credit.

Relig 323. Science and Religion. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of changing interplay of science and religion in our understanding nature, from the trial of Galileo to the reception of Darwin.

Relig 328. American Indian Religions. (Cross-listed with Am In). (3-0) Cr. 3. An introduction to the beliefs and rituals of Native American religious traditions, with attention to cultural and historical contexts and implications. Nonmajor graduate credit.

Relig 333. Introduction to Judaism. (3-0) Cr. 3. An introduction to basic Judaism. Special attention is given to Jewish sacred texts, rituals, social practices, and modern forms.

Relig 334. African American Religious Experience. (Cross-listed with Af Am). (3-0) Cr. 3. F. *Prereq: Prior course work in Religious Studies or African American Studies required.* Examination of the African American experience from the perspective of black religion and the black church, with attention to political, economic, and social, as well as spiritual, concerns. Nonmajor graduate credit.

Relig 336. Women and Religion. (Cross-listed with W S). (3-0) Cr. 3. F. *Prereq: 105, 210 or W S 201 recommended.* Examines the status of women in various religions, feminist critiques of religious structures and belief systems, and contemporary women's spirituality movements. Nonmajor graduate credit.

Relig 339. Goddess Religions. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Relig 205 recommended.* Exploration of the foundational myths of Goddess spirituality, including historical and cross-cultural female images of the divine and their modern usage by American women. Nonmajor graduate credit.

Relig 340. Magic, Witchcraft, and Religion. (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 201 or 306.* Origin and development of indigenous magico-religious systems; myth and ritual; therapeutic aspects; symbols and meanings; religion and sociocultural change, including acculturation, nativistic, and revitalization movements.

Relig 342. Religion and U.S. Latino/a Literature. (3-0) Cr. 3. Alt. S., offered 2010. A study of the religious behavior and attitudes expressed in the literature of Mexican Americans, Puerto Ricans, Cuban Americans and other groups of people living in the U.S. who trace their ancestry to the Spanish-speaking countries of Latin America. Nonmajor graduate credit.

Relig 348. Psychology of Religion. (Cross-listed with PSYCH). (3-0) Cr. 3. *Prereq: Nine credits in psychology.* Survey of psychological theory and research investigating religious and spiritual attitudes, beliefs and practices.

Relig 350. Philosophy of Religion. (Cross-listed with Phil). (3-0) Cr. 3. F. *Prereq: Phil 201.* The value and truth of religious life and belief. Mystical experience; religious faith and language; arguments for God's existence; the problem of evil; miracles; and religion and morality. Historical and contemporary readings. Nonmajor graduate credit.

Relig 352. Religious Traditions of India. (3-0) Cr. 3. *Prereq: Prior course work in Asian, Asian-American or Religious Studies or Anthropology required.* Examines the religious traditions of India, including Hinduism, Jainism, and Skihism, through text, ritual, and contemporary practice. Nonmajor graduate credit.

Relig 353. Buddhism. (3-0) Cr. 3. S. The various Buddhist paths to realize enlightenment and freedom. Special attention to meditation and yoga and their relationship to altered states of consciousness and to social contexts. Nonmajor graduate credit.

Relig 356. African Religions. (3-0) Cr. 3. *Prereq: Prior course work in African, African-American or Religious Studies or Anthropology required.* An introduction to the teachings, practices, and history of the religions that originated in Africa and other religions which have gained substantial followings among African peoples. Nonmajor graduate credit.

Relig 358. Introduction to Islam. (3-0) Cr. 3. An introduction to Islamic religion, culture, and society from 700 to the present. Nonmajor graduate credit.

Relig 360. Religious Ethics. (3-0) Cr. 3. Investigates different religious ethical theories and traditions of reasoning about practical moral issues (e.g., abortion, the just distribution of wealth, environmental ethics). Explores in detail the relationship between religious beliefs and moral practice.

Relig 367. Christianity in the Roman Empire. (Cross-listed with Cl St). (3-0) Cr. 3. An historical introduction to the rise of Christianity in the Roman empire, with special attention to the impact of Greco-Roman culture on the thought and practice of Christians and the interaction of early Christians with their contemporaries. Nonmajor graduate credit.

Relig 370. Religion and Politics. (Cross-listed with Pol S). (3-0) Cr. 3. *Prereq: Relig 105 or 210 recommended.* The interaction of religion and politics in the U.S. from both an historical and contemporary perspective, as well as the role of religion in politics internationally. Nonmajor graduate credit.

Relig 376. Classical Archaeology. (Cross-listed with Cl St, Hist). (3-0) Cr. 3. Repeatable. S. Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.
A. Bronze Age (Minoan and Mycenaean palatial cultures) and Early Iron Age Greece. (ca 3000-700 BC).
B. Archaic through Hellenistic Greece (ca 700-30 BC).

Relig 377. Social Dimensions of Religion. (Cross-listed with Soc). (3-0) Cr. 3. *Prereq: Prior course work in Religious Studies or Sociology required.* The influence of religion in society, both as a conservator of values and as a force for social change. Nonmajor graduate credit.

Relig 380. Catholic Social Thought. (3-0) Cr. 3. S. Examines biblical roots of and major developments in Catholic social thought. Contemporary issues such as human rights, economic justice, the environment, and war and peace will be treated using principles of Catholic ethics, social analysis, official church documents, and contributions of notable theologians and activists. Nonmajor graduate credit.

Relig 384. Religion and Ecology. (Cross-listed with Env S). (3-0) Cr. 3. Introduction to concepts of religion and ecology as they appear in different religious traditions, from both a historical and contemporary perspective. Special attention to religious response to contemporary environmental issues. Nonmajor graduate credit.

Relig 385. Theory and Method in Religious Studies. (3-0) Cr. 3. *Prereq: 6 credits in Religious Studies or permission of instructor.* Examines the variety of theories and methods employed in the study of religion. Application of these methods to various religions of the world. Nonmajor graduate credit.

Relig 475. Seminar: Issues in the Study of Religion. (3-0) Cr. 3. *Prereq: 6 credits in religious studies.* Topic changes each time offered. Closed to freshmen. Sophomores must have approval of instructor. Nonmajor graduate credit.

Relig 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in religious studies, and permission of instructor, approval of professor in charge of program.* Guided reading and research on special topics selected to meet the needs of advanced students. No more than 9 credits of Relig 490 may be counted toward graduation.
H. Honors

Relig 491. Senior Thesis. Cr. 3. Written under the supervision of a Religious Studies faculty advisor.

Relig 494. Special Studies in Religious Research Languages. Cr. arr. Repeatable. *Prereq: 6 credits in Religious Studies and permission of instructor.*

Relig 499. Peace and Justice Internship. Cr. arr. Repeatable. *Prereq: 3 credits in religious studies, permission of faculty internship coordinator.* Supervised placement with a peace and justice agency; structured reflection on the relation of religion and practical social issues. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Relig 590. Special Topics in Religious Studies. Cr. arr. Repeatable. *Prereq: Permission of instructor, 9 credits in religious studies.*

Physics and Astronomy

www.physics.iastate.edu/

Joseph Shinar, Chair of Department

Distinguished Professors: Canfield, Goldman, Harmon, Ho, Johnston, Soukoulis

Distinguished Professors (Emeritus): Clem, Finnemore, Lynch, Swenson

University Professor: Willson

Professors: Anderson, Carter-Lewis, Crawley, Hauptman, Hill, Kawaler, Krennrich, Lajoie, Luban, Ogilvie, Qiu, Rosenberg, Schmalian, Shinar, Struck, Tringides, Valencia, Vary, Whisnant, Wolford

Professors (Adjunct): Meyer, Vaknin

Professor (Collaborator): Womersley

Associate Professors: Cochran, Mcqueeney, Pohl, Prell, Rosati, Travesset-Casas

Associate Professors (Adjunct): Biswas, Budko, Kogan

Assistant Professors: Kaminski, Kerton, Prozorov, Sivasankar, Tuchin, Wang, Yu

Assistant Professor (Adjunct): Kreyssig

Senior Lecturers: Atwood, Herrera-Siklody

Lecturers: Fretwell, Frishman, Levin, Meyers, Schuler, Shirokov

Undergraduate Study

For the undergraduate curriculum in liberal arts and sciences, major in physics, leading to the degree bachelor of science, see *Liberal Arts and Sciences, Curriculum.*

Physics and astronomy are basic natural sciences which attempt to describe and provide an understanding of both our world and our universe. Physics serves as the underpinning of many different disciplines including the other natural sciences

and technological areas. Graduates are proficient in the methods of rigorous scientific analysis, relevant mathematical techniques, and modern computational and laboratory methods. They have a broad knowledge of physics, including mechanics, electricity and magnetism, thermodynamics, and modern physics. They are able to communicate clearly and effectively at general and technical levels. They are prepared to pursue a wide range of careers as a professional physicist, astronomer, or science educator. They are also prepared to pursue advanced studies and careers in areas as diverse as engineering, medicine, law, and business administration.

Many opportunities exist for students who terminate their studies with a bachelor's degree, especially when combined with technology studies in other areas. Students who meet the necessary scholastic standards often continue their studies in a graduate college, exploring and contributing to new developments in the field.

The department normally expects each student majoring in physics to complete at least the following courses: Phys 221, 222, 321, 321L, 322, 322L, 304, 306, 361, 362, 364, 365, and three credits of laboratory work chosen from 310, 311, 311T, 470L, or Astro 344L. All students are required to earn at least 5 credits in laboratory work in physics in addition to the laboratory components of Phys 221 and 222. These 5 credits must be in courses numbered 300 or higher or in approved substitutions. All students must earn at least 20 credits in physics and astronomy courses numbered 304 or higher. The basic list of expected courses is not a rigid requirement and changes in this basic list will be approved by the department curriculum committee on recommendation of the student's adviser when such changes will better serve the student's needs. In particular, students planning a physics major and also seeking certification for high school teaching may, with the approval of their adviser, follow a significantly different program designed to meet their particular needs; these students should consult the department for further information. Further information concerning programs of study, including sample degree programs, is available from the department.

Students majoring in physics who wish an emphasis in astronomy/astrophysics should consider a minor in astronomy (see below). Those planning graduate work in physics or astronomy/astrophysics should add to the basic list the courses Phys 480 and 481. Other useful courses include Phys 496, Math 365, 426, and 471, and Stat 447. One or more of Astro 405, Phys 511 or 526 may also be added according to interest.

The department offers a minor in physics which may be earned by completing 20 credits in physics courses chosen as follows: Phys 221, 222; 321; at least one credit of laboratory chosen from 321L, 322L, 310, 311, and 311T. Other acceptable courses are 304, 306, 322, 361, 362, 364, 365, 480, 481, and 496.

The department offers a minor in astronomy which may be earned by completing 15 credits chosen as follows: a total of 12 or more credits in Astro courses (must include Astro 344L and may include one of the courses Astro 120, Astro 150 or Astro 250), with the remaining 3 credits (if applicable) chosen from among Physics 304, 321, 361, 362, 364, 365, 480, 481, or 496; 12 or more credits must be at the 300 level or higher. Note that the same course may not be used to satisfy both the requirements of a physics major and an astronomy minor.

Communication Proficiency requirement: The department requires a grade of C or better in each of Engl 150 and 250 (or 250H), and a C– or better in Engl 302, 305, 309 or 314. Students are also encouraged to study at least one foreign language.

The expected outcomes for students in these programs are: (1) a broad knowledge of physics, including mechanics, electricity and magnetism, thermodynamics, wave motion and modern physics; (2) proficiency in laboratory methods; (3) proficiency in modern scientific computational methods; and (4) a sound foundation in the liberal arts including proficiency in communication skills.

In addition to the performance on exams and course grades, information on evaluating of the success in meeting these goals is obtained by: (1) an annual written survey of all students majoring in the program: (2) an annual written survey of all graduating seniors; (3) a periodic written survey of program alumni; (4) student evaluations of all courses; (5) adviser evaluations; and (6) a bimonthly meeting of program majors with the department chair.

Graduate Study

The department offers studies for the degrees master of science and doctor of philosophy with majors at both levels in applied physics, astrophysics, condensed matter physics, high energy physics, nuclear physics, and physics; and minor credit courses for students majoring in other departments.

Facilities of various research groups of the department, the Ames Laboratory, and the Applied Science Center, including the Microelectronics Research Center, are available for research.

Students with bachelor's degrees in physics or astronomy from other institutions ordinarily will qualify for graduate study at Iowa State provided they have satisfactorily completed course work similar to that suggested for undergraduate majors here intending to go on to graduate school. In some cases additional instruction at the intermediate level may be required.

Graduates have a broad understanding of physical science, as well as mastery of state-of-the-art methods in their area of specialization. They are able to communicate effectively to a wide range of audiences, from the general public to research colleagues. Their skills in rigorous scientific thinking prepare them for leadership in the broader community. They are skilled in carrying out research, communicating research results, and soliciting research support. They have considerable teaching experience. They have developed problem solving skills that prepare them for careers in either industry or academia.

All candidates for an advanced degree in physics are expected to complete Phys 531, 564, 571, 572, 591 and 592. Candidates for an advanced degree in applied physics are expected to complete Phys 571, 591, 470L (6 cr.), 699 (3 cr.), and either 572. Candidates for an advanced degree in astrophysics should complete Phys 531 and/or 564, Phys 571, Phys 591, Astro 505, and Astro 510. Astrophysics Ph.D. candidates must take at least three of the 580 level Astro courses, while candidates for the Research Masters must take at least two 580 level Astro courses.

Except for the applied physics major where a thesis is always required, the degree master of science is offered both with and without thesis. For all areas of study except applied physics the basic requirements for the M.S. are the same: at least 30 credits of acceptable graduate work must be completed, not less than 21 of which must be in physics or astronomy. Students must complete not less than 6 credits from outside their major area, with 3 credits being required from outside the department, and 3 credits from a 500 or 600 level course in another area of specialization. Students choosing a M.S. degree with thesis may apply up to 8 credits of 699 but no credits of 599 toward the minimum 30 credits. Students choosing a degree without thesis should apply 2 credits of 599, but may not apply any credits of 699 toward the minimum 30 credits.

Students whose major area is applied physics must complete at least 30 credits of acceptable graduate work for the M.S. degree and not less than 19 credits of these must be in the required courses listed above; the remaining 11 credits of the 30 credit minimum may be chosen freely either from within the student's major area or from without and either from the department or outside, but it should be noted that not more than 3 credits of Phys 699 may be applied toward the 30 credit minimum.

In addition to course work in the major area of study, all candidates for the Ph.D. degree must complete 12 credits from outside this area. Of these 6 must be taken from other departments and 6 must be taken from the department with the additional constraint that this latter 6 must include at least one 500 or 600 level introductory course in another area of specialization. Each candidate for the Ph.D. degree is required to teach one year of elementary physics or astronomy.

Graduate students interested in a physics minor should contact the department for requirements.

Astronomy and Astrophysics (Astro)

Courses primarily for undergraduate students

Astro 102. North Star Astronomy. Cr. 1. F.S. An entirely WEB-based course covering topics in observing the sky and navigation by the stars for students with little or no previous experience. The course combines material on common naked-eye phenomena, such as daily and seasonal variations in the sky, with information on how these helped navigators determine where they are on Earth. The course "lectures" are on-line, interactive units with build in exercises, hands-on (offline) activities and layers of help. Graded homework and quizzes are administered via Web-CT. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

Astro 103. Evening Star. Cr. 1. F.S. An entirely web-based course covering topics in celestial mechanics. ("Rocket science!") For students with little or no previous experience. It combines the geography of the solar system with discussion of methods of traveling to the other planets. The course "lectures" are on-line, interactive units with built-in exercises, hands-on (offline) activities, and layers of help. Graded homework and quizzes are administered via WebCT. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

Astro 120. The Sky and the Solar System. (3-0) Cr. 3. F.S.SS. For the nonscientist. The sky: constellations; motions of the sun, moon, and planets; seasons and the calendar; eclipses. The solar system: origin and evolution; characteristics of the sun, planets, satellites, comets, meteorites, and asteroids. Extensive use of the planetarium is included. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

Astro 125L. The Sky and the Solar System Laboratory. (0-2) Cr. 1. F.S. *Prereq: Concurrent or previous enrollment in Astro 120.* Laboratory course to accompany Astro 120. Students carry out practical exercises involving naked eye and telescopic observing to explore and reinforce ideas covered in Astro 120. Activities based on a sky-simulation computer program and other weather-independent exercises are also included.

Astro 150. Stars, Galaxies, and Cosmology. (3-0) Cr. 3. F.S. For the nonscientist. Observational aspects of stellar astronomy: motions, distances, sizes, spectra; types of stars; variability; binary systems. Stellar evolution: the birth, life, and death of stars, including supernovae, neutron stars, and black holes. The Milky Way Galaxy: clouds of matter in space, the structure and evolution of our galaxy. Other galaxies, clusters of galaxies, quasars. Theories of the origin of the universe.

Astro 250. Astronomy Bizarre. (3-0) Cr. 3. S. *Prereq: 120 or 150.* For the nonscientist. New and exciting topics in modern astronomy. Galaxy and star formation. Black holes and pulsars. Colliding galaxies. Quasars. Cosmology, the Big Bang and the future of the universe. Prospects and searches for extraterrestrial life.

Astro 290. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

Astro 342. Introduction to Solar System Astronomy. (3-0) Cr. 3. F. *Prereq: Phys 222.* Analytical and comparative studies of solar system objects-planets, satellites, rings, asteroids, comets, meteoroids, and interplanetary dust-with emphasis on the physical processes affecting them, their interactions, and their evolution. Orbital mechanics, including perturbations, stability, and resonances. Tidal forces and effects. Radiation laws and thermal physics with applications. Brief study of the sun as a star, and of stellar evolution. Origin and evolution of the solar system. Detection of other planetary systems. Nonmajor graduate credit.

Astro 344L. Astronomy Laboratory. (1-6) Cr. 3. F. *Prereq: Phys 222.* Experiments in optical astronomy. Observational techniques, ranging from stellar photometry to CCD imaging. Available instruments include a variety of small telescopes up to 14-inch in size. Class meets at Fick Observatory south of Boone. Nonmajor graduate credit.

Astro 346. Introduction to Astrophysics. (3-0) Cr. 3. S. *Prereq: Phys 222.* Basic radiation theory; spectra. Observational determination of stellar properties; spectral classification. Binary systems. Stellar structure and evolution. White dwarfs, neutron stars, black holes. The Galaxy: structure and composition; the interstellar medium. Other galaxies; active galaxies; cosmology. Nonmajor graduate credit.

Astro 405. Astrophysical Processes. (Dual-listed with 505). (3-0) Cr. 3. F. *Prereq: 346 or permission of instructor.* Survey of astrophysical processes relating to stars, galaxies and the Universe. Radiation transport, radiation processes, scattering, kinetic description of plasma, hydrodynamics, magnetohydrodynamics, MHD waves, shocks, properties of systems in local thermodynamic equilibrium, non-thermal systems, astrophysical effects of general relativity.

Astro 450. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Research under supervision of astronomy faculty.

Astro 450L. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: 344L and permission of instructor.* Laboratory or observational project under supervision of astronomy faculty.

Astro 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in astronomy, permission of instructor.* No more than 9 credits of Astro 490 may be counted toward graduation.
H. Honors

Courses primarily for graduate students, open to qualified undergraduate students

Astro 505. Astrophysical Processes. (Dual-listed with 405). (3-0) Cr. 3. F. *Prereq: 346 or permission of instructor.* Survey of astrophysical processes relating to stars, galaxies and the Universe. Radiation transport, radiation processes, scattering, kinetic description of plasma, hydrodynamics, magnetohydrodynamics, MHD waves, shocks, properties of systems in local thermodynamic equilibrium, non-thermal systems, astrophysical effects of general relativity.

Astro 510. Observational Astrophysics. (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 405 or 505.* Techniques in optical and near-IR astronomy, including spectroscopy and CCD photometry. Emphasis on projects involving proficiency in the use of research telescopes and modern instrumentation. Project topics range from photometric studies of pulsating and binary star systems to deep CCD imaging of faint nebulae and galaxies.

Astro 580. Stellar Astrophysics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 405 or 505.* The interior structure and atmospheric properties of stars: Stellar structure equations and constitutive relations: energy generation, energy transport by radiation and convection; equation of state, nuclear energy generation and nucleosynthesis. Numerical and analytic solutions to the equations of structure and evolution. Observational connections through the theory of radiative transfer. Line and continuum processes and sources of opacity. Non-LTE and statistical equilibrium. Line profiles. Interpretation of stellar spectra: temperature, pressure, and abundance determinations. Stellar evolution from formation to final phases.

Astro 582. High Energy Astrophysics. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 405 or 505.* Interactions of high-energy particles, non-thermal radiation processes, spectral evolution of non-thermal systems, cosmic rays, active galactic nuclei, pulsars, neutrinos, measurement techniques for relativistic charged particles, high energy photons, and neutrinos.

Astro 584. Galactic Astronomy. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 405 or 505.* Overall structure of our Galaxy and the interstellar medium. Physical processes in the interstellar medium (e.g., heating and cooling mechanisms, turbulence). Observational techniques for studying the interstellar medium. Kinematics and chemical evolution of the Galaxy.

Astro 586. Extragalactic Astronomy. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 405 or 505.* Galaxy evolution, dynamics of external galaxies, evolution and classification of galaxies, groups and clusters of galaxies, extragalactic radio sources, quasars, structure formation, cosmological models and their observational consequences.

Astro 590. Special topics. Cr. arr. Repeatable.

Astro 599. Creative Component. Cr. arr. *Prereq: Permission of instructor.* Individually directed study of research-level problems for students electing the nonthesis M.S. option in astronomy.

Astro 650. Advanced Seminar. (1-0) Cr. 1. Repeatable. F.S. Topics of current interest in astronomy and astrophysics. Satisfactory-fail only.

Astro 660. Advanced Topics in Astronomy and Astrophysics. Cr. arr. Repeatable. F.S. Topics in stellar, galactic, and extragalactic astronomy, including stellar evolution, solar physics, variable stars, compact objects, the interstellar medium, active galaxies and quasars, formation and evolution of galaxies, cosmology, high energy astrophysics, advanced observational techniques, and astrophysical applications of hydrodynamics.

Astro 675. Advanced Stellar Astrophysics. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 405 or 505 and 580.* Advanced topics in stellar astrophysics. Dynamic and extended atmospheres, chromospheres, coronae, and stellar winds. MHD, stellar activity, and dynamo theory. Radiative transfer and the transition from extended atmospheres to the interstellar medium. Diffusive processes in stellar atmospheres and interiors. Techniques for quantitative analysis of planetary and stellar spectra including detailed modeling and spectrum synthesis. Evolution in interacting binaries. Nucleosynthesis II. Variable stars. Supernovae. Neutron stars and black holes.

Astro 699. Research. Cr. arr. Repeatable.

Physics (Phys)

Courses primarily for undergraduate students

Phys 101. Physics for the Nonscientist. (3-0) Cr. 3. F.S. Survey of the principal areas of both classical and modern physics. Emphasis on the nature of the physical universe and the application of physical principles to life in the modern world. Not suitable to meet a general physics requirement for natural science majors.

Phys 106. The Physics of Common Experience. (4-2) Cr. 4. F.S. Elementary topics from mechanics, heat, electricity, sound, and light, emphasizing the use of basic principles to understand everyday experience. Includes practical problem exercises and a coordinated laboratory. Not suitable to meet a general physics requirement for natural science majors.

Phys 111. General Physics. (4-2) Cr. 4. F.S.SS. *Prereq: 1 1/2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry.* General background in physical concepts, principles, and methods for those who do not plan advanced study in physics or engineering. Mechanics, fluids, heat and thermodynamics, vibrations, waves, sound.

Phys 112. General Physics. (4-2) Cr. 4. F.S.SS. *Prereq: 111.* General background in physical concepts, principles, and methods for those who do not plan advanced study in physics or engineering. Electricity and magnetism, ray and wave optics, topics in modern physics.

Phys 198. Physics of Music. (2-2) Cr. 3. F. Introductory level course on sound for nonphysics majors. Properties of pure tones and harmonics; human perception of sound; room acoustics; scales; production, and analysis of musical by voice, string, woodwind, brass, and percussion instruments. Not suitable to meet a general physics requirement for natural science majors.

Phys 199. Introductory Seminar. Cr. R. F. (1-1) Gain experience in key skills that physicists/astronomers use routinely, but are rarely explicitly taught in formal courses. Participate in faculty-led discussions on frontier areas and careers. Satisfactory-fail only.

Phys 221. Introduction to Classical Physics I. (4-1) Cr. 5. F.S.SS. *Prereq: Credit or enrollment in Math 166.* For engineering and science majors. 3 hours of lecture each week plus 3 recitations and 1 laboratory every 2 weeks. Elementary mechanics including kinematics and dynamics of particles, work and energy, linear and angular momentum, conservation laws, rotational motion, oscillations, gravitation. Heat, thermodynamics, kinetic theory of gases; waves and sound.
H. Honors. F.S.

Phys 222. Introduction to Classical Physics II. (4-2) Cr. 5. F.S.SS. *Prereq: 221, Math 166.* 3 hours of lecture each week plus 1 recitation and 1 laboratory each week. Electric forces and fields. Electrical currents; DC circuits. Magnetic forces and fields: LR, LC, LCR circuits; Maxwell's equations; ray optics and image formation; wave optics: topics in modern physics.
H. Honors. F.S.

Phys 290. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

Phys 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Phys 302. The Challenge of Contemporary Physics. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* A largely nonmathematical but intellectually challenging exploration of physics, which assumes no previous work in the field. Selected material from classical and modern physics establishes the conceptual framework for the study of major areas of contemporary physics, culminating in the discussion of topics at the frontier of present knowledge. Topics vary yearly and

may include quarks, lasers, superconductivity, fission and fusion, solid state devices, gravitational waves, string theory, facilities, left handed materials, and quantum computing. Not suitable to meet a general physics requirement for natural science majors.

Phys 304. Thermal Physics. (3-0) Cr. 3. F. *Prereq: 222, Math 266.* Concepts of temperature, entropy, and other characteristic thermodynamic functions, with application to macroscopic properties of matter. The laws of thermodynamics. Introduction to statistical mechanics, including quantum statistics. Application to black body radiation, crystalline vibrations, magnetic ions in solids, electronic heat capacity of metals. Phase transformations and chemical reactions. Nonmajor graduate credit.

Phys 306. Physics of Wave Motion. (3-0) Cr. 3. S. *Prereq: 222, credit or enrollment in Math 267.* Oscillating systems including damped and forced oscillations; fluids, geometric optics, water waves, the wave equation, Fourier and Laplace transforms, non-uniform media, cylindrical and spherical waves, polarization, interference and diffraction, transmission lines, non-linear waves.

Phys 310. Electronic Instrumentation for Experimental Physics. (2-4) Cr. 4. F. *Prereq: 222; Math 166.* Common electrical instruments; power supplies; transducers; passive and active devices, analog integrated circuits, including filters and amplifiers; digital integrated circuits; signal transmission and enhancement. Nonmajor graduate credit.

Phys 311. Intermediate Laboratory. Cr. arr. Repeatable. S. *Prereq: 322.* Experiments in classical and modern physics performed independently by each student. Nonmajor graduate credit.

Phys 311T. Intermediate Laboratory. (0-6) Cr. 3. Repeatable. S. *Prereq: 112 or 222.* Experiments in classical and modern physics performed independently by each student. For students preparing for a career in high school teaching.

Phys 321. Introduction to Modern Physics I. (3-0) Cr. 3. F. *Prereq: 222, credit or enrollment in Math 266.* Quantum nature of matter: photons, de Broglie's postulate: wave-like properties of matter; Bohr's model of hydrogen atom; Schrodinger equations in one dimension: energy quantization; detailed solutions for potential steps, barriers and wells; one-electron atoms, spin and magnetic interactions; ground states, optical and x-ray excitations of multi-electron atoms.

Phys 321L. Introductory Laboratory in Modern Physics. (0-2) Cr. 1. F. *Prereq: Credit or enrollment in 321.* Experiments related to the foundations of modern physics. The dual wave and particle character of electrons and photons, statistics, interferometry and x-ray spectroscopy.

Phys 322. Introduction to Modern Physics II. (3-0) Cr. 3. S. *Prereq: 321.* Quantum statistics; lasers; physics of molecules. Properties of solids, including electron band structure, superconductivity and magnetism. Nuclear physics, including nuclear sizes and masses, stability, decay modes, reactions, fission and fusion. Elementary particles, including strangeness, charm, and quarks. Fundamental forces of nature.

Phys 322L. Introductory Laboratory in Modern Physics II. (0-2) Cr. 1. S. *Prereq: Credit or enrollment in 322.* Experiments related to the foundations of modern physics. Radioactive decay, elementary particles, Hall effect, quantization, spectroscopy, statistics and instrumentation.

Phys 361. Classical Mechanics. (3-0) Cr. 3. F. *Prereq: 222, Math 265, 266.* Newtonian mechanics including forced oscillations, central forces and orbital motion, collisions, moving frames of reference, Lagrange's equations. Nonmajor graduate credit.

Phys 362. Intermediate Mechanics. (3-0) Cr. 3. S. *Prereq: 361.* Rigid body motion; small oscillations, normal modes. Special relativity including length contraction, time dilation, simultaneity, Lorentz transformation, 4-vector covariant formalism, relativistic mechanics. Nonmajor graduate credit.

Phys 364. Electricity and Magnetism I. (3-0) Cr. 3. F. *Prereq: 222, Math 385 or Math 395.* Static electric and magnetic fields, potential theory; electromagnetism, Maxwell's equations. Nonmajor graduate credit.

Phys 365. Electricity and Magnetism II. (3-0) Cr. 3. S. *Prereq: 364.* Relativistic electromagnetic theory; radiation and propagation of electromagnetic waves; interaction with matter. Nonmajor graduate credit.

Phys 389. Seminar. Cr. R. S. (1-0) Required of all junior physics majors. Career opportunities: graduate school programs and application, job placement, alternative careers, basic skills needed for the job market competition. Satisfactory-fail only.

Phys 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Phys 399. Seminar on Secondary School Physics. Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Review of materials and curricula for secondary school physics presented and discussed by members of the class. Required for approval to teach physics in secondary schools.

Phys 432. Molecular and Cell Biophysics. (Dual-listed with 532). (3-0) Cr. 3. S. *Prereq: 304 or Chem 325..* Quantitative description of biological systems using basic physical laws, including a brief discussion of a variety of biophysical techniques. Topics include: thermodynamics, chemical equilibrium, gene expression, structure and physical properties of nucleic acids and proteins, folding of nucleic acids and proteins, chemical kinetics, catalysis, allosteric enzymes, cell membrane structure and physical properties, and machines in cell membranes. Nonmajor graduate credit.

Phys 450. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Theoretical research under supervision of physics faculty.

Phys 450L. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: 311, permission of instructor.* Laboratory project under supervision of physics faculty.

Phys 470L. Applied Physics Laboratory. Cr. arr. Repeatable. F.S.SS. *Prereq: 322 and permission of instructor.* Studies in modern experimental techniques via experimentation and simulation in various areas of applied physics, e.g. superconductivity, optical spectroscopy, nuclear magnetic resonance, electron spin resonance, x-ray diffraction, and computation of electronic and structural properties of matter.

Phys 480. Quantum Mechanics I. (3-0) Cr. 3. F. *Prereq: 322, Math 385.* First semester of a full-year course. A systematic development of the formalism and applications of quantum mechanics. Solutions to the time independent Schrodinger equation for various one-dimensional potentials including the harmonic oscillator; operator methods; Heisenberg picture; angular momentum; the hydrogen atom; spin; symmetry properties. Nonmajor graduate credit.

Phys 481. Quantum Mechanics II. (3-0) Cr. 3. S. *Prereq: 480.* Continuation of 480. Addition of angular momentum; charged particles in electromagnetic fields; time-independent perturbation theory; variational principles; WKB approximation; interaction picture; time-dependent perturbation theory; adiabatic approximation; scattering; selected topics in radiation theory; quantum paradoxes. Nonmajor graduate credit.

Phys 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in physics, permission of instructor.* No more than 9 credits of Phys 490 may be counted toward graduation.
H. Honors

Phys 496. Modern Optics. (Cross-listed with E E). (3-0) Cr. 3. *Prereq: Credit or enrollment in Phys 322 and 365.* Review of wave and electromagnetic theory; topics selected from: reflection/refraction, interference, geometrical optics, Fourier analysis, dispersion, coherence, Fraunhofer and Fresnel diffraction, holography, quantum optics, nonlinear optics. Nonmajor graduate credit.

Phys 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

Phys 501. Oral Communication of Physics Seminar. (2-0) Cr. 1. Repeatable. F. A practical introduction to communication methods in physics and astronomy classrooms and professional settings. For graduate physics majors only. Satisfactory-fail only.

Phys 502. Introductory Research Seminar. Cr. R. F. (1-1) Discussion by research staff of their research areas, expected thesis research work, and opportunities in the field. For graduate physics majors only. Satisfactory-fail only.

Phys 511. Condensed Matter Physics I. (3-0) Cr. 3. S. *Prereq: 304, credit or enrollment in 481.* First semester of a full-year course. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

Phys 512. Condensed Matter Physics II. (3-0) Cr. 3. F. *Prereq: 511.* Continuation of 511. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

Phys 526. Particle and Nuclear Physics. (4-0) Cr. 4. S. *Prereq: Credit or enrollment in 481.* Basic properties and structures of nuclei, hadrons, and elementary particles; weak and strong interactions; the Standard Model; accelerators and detectors; nuclear models; nuclear decay and stability; nuclear astrophysics; the Higgs mechanism; the CKM matrix; running coupling constants; relativistic heavy-ion collisions; selected topics beyond the standard model such as SUSY and grand unification.

Phys 531. Statistical Mechanics. (3-0) Cr. 3. S. *Prereq: 304 and credit or enrollment in 481, Math 465, credit or enrollment in Math 365 or 426.* Thermodynamic properties of systems of many particles obeying Boltzmann, Fermi-Dirac, and Bose-Einstein statistics; microcanonical, canonical, and grand canonical ensembles and their application to physical problems; density matrices; introduction to phase transitions; renormalization group theory; kinetic theory and fluctuations.

Phys 532. Molecular and Cell Biophysics. (Dual-listed with 432). (3-0) Cr. 3. S. *Prereq: 304 or Chem 325..* Quantitative description of biological systems using basic physical laws, including a brief discussion of a variety of biophysical techniques. Topics include: thermodynamics, chemical equilibrium, gene expression, structure and physical properties of nucleic acids and proteins, folding of nucleic acids and proteins, chemical kinetics, catalysis, allosteric enzymes, cell membrane structure and physical properties, and machines in cell membranes.

Phys 534. Symmetry and Group Theory in Physics. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 481.* Theory of groups and group representations; introduction to both point and continuous groups, and their applications in physics.

Phys 535. Physics of Semiconductors. (Cross-listed with E E). (3-3) Cr. 4. *Prereq: E E 311 and E E 332.* Basic elements of quantum theory, Fermi statistics, motion of electrons in periodic structures, crystal structure, energy bands, equilibrium carrier concentration and doping, excess carriers and recombination, carrier transport at low and high fields, phonons, optical properties, amorphous semiconductors, heterostructures, and surface effects. Laboratory experiments on optical properties, carrier lifetimes, mobility, defect density, doping density.

Phys 536. Physics of Semiconductor Devices. (Cross-listed with E E). (3-0) Cr. 3. *Prereq: E E 535.* P-n junctions, band-bending theory, tunneling phenomena, Schottky barriers, heterojunctions, bipolar transistors, field-effect transistors, negative-resistance devices and optoelectronic devices.

Phys 541. General Relativity. (3-0) Cr. 3. F. *Prereq: 362 or Math 465.* Tensor analysis and differential geometry developed and used to formulate Einstein field equations. Schwarzschild and Kerr solutions. Other advanced topics may include gravitational radiation, particle production by gravitational fields, alternate gravitational theories, attempts at unified field theories, cosmology.

Phys 551. Computational Physics. (0-4) Cr. 2. S. *Prereq: 365, credit or enrollment in 481.* Use of modern computational techniques to analyze topics in classical and modern physics. Satisfactory-fail only.

Phys 564. Advanced Classical Mechanics. (3-0) Cr. 3. F. *Prereq: 362, Math 426, 465.* Variational principles, Lagrange's equations, Hamilton's canonical equations, canonical transformations, Hamilton-Jacobi theory, infinitesimal transformations, classical field theory, canonical perturbation theory, classical chaos.

Phys 571. Electricity and Magnetism I. (3-0) Cr. 3. F. *Prereq: 365, Math 426.* Electrostatics, magnetostatics, boundary value problems, Maxwell's equations, wave phenomena in macroscopic media, wave guides.

Phys 572. Electricity and Magnetism II. (3-0) Cr. 3. S. *Prereq: 571.* Special theory of relativity, least action and motion of charged particles in electromagnetic fields, radiation, collisions between charged particles, multipole fields, radiation damping.

Phys 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics of current interest.
A. Nuclear Physics
B. Condensed Matter Physics
C. High Energy Physics
D. Physics
E. Applied Physics
F. Biophysics

Phys 591. Quantum Physics I. (4-0) Cr. 4. F. *Prereq: 481.* First semester of a full-year course. Postulates of quantum mechanics; time-dependent and time-independent Schrodinger equations for one-, two-, and three-dimensional systems; theory of angular momentum; Rayleigh-Schrodinger time-independent perturbation theory.

Phys 592. Quantum Physics II. (4-0) Cr. 4. S. *Prereq: 591.* Continuation of 591. Variational theorem and WKB method; time-dependent perturbation theory; method of partial waves and Born approximation for scattering by central potentials; identical particles and symmetry; Dirac and Klein-Gordon equation for free particles; path integral formalism.

Phys 599. Creative Component. Cr. arr. *Prereq: Permission of instructor.* Individually directed study of research-level problems for students electing the nonthesis M.S. degree option.

Courses for graduate students

Phys 501. Oral Communication of Physics Seminar. (2-0) Cr. 1. Repeatable. F. A practical introduction to communication methods in physics and astronomy classrooms and professional settings. For graduate physics majors only. Satisfactory-fail only.

Phys 502. Introductory Research Seminar. Cr. R. F. (1-1) Discussion by research staff of their research areas, expected thesis research work, and opportunities in the field. For graduate physics majors only. Satisfactory-fail only.

Phys 511. Condensed Matter Physics I. (3-0) Cr. 3. S. *Prereq: 304, credit or enrollment in 481.* First semester of a full-year course. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

Phys 512. Condensed Matter Physics II. (3-0) Cr. 3. F. *Prereq: 511.* Continuation of 511. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

Phys 526. Particle and Nuclear Physics. (4-0) Cr. 4. S. *Prereq: Credit or enrollment in 481.* Basic properties and structures of nuclei, hadrons, and elementary particles; weak and strong interactions; the Standard Model; accelerators and detectors; nuclear models; nuclear decay and stability; nuclear astrophysics; the Higgs mechanism; the CKM matrix; running coupling constants; relativistic heavy-ion collisions; selected topics beyond the standard model such as SUSY and grand unification.

Phys 531. Statistical Mechanics. (3-0) Cr. 3. S. *Prereq: 304 and credit or enrollment in 481, Math 465, credit or enrollment in Math 365 or 426.* Thermodynamic properties of systems of many particles obeying Boltzmann, Fermi-Dirac, and Bose-Einstein statistics; microcanonical, canonical, and grand canonical ensembles and their application to physical problems; density matrices; introduction to phase transitions; renormalization group theory; kinetic theory and fluctuations.

Phys 532. Molecular and Cell Biophysics. (Dual-listed with 432). (3-0) Cr. 3. S. *Prereq: 304 or Chem 325.*. Quantitative description of biological systems using basic physical laws, including a brief discussion of a variety of biophysical techniques. Topics include: thermodynamics, chemical equilibrium, gene expression, structure and physical properties of nucleic acids and proteins, folding of nucleic acids and proteins, chemical kinetics, catalysis, allosteric enzymes, cell membrane structure and physical properties, and machines in cell membranes.

Phys 534. Symmetry and Group Theory in Physics. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 481.* Theory of groups and group representations; introduction to both point and continuous groups, and their applications in physics.

Phys 535. Physics of Semiconductors. (Cross-listed with E E). (3-3) Cr. 4. *Prereq: E E 311 and E E 332.* Basic elements of quantum theory, Fermi statistics, motion of electrons in periodic structures, crystal structure, energy bands, equilibrium carrier concentration and doping, excess carriers and recombination, carrier transport at low and high fields, phonons, optical properties, amorphous semiconductors, heterostructures, and surface effects. Laboratory experiments on optical properties, carrier lifetimes, mobility, defect density, doping density.

Phys 536. Physics of Semiconductor Devices. (Cross-listed with E E). (3-0) Cr. 3. *Prereq: E E 535.* P-n junctions, band-bending theory, tunneling phenomena, Schottky barriers, heterojunctions, bipolar transistors, field-effect transistors, negative-resistance devices and optoelectronic devices.

Phys 541. General Relativity. (3-0) Cr. 3. F. *Prereq: 362 or Math 465.* Tensor analysis and differential geometry developed and used to formulate Einstein field equations. Schwarzschild and Kerr solutions. Other advanced topics may include gravitational radiation, particle production by gravitational fields, alternate gravitational theories, attempts at unified field theories, cosmology.

Phys 551. Computational Physics. (0-4) Cr. 2. S. *Prereq: 365, credit or enrollment in 481.* Use of modern computational techniques to analyze topics in classical and modern physics. Satisfactory-fail only.

Phys 564. Advanced Classical Mechanics. (3-0) Cr. 3. F. *Prereq: 362, Math 426, 465.* Variational principles, Lagrange's equations, Hamilton's canonical equations, canonical transformations, Hamilton-Jacobi theory, infinitesimal transformations, classical field theory, canonical perturbation theory, classical chaos.

Phys 571. Electricity and Magnetism I. (3-0) Cr. 3. F. *Prereq: 365, Math 426.* Electrostatics, magnetostatics, boundary value problems, Maxwell's equations, wave phenomena in macroscopic media, wave guides.

Phys 572. Electricity and Magnetism II. (3-0) Cr. 3. S. *Prereq: 571.* Special theory of relativity, least action and motion of charged particles in electromagnetic fields, radiation, collisions between charged particles, multipole fields, radiation damping.

Phys 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics of current interest.
A. Nuclear Physics
B. Condensed Matter Physics
C. High Energy Physics
D. Physics
E. Applied Physics
F. Biophysics

Phys 591. Quantum Physics I. (4-0) Cr. 4. F. *Prereq: 481.* First semester of a full-year course. Postulates of quantum mechanics; time-dependent and time-independent Schrodinger equations for one-,two-, and three-dimensional systems; theory of angular momentum; Rayleigh-Schrodinger time-independent perturbation theory.

Phys 592. Quantum Physics II. (4-0) Cr. 4. S. *Prereq: 591.* Continuation of 591. Variational theorem and WKB method; time-dependent perturbation theory; method of partial waves and Born approximation for scattering by central potentials; identical particles and symmetry; Dirac and Klein-Gordon equation for free particles; path integral formalism.

Phys 599. Creative Component. Cr. arr. *Prereq: Permission of instructor.* Individually directed study of research-level problems for students electing the nonthesis M.S. degree option.

Phys 611. Quantum Theory of Condensed Matter. (3-0) Cr. 3. S. *Prereq: 512, 681.* Quasiparticles in condensed matter: phonons, magnons, photons, electrons. Quantum theory of interacting many body systems: Green's functions and diagrammatic techniques.

Phys 624. Advanced Nuclear Physics. (3-0) Cr. 3. *Prereq: 526 and 592.* Microscopic few-body and many-body theory; theory of effective Hamiltonians; relativistic nuclear physics; nuclear effects in hadron-nucleus, lepton-nucleus, and nucleus-nucleus reactions.

Phys 625. Physics of Strong Interactions. (3-0) Cr. 3. *Prereq: 681.* Quark model; Quantum Chromodynamics IQCD); perturbation methods for QCD; effective field theories for pions and nucleons; finite temperature field theories; quark-gluon plasma; phase transitions in QCD.

Phys 637. Elementary Particle Physics I. (3-0) Cr. 3. *Prereq: 526 and 592.* First semester of a full year course. Properties of leptons, bosons, and quarks and their interactions; quantum chromodynamics, Glashow-Weinberg-Salam model, grand unification theories, supersymmetry; modern theoretical techniques and tests of the Standard Model.

Phys 638. Elementary Particle Physics II. (3-0) Cr. 3. *Prereq: 637.* Continuation of 637. Properties of leptons, bosons, and quarks and their interactions; quantum chromodynamics, Glashow-Weinberg-Salam model, grand unification theories, supersymmetry, and superstring theory; modern theoretical techniques.

Phys 650. Advanced Seminar. (1-0) Cr. 1. Repeatable. F.S. Topics of current interest. Satisfactory-fail only.
A. Nuclear Physics
B. Condensed Matter Physics
C. High Energy Physics
D. Physics
E. Applied Physics
F. Biophysics

Phys 660. Advanced Topics in Physics. Cr. arr. Repeatable. F.S. Courses on advanced topics and recent developments.
A. Nuclear Physics
B. Condensed Matter Physics
C. High Energy Physics
D. Physics
E. Applied Physics
F. Biophysics

Phys 681. Quantum Field Theory I. (3-0) Cr. 3. F. *Prereq: 564, 572, 592.* Quantization of fields (canonical and path integral); Feynman rules; introduction to gauge theories; Quantum Electrodynamics; radiative corrections; renormalization and renormalization group.

Phys 682. Quantum Field Theory II. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 681.* Continuation of 681. Systematics of renormalization; renormalization group methods; symmetries; spontaneous symmetry breaking; non-abelian gauge theories; the Standard Model and beyond; special topics.

Phys 699. Research. Cr. arr. Repeatable.

Plant Biology

(Interdepartmental Graduate Major)

www.agron.iastate.edu/ptf/ippm/home.asp

Supervisory Committee: K. Wang, Chair; D. Hannapel, Interim Associate Chair; M. Bhattacharyya, M. James, R. Thornburg (ex-officio), S. Whitham

The Interdepartmental Plant Physiology Major (IPPM) coordinates graduate education and research in the areas of plant biology including but not limit to plant biochemistry, plant cellular and molecular biology and plant physiology. Graduate study in IPPM, leading to the M.S. and Ph.D. Degrees, is offered through seven participating departments: Agronomy, Biochemistry, Biophysics & Molecular Biology, Chemical and Biological Engineering, Ecology, Evolution and Organismal Biology, Genetics Development & Cell Biology, Horticulture, and Plant Pathology.

Research conducted by the faculty and students of the major represents basic plant physiology, biochemistry and molecular biology. The experimental approaches represented in the major span the range of complexity from molecular studies, to cellular, organismal and the ecological level (crop monocultures and natural populations). Graduates have a broad understanding of basic, functional plant biology with emphases on fundamental biology, biochemistry, and molecular biology. They are able to address complex research and policy problems in agriculture, biotechnology, and basic plant biology.

All M.S. candidates take a core curriculum comprising courses recommended from the following four categories, attend research seminars, research credits (PlBio 699), annual Loomis Lecture and mini-symposium and retreats. Students will take additional courses of interest as directed by their Program of Study (POS) Committee members.

A total of 36 credits including a minimum of 16 course credits are required for a M.S.

(1) Complete the following core courses:

a) Stat 401; b) BBMB 404 or BBMB 501; c) GDCB 513; d) Agron/Gen/Pl P 565; e) Make two seminar presentations and enroll each term in the Interdepartmental Plant Physiology seminar PlBio 696P or its listed equivalent. The first seminar must be during the student's first year and is a 20 minutes seminar. The last presentation must be an exit seminar.

(2) Take one course from the following courses:

a) GDCB 512; b) GDCB 529;

(3) Take additional courses from the following list:

Agron 516; Agron 527; Agron/Hort/NREM 529; Agron 616; Agron 625; BBMB 405; BBMB 451; BBMB 502; BBMB 607; BBMB 645; BBMB 660; BBMB 675; BBMB 676; BCB 551; BCB 596; Biol 454; Biol 474; EEOB 563; EEOB 566; EEOB 595; GDCB 510; GDCB 511; GDCB 512; GDCB 528; GDCB 529; GDCB 545; GDCB 640; GDCB 679; GDCB 680; GDCB 681.

All Ph.D. candidates take a core curriculum comprising courses recommended from the following four categories, attend research seminars, research credits (PlBio 699), annual Loomis Lecture and mini-symposium and retreats. Students will take additional courses of interest as directed by their Program of Study (POS) Committee members.

A total of 72 credits including a minimum of 24 course credits are required for a Ph.D.

(1) Complete the following core courses:

a) Stat 401; b) BBMB 404 or BBMB 501; c) GDCB 513; d) Agron/Gen/Pl P 565; e) Make four seminar presentations and enroll each term in the Interdepartmental Plant Physiology seminar PlBio 696P or its listed equivalent. The first seminar must be during the student's first year and is a 20 minutes seminar. The last presentation must be an exit seminar.

(2) Take one course from the following courses:

a) BBMB 405; b) BBMB 502; c) GDCB 511; d) GDCB 545

(3) Take one course from the following courses:

a) GDCB 512; b) GDCB 529

(4) Take additional courses from the following list:

Agron 516; Agron 527; Agron/Hort/NREM 529; Agron 616; Agron 625; BBMB 405; BBMB 451; BBMB 502; BBMB 607; BBMB 645; BBMB 660; BBMB 675; BBMB 676; BCB 551; BCB 596; Biol 454; Biol 474; EEOB 563; EEOB 566; EEOB 595; GDCB 510; GDCB 511; GDCB 512; GDCB 528; GDCB 529; GDCB 545; GDCB 640; GDCB 679; GDCB 680; GDCB 681.

Requirements for students seeking Plant Physiology as Minor:

(1) Prerequisite courses:

Stat 401; BBMB 404 or BBMB 501.

(2) Take a minimum of nine credits from the following courses:

Agron 516; Agron 527; BBMB 607; Biol 454; GDCB 512; GDCB 513; GDCB 529; GDCB 545.

In addition to the required core courses, a wide selection of courses is available to IPPM graduate students for broadening their scientific education. Decisions about which courses are taken and when they are taken are made by the student, initially in consultation with his or her temporary advisor, and then with his or her major advisor and eventually with POS Committee, which also serves as the Thesis or Dissertation Committee.

Courses for graduate students

PLBio 512. Plant Growth and Development. (Cross-listed with GDCB, MCDB). (2-0) Cr. 2. S. *Prereq: Biol 330 or a course in developmental biology; GDCB 545 or BBMB 404, 405 or GDCB 520.* Plant growth and development and its molecular genetic regulation. Hormone biosynthesis, metabolism, and action. Signal transduction in plants.

PlBio 513. Plant Metabolism. (Cross-listed with GDCB). (2-0) Cr. 2. F. *Prereq: Biol 330, Phys 111, Chem 331; one semester of biochemistry recommended.* Photosynthesis, respiration, and other aspects of plant metabolism.

PlBio 545. Plant Molecular Biology. (Cross-listed with GDCB, MCDB). (3-0) Cr. 3. F. *Prereq: Biol 314, 330.* Organization and function of plant nuclear and organelle DNA; regulation of gene expression. Methods of generating novel genetic variation. Impact of plant biotechnology on agriculture.

PlBio 696. Research Seminar. (Cross-listed with Agron, BBMB, GDCB, Hort, For). Cr. 1. Repeatable. F.S. Research seminars by faculty and graduate students. Satisfactory-fail only.

PlBio 699. Research. Cr. arr. Repeatable.

Plant Pathology

www.plantpath.iastate.edu

Thomas Baum, Chair of Department

Distinguished Professors (Emeritus): Tiffany

University Professors (Emeritus): McNabb

Professors: Baum, Braun, Bronson, Gleason, Harrington, Hill, Miller, Nutter, Tylka, Yang

Professors (Emeritus): Durand, Epstein, Hodges, Mcgee, Stewart

Professor (Collaborator): Wise

Associate Professors: Beattie, Bogdanove, Munkvold, Whitham

Assistant Professors: Halverson, Leandro, Robertson

Assistant Professors (Collaborators): Block, Lauter

Undergraduate Study

The department participates in the interdepartmental undergraduate Microbiology major; see *Agriculture, Curricula.*

Graduate Study

The department offers studies for the degrees master of science and doctor of philosophy with a major in plant pathology, and minor work for students majoring in other departments or programs. A master of science nonthesis option is available. The department also participates in the interdepartmental majors in microbiology; toxicology; genetics; plant physiology; molecular, cellular, and developmental biology; ecology and evolutionary biology; and sustainable agriculture.

Students entering graduate programs in the department need a sound background in the physical, biological, and mathematical sciences as well as adequate preparation in English.

Graduates have a broad understanding of the biology and management of plant pathogenic microorganisms and the interactions of pathogens with their host plants. They understand the relationship between plant pathology and allied disciplines and are able to communicate effectively with scientific colleagues and the general public in both formal and informal settings. Graduates are able to address complex plant disease problems facing agricultural and bioscience professionals, taking into account the related ethical, social, legal, and environmental issues. They are skilled in research procedures, communicating research results, and writing concise and persuasive grant proposals.

Courses primarily for undergraduate students

Pl P 391. Practical Plant Health. (0-4) Cr. 2. F. *Prereq: 6 credits in biological sciences.* Diagnosis of all types of plant health problems caused by diseases, insects, weeds, nutrient deficiencies and toxicities, herbicide injury, and environmental stress. Emphasis is on acquiring practical skills. Students will gain experience in written and oral communication.

Pl P 408. Principles of Plant Pathology. (Dual-listed with 508). (2-3) Cr. 3. F.S. *Prereq: 8 credits in biological sciences, including Biol 212.* Braun. Principles underlying the nature, diagnosis, and management of plant diseases. Laboratory complements lecture topics and provides experience in plant disease diagnosis.

Pl P 416. Forest Insect and Disease Ecology. (Cross-listed with For). (3-3) Cr. 4. S. *Prereq: 8 credits in biological sciences, including Biol 211.* T. Harrington, M. Harris . Nature of insects and pathogens of forest and shade trees; their role in the dynamics of natural and managed forest ecosystems; and the management of indigenous and exotic pests. Nonmajor graduate credit.

Pl P 452. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 552). (Cross-listed with Ent, Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Pl P 477. Bacterial-Plant Interactions. (Dual-listed with 577). (Cross-listed with Micro). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interaction with plants; covers symbiotic nitrogen fixation, plant pathogenesis, plant growth promotion, and biological control.

Pl P 483. Wood Deterioration and Preservation. (Cross-listed with For). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: For 280.* Deterioration of wood in use by biological and physical agents. Wood preservation and fire retardant treatments. Environmental impact of wood treating. Nonmajor graduate credit.

Pl P 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior or senior classification, 7 credits in biological sciences, permission of instructor.* A maximum of 6 credits of Pl P 490 may be used toward the total of 128 credits required for graduation.
A. Plant Pathology
H. Honors

Pl P 494. Seed Pathology. (Dual-listed with 594). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: 408.* Munkvold. Significance of diseases on the major phases of seed production; growing, harvesting, conditioning, storing, and planting seed. Pathogens considered include fungi, bacteria, viruses, nematodes, and abiotic agents. Emphasis on epidemiology, management, host-pathogen relationships, seed transmission, and seed health testing. Credit may not be obtained for both Pl P 494 and STB/Pl P 592.

Courses primarily for graduate students, open to qualified undergraduate students

Pl P 506. Plant-Pathogen Interactions. (2-0) Cr. 2. S. *Prereq: 408 or 416, Biol 313.* Baum, Whitham. Introduction to mechanisms of plant-parasite interaction. Genetics and molecular genetics of plant disease resistance and pathogenicity.

Pl P 508. Principles of Plant Pathology. (Dual-listed with 408). (2-3) Cr. 3. F.S. *Prereq: 8 credits in biological sciences, including Biol 212.* Braun. Principles underlying the nature, diagnosis, and management of plant diseases. Laboratory complements lecture topics and provides experience in plant disease diagnosis.

Pl P 509. Plant Virology. (Cross-listed with Micro). (2-6) Cr. 4. Alt. S., offered 2011. *Prereq: 408, Biol 454, BBMB 405, Chem 211.* Hill. Plant viruses and the diseases they cause. Emphasis on epidemiology and control. Structure, function, and biochemical-biophysical properties of plant viruses.

Pl P 511. Integrated Management of Tropical Crops. (Cross-listed with Ent, Hort). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Pl P 408 or 416 or Ent 370 or 376 or Hort 221.* Gleason, Lewis, Nonnecke. Applications of Integrated Crop Management principles (including plant pathology, entomology, and horticulture) to tropical cropping systems. Familiarization with a variety of tropical agroecosystems and Costa Rican culture is followed by 10-day tour of Costa Rican agriculture during spring break, then writeup of individual projects. Tour expenses paid by students.

Pl P 530. Ecologically Based Pest Management Strategies. (Cross-listed with Agron, Ent, SusAg). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: SusAg 509.* Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

Pl P 543. Ecology and Epidemiology of Plant Diseases. (2-4) Cr. 4. Alt. F., offered 2009. *Prereq: 408 or 416.* Nutter. Theory and practice related to the ecology and epidemiology of plant disease epidemics. Interactions among host and pathogen populations as affected by the environment are quantified with respect to time and space. Analysis of ecological and host and pathogen genetic factors that alter the course of plant disease epidemics. Risk assessment theory, disease forecasting, and modeling the impact of biotic plant stresses on yield and quality are also emphasized.

Pl P 552. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 452). (Cross-listed with Ent, Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Pl P 565. Professional Practice in the Life Sciences. (Cross-listed with Agron, An S, BCB, Hort, V MPM, Micro). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.
A. Professional Practices in Research. (Cr. 1.0). Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5). Ethical and legal issues facing life scientists involved in research interactions with industry.

Pl P 574. Plant Nematology. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 408 or 416.* Baum. Morphology, anatomy, identification, control, and life cycles of common plant-parasitic nematodes; host-parasite interactions; Caenorhabditis elegans.

Pl P 577. Bacterial-Plant Interactions. (Dual-listed with 477). (Cross-listed with Micro). (3-1) Cr. 3. Alt. S., offered 2010. *Prereq: 3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interaction with plants; covers symbiotic nitrogen fixation, plant pathogenesis, plant growth promotion, and biological control.

Pl P 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: 10 credits in biological sciences, permission of instructor.*

Pl P 592. Seed Health Management. (Cross-listed with STB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Admission to the Graduate Program in Seed Technology and Business/Consent of instructor.* Munkvold. Occurrence and management of diseases during seed production, harvest, conditioning, storage, and planting. Emphasis on epidemiology, disease management in the field, seed treatment, effects of conditioning on seed health, and seed health testing. Credit may not be obtained for both Pl P/STB 592 and Pl P 594.

Pl P 594. Seed Pathology. (Dual-listed with 494). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: 408.* Munkvold. Significance of diseases on the major phases of seed production; growing, harvesting, conditioning, storing, and planting seed. Pathogens considered include fungi, bacteria, viruses, nematodes, and abiotic agents. Emphasis on epidemiology, management, host-pathogen relationships, seed transmission, and seed health testing. Credit may not be obtained for both Pl P 594 and STB/Pl P 592.

Courses for graduate students

Pl P 608. Molecular Virology. (Cross-listed with V MPM, Micro). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: BBMB 405 or GDCB 511.* C. Miller, B. Blitvich, A. Miller. Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

Pl P 691. Field Plant Pathology. (0-6) Cr. 2. Repeatable. Alt. SS., offered 2011. *Prereq: 408 or 416.* Diagnosis of plant diseases, plant disease assessment methods, and the integration of disease management into commercial crop production practices. Objectives are to familiarize students with common diseases of Midwest crops and landscape plants, and to provide experience in disease diagnosis. Field trips include commercial operations, agricultural research facilities, and ornamental plantings.

Pl P 692. Molecular Biology of Plant-Pathogen Interactions. (Cross-listed with Micro). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 506 or BBMB 405 or Gen 411 or Micro 402 or course in molecular biology.* Bogdanove, Whitham. Seminal and current research in molecular and physiological aspects of plant interactions with pathogens, including mechanisms of pathogenesis, host-pathogen recognition and host defense, with an emphasis on critical evaluation of primary literature. Students also complete an interinstitutional research proposal writing and peer review exercise.

Pl P 694. Colloquium in Plant Pathology. (2-0) Cr. 2. Repeatable. F.S. *Prereq: 408 or 416, permission of instructor.* Advanced topics in plant pathology, including biological control, cultural control, resistance gene deployment, genetic engineering for disease resistance, chemical control, integrated pest management, emerging diseases, fungal genetics, insect vector biology, professional communications, etc.

Pl P 698. Seminar. Cr. 1. Repeatable. F.S.

Pl P 699. Thesis and Dissertation Research. Cr. arr. Repeatable. F.S.SS.

Political Science

www. iastate.edu/~polsci/

James McCormick, Chair of Department

Distinguished Professors (Emeritus): Rasmussen

University Professors: Schmidt, Shelley

Professors: Dobratz, Mansbach, McCormick, Smith

Professors (Emeritus): Dearin, Kihl, Lee, Maney, Moses

Associate Professors: Hutter, Potoski, Tuckness, Wolf

Associate Professor (Emeritus): Whitmer

Associate Professor (Adjunct): Waggoner

Assistant Professors: Birskyte, Conger, D. Cunningham, K. Cunnigham, Urbatsch

Assistant Professor (Adjunct): Bystrom

Senior Lecturer: Deam

Undergraduate Study

For the undergraduate curriculum in Liberal Arts and Sciences, with major in political science, leading to the degree of Bachelor of Arts, see *Liberal Arts and Sciences, Curriculum.*

The study of political science is designed to enable students to understand the nature of politics, public values, and the institutions and processes of politics in their various forms.

Students completing a major in political science will understand and be able to interrelate the leading theories, literature, and approaches in the subfields of American government, political theory and methods, international relations, and comparative politics. Graduates can analyze and formulate effective argumentation in written and oral forms, including the ability to appreciate and

accommodate diverse political ideas, and the ability to collect and critique information and ideas of others in support of original arguments. Graduates appreciate the knowledge and civic responsibilities required for effective participation in political life.

The political science major is often chosen by students preparing for a career in law. Students with this goal should consult with the department in selecting courses. See also Preprofessional Study.

Several internship options are available to the political science major, offering students the opportunity to experience practical application of the knowledge learned in academic courses.

Requirements for the Major:

For the purpose of defining undergraduate requirements in the Department of Political Science, the Department employs four subfields within the discipline, with the following courses in each:

I. Theory and Methods (Pol S 235, 313, 334, 335, 356, 406, 430, 431, 433, 470, 480, 487, 490B).

II. American Government and Politics (Pol S 215, 305, 310, 311, 312, 318, 319, 320, 334, 335, 344, 358, 359, 360, 361, 363, 370, 371, 385, 413, 417, 420, 421, 442, 464, 475, 476, 477, 480, 482, 483, 490A).

III. Comparative Politics (Pol S 241, 314, 340, 341, 343, 346, 347, 349, 350, 442, 485, 490C).

IV. International Relations (Pol S 251, 315, 356, 357, 358, 359, 381, 422, 452, 453, 485, 487, 490D).

To complete the major in Political Science a student must earn 33 semester credits of courses in Political Science subject to the following conditions:

a. Students must satisfactorily complete Pol S 101, 301, and 302.

b. Students must complete at least 3 credits in each of the four subfields listed above. Students may apply only one half-semester mini-course (Pol S 312, 313, 314, 315) in each group.

c. Political Science courses in which a student has a grade of D+ or lower will not count for the major but can be counted as electives.

d. At least 18 credits of Political Science courses must be numbered 300 or above.

e. Students must pass one statistics course from among Stat 101, 104, 226 or 231.

f. No more than six credits of Pol S 490 or 499 (alone or in combination) can be used to fulfill any of these requirements. A maximum of three credits of Pol S 490 can be applied to meet any of the four subfield requirements.

g. A maximum of six credits from half-semester mini-courses (Pol S 312, 313, 314, 315) can be applied to satisfy the above requirements.

h. At least 15 credits of Political Science coursework must be earned at Iowa State University.

i. Advanced Communication Skills: Majors must earn at least a C+ in each of Engl 150 and 250. Those who do not must complete Engl 309 or 314 with a grade of C or higher. Majors must also complete Pol S 302.

The department offers a minor in political science that may be earned by completing 15 credits beyond the 100-level of coursework in political science, nine of which must be at the 300 level or above. A student minoring in Political Science normally will be expected to take at least 9 credits in Political Science coursework at Iowa State University. Only 3 credits of Pol S 490 or Pol S 499, alone or in combination, and only 2 credits of Pol S 312-315 may be included in the total of 15 credits required for the minor. All minors in the College of Liberal Arts and Science required a minimum of 6 credits in courses numbered 300 and above taken at ISU with a grade of C or higher. Credits earned in Pol S 499, offered on a satisfactory/fail basis only, will not fulfill this requirement.

Graduate Study

The department offers work for a Master of Arts degree (M.A.), with a major in political science, and minor for students in other departments. The department also offers work for a Master of Public Administration (MPA) degree or a Graduate Certificate of Public Management (GCPM) for those interested in an educational certificate program that requires less work than a full masters program. In addition, the Political Science Department offers work for the Master of Science in Information Assurance. Information with detailed requirements for all graduate degrees may be obtained at the department's web page at www.pols.iastate.edu/gradhome.shtml.

The M.A. program is designed to enable its graduates to engage in governmental research, enter public service or private industry, teach, or pursue further graduate study. Graduate students may also wish to work for certification for high school or junior college teaching. A thesis is required for this degree. The department also has a joint Master of Arts/Juris Doctor (M.A./J.D.) program with the Law School of Drake University. Detailed information for the M.A./J.D. can be found at the ISU Political Science webpage as well as the Drake Law School website (under Joint Degree): www.law.drake.edu/admissions/ specprograms.html. Students wishing to pursue this joint degree must submit separate applications to both Drake University and Iowa State University and be accepted by both institutions.

M.A. graduates have a broad substantive understanding of the political process and the academic study of politics. They also have in-depth knowledge of one or more subfields in political science. Graduates are skilled at conducting research and preparing thorough research summaries. They are able to identify and address complex political questions, taking into account related ethical, legal, economic, and social issues.

The usual prerequisites for major graduate work in the M.A. program normally are completion of at least 15 credits in political science, the GRE (Graduate Record Examination), one year of a foreign language (equivalent to 8 semester hours) and a course in basic statistics (equivalent to Stat 101). If the basic statistics requirement has not been met, the student may remedy the deficiency by passing equivalent courses, for which no graduate credit will be received. During their program of study, all students are expected to complete Stat 401, Pol S 502, and a thesis. Students normally do concentrated course work in at least one of the following three areas: international relations, comparative politics, or American politics. The student's program of study committee may require additional work.

Students in other graduate programs may obtain a minor in political science by completing at least 9 credits of political science courses, including one of the proseminars. Interested students should consult the Graduate College Handbook for additional information on graduate minors.

The Master of Science in Information Assurance (MSIA) is a multi-disciplinary program designed to provide students with diverse backgrounds and interests the opportunity to obtain professional training in the emerging field of information assurance. The core of the MSIA program is built around a series of courses taught in Electrical and Computer Engineering, Mathematics, and Computer Science that introduce students to software and hardware aspects of cryptography and computer security. The program also recognizes, however, that information assurance-defined in terms of security, privacy, access, and reliability-is not simply a technical problem but also involves important societal dimension, including policy, education, ethics, and management. Recognizing that political science offers many potential intersections with information assurance (e.g., public sector management of information technology; forensics and computer crime; information technology policy and law; information technology and international relations; information warfare; etc.), students with interests in these areas are encouraged to select the Department of Political Science as their home department.

Students opting to pursue a MSIA degree through the Department of Political Science can expect to acquire skills and background knowledge relevant to a career in public policy or public sector management of information assurance technologies. The InfAs degree can also help prepare students who wish to go on to pursue a PhD in information politics and policy.

Students interested in the InfAs degree program should consider Political Science as a home department if their future career and/or educational interests lie in such areas as: institutional issues related to the internet and information technologies; information technology, international security, and information warfare; information technology policy and law; and public administration and public sector management of information technology.

Admission requirements generally follow the same guidelines as the M.A. or MPA in Political Science. Degree requirements are specified by the InfAs program in cooperation with Political Science. More in-depth information on the program can be found at: http://www.issi.iastate.edu/infas.html.

Public Policy and Administration

The Public Policy and Administration program offers work for the professional Master of Public Administration degree (MPA). The program is designed to educate and train students for careers in management and policy analysis at the federal, state, and local levels of government, and nonprofit sector management. The program serves a diverse student body, including pre-service students and in-service employees in government and nonprofit organizations. The curriculum covers a broad range of public administration and policy topics, including organizational and administrative processes, eGovernment, leadership, organizational change dynamics, human resource management, budgeting, cost benefit analysis, financial management, policy analysis, and ethics. The program offers three concentrations: Public Management, eGovernment and Management of Information Technology, and Policy Analysis.

The MPA degree requires 37 credits, which includes (a) 15 credits in core competency, (b) 9 credits in one of the concentration areas, (c) 4 credits in other required courses, (d) up to 7 credits of electives, and (e) 3 credits of creative component (a capstone project) or a minimum of 3 credits of research (thesis). Pre-service students are encouraged to obtain an internship for 3 credits.

The Program also offers a Graduate Certificate of Public Management program (GCPM), which requires a completion of 15 credits: 9 credits in the core, and two additional courses in the area of student interest. Some classes are available via videoconferencing, streaming video, one week and executive weekend formats, and online.

The Program also offers joint master's degrees with the Department of Community and Regional Planning (25 credits in each program plus a six credit thesis), and the interdisciplinary Information Assurance program (30 credits). The requirement for all double degrees consists of 22 credits from each discipline for a total of 54 credits. Under the rules of the Graduate College a graduate student may pursue a joint degree between any two disciplines of their interest. Interested students are encouraged to consult the ISU's Graduate Handbook. The minimum requirements for all double degrees consist of 22 credits from each program.

Requirements for admission are a graduate school application, an essay stating purposes for study, college transcripts, the GRE (waived for those with five or more years of public or nonprofit sector experience), three letters of recommendation, and the TOEFL for international students.

The department cooperates in the interdepartmental majors in transportation and water resources, and an interdepartmental minor in gerontology (see Index).

Refer to the Schedule of Classes (www.iastate.edu/~catalog/) or consult the Public Policy and Administration (MPA) web page (http://mpa.las.iastate.edu for up-to-date scheduling information.

Courses primarily for undergraduate students

Pol S 101. Orientation to Political Science. (2-0) Cr. 1. F.S. *Prereq: Political Science and Open Option majors only or permission of the instructor.* Introduction to the discipline and sub-fields of Political Science, including an introduction to analytical thinking, and research skills relevant to political science. Orientation to university, college, and departmental structure, policies, and procedures; student roles and responsibilities; degree planning and career awareness. Satisfactory-fail only.

Pol S 215. Introduction to American Government. (3-0) Cr. 3. F.S.SS. Fundamentals of American democracy; constitutionalism; federalism; rights and duties of citizens; executive, legislative, and judicial branches of government; elections, public opinion, interest groups, and political parties.

Pol S 235. Introduction to Ethics and Politics. (3-0) Cr. 3. F.SS. *Prereq: Sophomore standing.* Introduction to moral controversies surrounding political issues such as violence, deception, corruption, civil disobedience, democracy, justice, equality, and freedom. Students will read classic and contemporary texts and consider political applications. This course serves as an introduction to advanced courses in political theory.

Pol S 241. Introduction to Comparative Government and Politics. (3-0) Cr. 3. F.S. Basic concepts and major theories; application to selected political systems, including non-western political systems.

Pol S 251. Introduction to International Politics. (3-0) Cr. 3. F.S. Dynamics of interstate relations pertaining to nationalism, the nation state; peace and war; foreign policy making; the national interest; military capability and strategy; case studies of transnational issues, such as population, food, energy, and terrorism.

Pol S 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Pol S 301. Introduction to Empirical Political Science Research. (3-0) Cr. 3. F.S.SS. *Prereq: 3 credits in political science; one statistics course required; sophomore classification.* Techniques of quantitative and qualitative political research and analysis. Development and analysis of concepts and theories. Methods of data collection, research design, and critical thinking. Applications of statistics to political research.

Pol S 302. Politics of Writing, Speaking, and Reading. (3-0) Cr. 3. F.S. *Prereq: English 250; 3 credits in Political Science. Political Science majors only.* Focus on the connections between communicative and rhetorical skill and effective civic understanding and participation. Techniques of effective communication and persuasion in writing and speaking. Development of skills of critical and rhetorical analysis in reading.

Pol S 305. Political Behavior. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Empirical theories and descriptions of political behavior, including decision-making, opinion, and attitudes, with an emphasis on groups and political elites.

Pol S 310. State and Local Government. (3-0) Cr. 3. S. *Prereq: 3 credits in political science.* Role of state and local governments in the American federal system. Structures of participation: political parties, elections, interest groups. Major governmental institutions: legislative, executive, and judicial. Structure and functions of local governments.

Pol S 311. Municipal Government and Politics. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 215.* Legal position of municipal corporation; forms of organization; administration of municipal services; problem-solving in municipal government; urban and metropolitan political process; implications of federal urban policies.

Pol S 312. Minicourse in American Government and Politics. (3-0) Cr. 2. F.S. *Prereq: Sophomore classification.* Half-semester courses on selected topical issues in American government and politics. Designated repeat in Pol S 312 is not permitted. Use of Pol S 312 credit in Pol S major and minor is limited. See Undergraduate Study for information.

Pol S 313. Minicourse in Theory and Methods. (3-0) Cr. 2. F.S. *Prereq: Sophomore classification.* Half-semester course on selected topical issues in theory and methods in political science. Designated repeat in Pol S 313 is not permitted. Use of Pol S 313 credit in Pol S major and minor is limited. See Undergraduate Study for information.

Pol S 314. Minicourse in Comparative Politics. (3-0) Cr. 2. F.S. *Prereq: Sophomore classification.* Half-semester course on selected topical issues in comparative politics. Designated repeat in Pol S 314 is not permitted. Use of Pol S 314 credit in Pol S major and minor is limited. See Undergraduate Study for information.

Pol S 315. Minicourse in International Relations. (3-0) Cr. 2. F.S. *Prereq: Sophomore classification.* Half-semester course on selected topical issues in international relations. Designated repeat in Pol S 315 is not permitted. Use of Pol S 315 credit in Pol S major and minor is limited. See Undergraduate Study for information.

Pol S 318. Campaign and Elections. (3-0) Cr. 3. Alt. F., offered 2010. Methods and techniques of political campaigns in general elections. Supervised participation in candidate and political party campaign activities required.

Pol S 319. Law and Politics. (3-0) Cr. 3. F.S. *Prereq: Sophomore standing; 215 recommended.* An evaluation of the American judicial system as it relates to controversial topics emphasizing the relationship between law and politics. Primary emphasis on topics such as statutory construction, judicial review, the proper role of the judiciary, vagueness and ambiguity in law, competing constitutional philosophies, executive branch concerns, and relative power of different branches. Credit for both Pol S 319 and 230 may not be applied toward graduation.

Pol S 320. American Judicial Process. (Cross-listed with CJ St). (3-0) Cr. 3. S. *Prereq: Pol S 215.* An overview of the American judicial process. Emphasis on specific topics such as application of constitutional rights to the states (particularly the Fourth, Fifth, Sixth, and Fourteenth Amendments), mechanics of judicial opinions, constitutional philosophies of Supreme Court Justices, decisions of first impression, and the value and scope of precedent.

Pol S 334. Politics and Society. (Cross-listed with Soc). (3-0) Cr. 3. F. *Prereq: A course in political science or sociology.* The relationship between politics and society with emphasis on American society. Discussion of theories of inequality, power, social movements, elites, ruling classes, democracy, and capitalism.

Pol S 335. Science, Technology, and Public Policy. (3-0) Cr. 3. S. Examines the history and political dynamics of public science and technology policies. Examines differences in political and technological orientations. Assessment of the roles of politics, media, engineering, science, and private business in the formation public policies that put heavy reliance on or seek to advance science and technology.

Pol S 340. Politics of Developing Areas. (3-0) Cr. 3. Alt. S., offered 2010. Examination of economic and political development as they relate to the political process of developing states. Impact of social and technological change on political systems of developing areas. Some case studies.

Pol S 341. Politics of Asia. (3-0) Cr. 3. Alt. S., offered 2010. Political institutions, processes, and contemporary issues. Selected countries examined intensively to illustrate generalizations. Topics such as foreign policy, role of parties, military, religious groups, human rights, women, environmental issues, interest groups, ideology, and globalization.

Pol S 343. Latin American Government and Politics. (3-0) Cr. 3. Political institutions, processes, and contemporary issues. Selected countries examined intensively to illustrate generalizations. Role of parties, military, church, human rights, women, environmental issues, interest groups, ideology, and globalization.

Pol S 344. Public Policy. (3-0) Cr. 3. S. How agendas come to be set in public policy, theories describing the policy-making process, forces molding policy choices and the impact of such choices.

Pol S 346. European Politics. (3-0) Cr. 3. S. Comparative study of political institutions of Europe and the European Union; emphasis on parties, elections, and governmental structures. Substance and process of public policies in selected problem areas.

Pol S 347. African Politics. (3-0) Cr. 3. F. Major trends in African politics over the last 150 years and current issues facing Africans today. Basic African geography. Topics include democratization, economic development, civil conflict, ethnic politics and foreign aid.

Pol S 349. Politics of Russia and the Soviet Successor States. (3-0) Cr. 3. Alt. F., offered 2010. Nation-states of the former Soviet Union. Analysis of Soviet Communist system 1917-85 and the politics and revolutionary conflict leading to the dissolution of the Soviet Union from 1985 through 1991. Problems of post-Soviet nation-states of Russia and Central Eurasia since 1991.

Pol S 350. Politics of the Middle East. (3-0) Cr. 3. S. Introduction to the Middle East as a region and to issues of political importance to the Middle East and its place in the world. Topics covered include Islam, regional conflicts and alliances, local leaders, economic issues, and gender and social relations. Nonmajor graduate credit.

Pol S 356. Theories of International Politics. (3-0) Cr. 3. Introduction to essential theoretical concepts and approaches, both classical and contemporary on world politics including realism, empiricism, liberalism, and postpositivism; for example, war and

conflict, peace and cooperation, political economy, crisis decision-making, systemic theory, dependence and interdependence.

Pol S 357. International Security Policy. (3-0) Cr. 3. F. The major theoretical approaches in security policy – strategy and deterrence, game theory, bargaining theory, compellance, and coercive diplomacy, and crisis diplomacy. Illustration of these various approaches through historical and contemporary cases.

Pol S 358. United States Foreign Policy. (3-0) Cr. 3. F. *Prereq: 215 or 251, or Hist 467 or 470 or 471.* U.S. foreign policy since World War II with emphasis on changing American values in foreign policy, the role of the President, Congress, and the bureaucracy in policy making, and a survey of current foreign policy issues and problems.

Pol S 359. Current Issues in American Foreign Policy. (3-0) Cr. 3. S. *Prereq: 215, 251, or 358.* Examination of contemporary U.S. foreign policy issues (e.g., U.S. policy in the Middle East; defense budgeting in the post-Cold War era; conventional and nuclear arms control policy). The course will explore alternate methods to analyze policy, survey the evolution of each issue, and discuss different policy alternatives.

Pol S 360. American Institutions: Congress. (3-0) Cr. 3. *Prereq: 215.* Theory and practice of representation and deliberation in the legislative branch of the republic; operations of Congress in terms of its committees, leadership, legislative and oversight processes, partisan politics, electoral campaigns, service to local and special electoral campaigns, service to local and special interests, and interactions with the President.

Pol S 361. American Institutions: The Presidency. (3-0) Cr. 3. F. *Prereq: 215.* Creation and historical development of the office of chief executive; character and behavior of past chief executives; selection and control; powers, roles, functions; executive staff; relations with Congress, press, public opinion.

Pol S 363. American Institutions: Media. (3-0) Cr. 3. *Prereq: Sophomore standing.* Course surveys the influence of mass media organizations, forms, techniques, and technologies on the practices and expectations of American politics. Evaluates the role of media in the political process, exploring the extents to which media promotes or discourages political participation. Topics will examine the influence and political uses of news coverage, political advertising, political debates, talk radio, film, the Internet, and media spectacles.

Pol S 370. Religion and Politics. (Cross-listed with Relig). (3-0) Cr. 3. *Prereq: Relig 105 or 210 recommended.* The interaction of religion and politics in the U.S. from both an historical and contemporary perspective, as well as the role of religion in politics internationally. Nonmajor graduate credit.

Pol S 371. Introduction to Public Administration. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* A survey of the historic and contemporary administrative realities that contribute to the unique challenges of public governance at the administrative and managerial levels of international, national, state, and local government. This introductory course explores the essential issues and competencies involved in the efficient, effective, and ethical provision of public goods and services. Critical topics addressed in the course include crisis management, intergovernmental relations, social equity, public-private partnerships, and privatization.

Pol S 381. International Political Economy. (3-0) Cr. 3. S. Introduction to the theoretical perspectives on international political economy. Exploration of specific issues such as the changing international trade regime, international finance, and Third World development under conditions of globalization.

Pol S 385. Women in Politics. (Cross-listed with W S). (3-0) Cr. 3. S. Examination of the entry and participation of women in politics in the United States and other countries including a focus on contemporary issues and strategies for change through the political process.

Pol S 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing work period.

Pol S 406. Public Opinion and Voting Behavior. (3-0) Cr. 3. S. *Prereq: 6 credits in political science or junior classification.* The formation of political opinions and attitudes, political participation, and voting behavior of the general public, and their influences on American politics; polling as a means of assessing public opinions and behaviors. Nonmajor graduate credit.

Pol S 413. Intergovernmental Relations. (Dual-listed with 513). (3-0) Cr. 3. S. *Prereq: 6 credits in American government.* Theories and practices of the American federal system. Politics and policy making among federal, state, and local governments. Nonmajor graduate credit.

Pol S 417. Campaign Rhetoric. (Cross-listed with Sp Cm). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Sp Cm 212.* Backgrounds of candidates for state and national elections; selected speeches and issues; persuasive strategies and techniques of individual speakers. Nonmajor graduate credit.

Pol S 420. Constitutional Law. (3-0) Cr. 3. F. *Prereq: 215; junior classification.* Development of the United States Constitution through judicial action; influence of public law and judicial interpretations upon American government and society. Nonmajor graduate credit.

Pol S 421. Constitutional Freedoms. (3-0) Cr. 3. S. *Prereq: 320 or 420.* Leading Supreme Court cases interpreting the Bill of Rights and the Fourteenth Amendment. Emphasis on religion, speech, privacy, due process, and equal protection. Nonmajor graduate credit.

Pol S 422. International Law. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 215 or 251; junior classification.* Development of the principles of international law of peace and war; analysis of theories concerning its nature and fundamental conceptions; its relation to national law; problems of international legislation and codification. Nonmajor graduate credit.

Pol S 430. Foundations of Western Political Thought. (Cross-listed with Cl St). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European history.* Study of original texts in political thought ranging from the classical period to the renaissance. Topics such as justice, freedom, virtue, the allocation of political power, the meaning of democracy, human nature, and natural law. Nonmajor graduate credit.

Pol S 431. Early Modern Political Thought. (Dual-listed with 531). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European history.* Study of original texts in political thought ranging from the Reformation to the French Revolution and its aftermath. Topics such as justice, freedom, rights, democracy, toleration, property, power, skepticism, and normative views of international politics. Nonmajor graduate credit.

Pol S 433. American Political Thought. (3-0) Cr. 3. S. *Prereq: 6 credits in political science or in American history.* Review of major political concepts and theorists in American political history. Analysis of current concepts in U.S. political thought, and their possible impacts on our political institutions. Nonmajor graduate credit.

Pol S 442. The Policy and Politics of Coastal Areas. (Dual-listed with 542). (Cross-listed with Env S). (3-0) Cr. 3. SS. Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, trade-offs between conservation and jobs, the quality of coastal lifestyle, ways in which citizens participate in policy for coastal areas.

Pol S 452. Comparative Foreign Policy. (Dual-listed with 552). (3-0) Cr. 3. S. *Prereq: 251.* Various theoretical approaches to explain foreign policy making and behavior through the use of case studies of selected nations. Nonmajor graduate credit.

Pol S 453. International Organizations. (3-0) Cr. 3. S. *Prereq: 251.* Private and public organizations such as the United Nations, other specialized agencies, and multinational organizations, and their influence on our daily lives. Nonmajor graduate credit.

Pol S 464. Political Parties and Interest Groups. (3-0) Cr. 3. F. *Prereq: 215; junior classification.* Interest groups and American political parties, their principles, organizations and activities.

Pol S 470. Public Choice. (3-0) Cr. 3. *Prereq: Econ 101.* Application of economics to political science in the study of nonmarket decision-making. Behavior of bureaucrats, elected officials, and voters. Market failure, collective action, representative democracies, direct democracies, logrolling, voter paradoxes, and game theory. Nonmajor graduate credit.

Pol S 475. Management in the Public Sector. (Dual-listed with 575). (3-0) Cr. 3. F. *Prereq: 371.* Literature and research on organizational behavior and management theory with emphasis on applied aspects of managing contemporary public sector organizations. Topics include distinctions between public and private organizations, leadership, productivity, employee motivation, organizational structure, and organizational change. Nonmajor graduate credit.

Pol S 476. Administrative Law. (Dual-listed with 576). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 215; junior classification.* Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations. Nonmajor graduate credit.

Pol S 477. Government, Business, and Society. (Dual-listed with 577). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Junior classification.* Diverse perspectives on the changing roles and relationships of business, government and society so as to open the way for more effective policy decisions on corporate-government affairs. Topics may include the changing economy; transformation of workplace and community conditions; consumerism; social responsibilities of businesses; economic policies and regulations; and politics in the business-government relationship. Nonmajor graduate credit.

Pol S 480. Ethics and Public Affairs. (Dual-listed with 580). (3-0) Cr. 3. *Prereq: 6 credits in political science.* Study of decision making approaches and application to case studies. Topics such as the different roles of public officials, proper scope and use of administrative discretion, and the admissibility of religious, political, and philosophical commitments in governmental decision making. Nonmajor graduate credit.

Pol S 482. Environmental Politics and Policies. (Dual-listed with 582). (Cross-listed with Env S). (3-0) Cr. 3. F. *Prereq: 3 credits in political science or 3 credits in Environmental Studies; junior classification.* Major ideologies relation to conservation and ecology. Processes, participants, and institutions involved in state, national, and global environmental policymaking. Case studies of environmental controversies and proposals for policy reform. Nonmajor graduate credit.

Pol S 483. Law and Management. (Dual-listed with 583). (3-0) Cr. 3. Alt. F., offered 2009. Emerging constitutional/legal doctrines and requirements in public management: concept of new property rights in public employment/public service delivery; procedural due process requirement; scope of free speech and liberty protected in the conduct of public management; equal employment opportunity requirements; and the scope of official and personal immunities and liability in public affairs.

Pol S 485. Comparative Public Administration. (Dual-listed with 585). (3-0) Cr. 3. F. Comparisons of government bureaucratic in major world regions, trends and issues of administrative and management reforms, globalization and other contemporary challenges to state administrative structures and policies, skills needed to evaluate and implement public management reforms.

Pol S 487. Electronic Democracy. (2-1) Cr. 3. F. *Prereq: Sophomore standing or instructor approval.* The impact of computers, the Internet, and the World Wide Web on politics and policy. The positive and negative effects on information technology (IT) on selected topics such as freedom, power and control, privacy, civic participation, the sense of "community," virtual cities," interest group behavior, the new media, campaigns, elections, and voting will be examined. Nonmajor graduate credit.

Pol S 490. Independent Study. Cr. arr. Repeatable. F.S. *Prereq: 6 credits in political science.* Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. No more than 9 credits of Pol S 490 may be counted toward graduation.

A. American Government and Politics
B. Theory and Method
C. Comparative Politics
D. International Relations
E. Extended credit. The student may earn an additional 1 or 2 credits for extra study done for any 300- or 400-level course, with instructor's approval.
G. Catt Center Project
H. Honors

Pol S 491. Senior Thesis. Cr. 3. *Prereq: 21 credits of Pol S and permission of instructor.* Written under the supervision of a Political Science faculty advisor.

Pol S 495. Capstone Project in Political Science. (3-0) Cr. 3. S. *Prereq: 21 credits in political science and permission of instructor.* Capstone project for political science majors; integrating research, analysis and participation.

Pol S 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Pol S 499. Internship in Political Science. Cr. arr. F.S.SS. *Prereq: 6 credits in political science; junior or senior classification; and permission of internship coordinator.* Work experience with a specific nongovernmental or governmental agency at the local, state, national, or international level, combined with academic work under faculty supervision. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Pol S 501. Quantitative Methods for Public Managers. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Use of data in managerial decison-making and policy analysis. Research design and sampling methods. Statistical software use required.

Pol S 502. Political Analysis and Research. (3-0) Cr. 3. F. *Prereq: 6 credits in political science.* Scope and methods of political science. Introduction to theoretical approaches and analytical reasoning in political science. Relationship of theory and data. Research design.

Pol S 504. Proseminar in International Politics. (3-0) Cr. 3. S. *Prereq: 6 credits in political science or graduate standing.* An overview of the major theoretical and empirical works in the study of international politics and foreign policy. Among the major theoretical approaches surveyed and applied to international politics are realism, neo-realism, liberalism, functionalism, rational choice theory, game theory, and decision-making theory. Seminal writings by leading scholars will be reviewed.

Pol S 505. Proseminar in Comparative Politics. (3-0) Cr. 3. F. *Prereq: 6 credits in political science or graduate standing.* Major theoretic approaches to the study of comparative politics -- varying concepts and definitions of society and policy, administrative traditions, institutional arrangements, political behavior, etc. Contrasting research method designs.

Pol S 506. Proseminar in American Politics. (3-0) Cr. 3. S. *Prereq: 6 credits in political science or graduate standing.* A presentation of the major theories and research on American government and politics. Substantive topics include modern democratic theory, institutional performance, and mass political behavior. A variety of research methodologies are examined, including normative theory, behavioralism, and rational choice analysis.

Pol S 510. State Government and Politics. (3-0) Cr. 3. *Prereq: 310.* Comparative analysis of state political systems. Role of interest groups, political parties, legislatures, courts, and governors in state politics. Possible determinants of public policy outputs at the state level.

Pol S 513. Intergovernmental Relations. (Dual-listed with 413). (3-0) Cr. 3. S. *Prereq: 6 credits of American government.* Theories and practices of the American federal system. Politics and policy making among federal, state, and local governments.

Pol S 525. Mass Political Behavior. (3-0) Cr. 3. *Prereq: 6 credits in Political Science or graduate standing.*. An in-depth survey of the theoretical, empirical, and methodological works concerning mass political behavior in the United States. Substantive topics include political attitudes and ideologies, public opinion and voting behavior, and political psychology. Methods for studying mass behavior include survey research and experimental approaches.

Pol S 531. Early Modern Political Thought. (Dual-listed with 431). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European history.* Study of original texts in political thought ranging from the Reformation to the French Revolution and its aftermath. Topics such as justice, freedom, rights, democracy, toleration, property, power, skepticism, and normative views of international politics.

Pol S 534. Legal and Ethical Issues in Information Assurance. (Cross-listed with Cpr E, InfAs). (3-0) Cr. 3. S. *Prereq: Graduate classification; Cpr E 531 or InfAs 531.* Legal and ethical issues in computer security. State and local codes and regulations. Privacy issues.

Pol S 535. Contemporary Political Philosophy. (Cross-listed with Phil). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits of philosophy or political science.* Examination of theories of justice proposed by contemporary political philosophers. Analysis of the philosophical foundations of perspectives such as liberalism, libertarianism, communitarianism, socialism, feminism. Normative assessments of socio-political institutions.

Pol S 541. Strategic Public Management. (40-0) Cr. 3. S. Theory and practice of strategic planning and implementation in the public sector. Alignment of planning with other strategic systems. Discussion of fundamental strategic management issues and concepts. Introduction of alternatives to the bureaucratic paradigm. Includes group exercises and guidance for strategic management facilitation. Course is one-week intensive format.

Pol S 542. The Policy and Politics of Coastal Areas. (Dual-listed with 442). (3-0) Cr. 3. SS. Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, tradeoffs between conservation and jobs, the quality of coastal lifestyle, ways in which citizens participate in policy for coastal areas.

Pol S 544. Comparative Public Policy. (3-0) Cr. 3. *Prereq: 6 credits in political science.* Examines how, why, and to what effect governments deal with substantive policy problems differently. Environmental factors, ideologies, cultures, domestic policy making processes, and interest groups.

Pol S 547. Political Leadership and Elites. (3-0) Cr. 3. *Prereq: 6 credits in political science.* Various forms of leadership and leader-follower relations. Obligations, exchanges, incentives, coercion, corruption, bossism in both the U.S. and foreign experience.

Pol S 552. Comparative Foreign Policy. (Dual-listed with 452). (3-0) Cr. 3. S. *Prereq: 251.* Various theoretical approaches to explain foreign policy making and behavior through the use of case studies of selected nations.

Pol S 559. International Relations Theory. (3-0) Cr. 3. F. *Prereq: 6 credits in international studies.* Selected theoretical writings, both classical and contemporary, on world politics. Realism, war and conflict, peace and cooperation, political economy, crisis decision making, and transnational relations.

Pol S 560. American Political Institutions. (3-0) Cr. 3. *Prereq: 6 credits in American government.* Examination of policy-making and governance in a separation of powers system. Interaction between the chief executive, the legislature, administrative agencies, and the public. How political and legal forces affect policy makers and are reflected in public policies and programs.

Pol S 569. Foundations of Public Administration. (3-0) Cr. 3. F. *Prereq: Graduate classification.* An examination of the social, political, intellectual, and environmental factors contributing to the historical development and central issues of American Public Administration. Exploration of classic and contemporary texts of public administration emphasizing constitutional and civic roles of public servants, administrative responsibility in democratic governance and justice, and essential frameworks to identify managerial skills, perspectives, and resources for effective, equitable public service.

Pol S 570. Politics and Management of Nonprofit Organizations. (3-0) Cr. 3. *Prereq: Graduate classification.* Discussion of contemporary issues and perspectives shaping the policy development and management of national and international nonprofit organizations. Topics include an historic overview of nonprofit and philanthropic perspectives; exploration of nonprofit organization roles in public service provision; review of the legal framework influencing nonprofit governance; and consideration of capacity building issues such as strategic planning, board development, fundraising, human resources, and volunteer management.

Pol S 571. Organizational Theory in the Public Sector. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Major theories of administrative organization, including motivations of administrators and organizations, comparisons of organizational arrangements, factors affecting organizational arrangements, and formal and informal decision-making structures.

Pol S 572. Public Finance and Budgeting. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Topics such as the fiscal role of government in a mixed economy; evaluation of sources of public revenue and credit; administrative, political, and institutional aspects of the budget and the budgetary process; alternative budget formats; skills required to analyze public revenue and spending. Spreadsheet use required.

Pol S 573. Public Personnel Administration. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Course discusses the history and development of high performance personnel administration in the public and nonprofit sectors regarding strategic planning, employee rights and responsibilities, performance assessment, collective bargaining, and civil service systems. Emphasized basic competencies in the essential human resource management tools in the areas of recruitment, retention, employee development, compensation, discipline, and conflict resolution.

Pol S 574. Policy and Program Evaluation. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Integration, application, and utilization of public administration and public policy concepts in the interpretation of results and effectiveness of public programs and the prediction of consequences for policymakers and administrators.

Pol S 575. Management in the Public Sector. (Dual-listed with 475). (3-0) Cr. 3. S. *Prereq: 6 credits in political science.* Literature and research on organizational behavior and management. Theory with emphasis on applied aspects of managing contemporary

public sector organizations. Topics include distinctions between public and private organizations, leadership, productivity, employee motivation, organizational structure, and organizational change.

Pol S 576. Administrative Law. (Dual-listed with 476). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations.

Pol S 577. Government, Business, and Society. (Dual-listed with 477). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Diverse perspectives on the changing roles and relationships of business, government and society so as to open the way for more effective policy decisions on corporate-government affairs. Topics may include the changing economy; transformation of workplace and community conditions; consumerism; social responsibilities of businesses; economic policies and regulations; and politics in the business-government relationship.

Pol S 579. Public Revenues and Cost Analysis. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Provides an overview of public revenue policies and administration, and concepts and techniques of cost analysis. Examines topics such as administration and policies of property taxes, income taxes, sales taxes, and user charges. Provides an introductory understanding of different cost analysis techniques such as average cost and marginal cost analysis and activity-based costing. Spreadsheet use required.

Pol S 580. Ethics and Public Affairs. (Dual-listed with 480). (3-0) Cr. 3. *Prereq: 6 credits in political science.* Study of decision making approaches and application to case studies. Topics such as the different roles of public officials, proper scope and use of administrative discretion, and the admissibility of religious, political, and philosophical commitments in governmental decision making.

Pol S 581. International Political Economy. (3-0) Cr. 3. F. *Prereq: 6 credits in political science.* An overview of the international political economy since the end of World War II. Special emphasis on national (primarily U.S.) development assistance and agricultural/food politics and policies, and those of the international food organizations, the World Bank, and the regional development banks.

Pol S 582. Environmental Politics and Policies. (Dual-listed with 482). (3-0) Cr. 3. F. *Prereq: 3 credits in political science or 3 credits in Environmental Studies; graduate classification.* Major ideologies relating to conservation and ecology. Processes, participants, and institutions involved in state, national, and global environmental policymaking. Case studies of environmental controversies and proposals for policy reform.

Pol S 583. Law and Management. (Dual-listed with 483). (3-0) Cr. 3. F. Emerging constitutional/legal doctrines and requirements in public management: concept of new property rights in public employment/public service delivery; procedural due process requirement; scope of free speech and liberty protected in the conduct of public management; equal employment opportunity requirements; and the scope of official and personal immunities and liability in public affairs.

Pol S 585. Comparative Public Administration. (Dual-listed with 485). (3-0) Cr. 3. Comparison of government bureaucratic in major world regions; trends and issues of administrative and management reforms; globalization and other contemporary challenges to state administrative structures and policies; skills needed to evaluate and implement public management reforms.

Pol S 590. Special Topics. Cr. arr. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor.*
A. American Political Institutions
B. Public Law
C. Political Theory and Methodology
D. Comparative Government
E. International Relations
F. Political Parties and Policy Formation
G. Public Administration and Public Policy
I. Internship
T. Teaching Preparation

Pol S 598. Public Administration Internship. Cr. arr. F.S. *Prereq: 15 credits in political science, permission of the instructor.* Supervised internship with administrative agencies, legislative organizations, judicial branch offices, and nonprofit groups.

Pol S 599. Creative Component. Cr. arr.

Courses for graduate students

Pol S 610. Graduate Seminars. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 15 credits in political science.*
A. American Political Institutions
B. Public Law
C. Political Theory and Methodology
D. Comparative Government
E. International Relations
F. Policy Process
G. Public Administration and Public Policy

Pol S 699. Research. Cr. arr. Repeatable.

Preprofessional Study

Requirements for admission to most professional academic programs can be met by study at Iowa State University. These requirements may be met in the course of obtaining a bachelor's degree from Iowa State or at a level below that of a degree, depending on the intended field of study. The specific courses taken in a preprofessional program will depend primarily upon the admission requirements of the professional schools to which a student wants to apply. In some programs requiring three years of preprofessional work, a student may, by careful planning, complete requirements for the bachelor's degree upon transferring to Iowa State up to 32 semester credits of professional coursework. Generally these credits will be counted as electives, but a maximum of 24 may be used as major credits in interdisciplinary studies and a smaller number as major credits in appropriate departments.

Students who have not declared a major upon entry should enter as preprofessional students, i.e., premedical, prelaw, PHP (preprofessional health programs), or GENPV (General Undergraduate Studies Pre Vet), until they choose a major or transfer to a professional school. All students, whether they have selected a major or not, are encouraged to identify their interest in a professional career by designating it on their application.

Information about preprofessional program admissions requirements and career opportunities in human health or law may be obtained in the Liberal Arts and Sciences Advising Center. Information about veterinary medicine admissions requirements and career opportunities may be obtained from the coordinator of the preveterinary program in the Office of the Dean of the College of Veterinary Medicine.

Clinical Laboratory Science/Medical Technology

Clinical laboratory scientists, still commonly referred to as medical technologists, are important members of health-care teams. They perform the chemical, microscopic, radio-assay, and microbiological tests that are necessary in disease diagnosis, and they type and cross-match blood samples to facilitate blood transfusions. They usually work under the supervision of a physician in a hospital or clinic laboratory, but may also be employed by a pharmaceutical company or by manufacturers of analytical instruments. The professional training requires 12 months in a hospital-based CLS/MT program following at least 3 years of college study that emphasizes chemistry and the biological sciences. Students may earn a bachelor's degree by completing the admissions requirements of the CLS/MT program and most of the degree requirements in 3 years on campus, then spending their fourth year in one of the hospital programs that are affiliated with Iowa State University. Before beginning the off-campus studies, students must earn at least 88 credits; the 32 most recent credits must have been earned in residence at ISU. A maximum of 32 semester credits earned in professional CLS/MT school can be used to partially fulfill the requirements for the bachelor's degree. Students who complete all degree requirements in residence at the university may apply to any school of medical technology for which the admission requirements have been met.

The following CLS/MT programs are affiliated with Iowa State University:

Mercy College of Health Sciences Clinical Laboratory Science Program, Des Moines, Iowa. Program Director: Kyla Deibler.

St. Luke's Methodist Hospital, Cedar Rapids, Iowa. Education Coordinator: Nadine Sojka. Medical Director: Dorryl Buck.

Dentistry

Dentists diagnose, treat, and try to prevent diseases and injuries of the teeth, jaws, and mouth. Usually a general practitioner will have spent 3 or 4 years taking preprofessional courses at the undergraduate level and 4 years in dental school earning the degree of doctor of dental surgery (D.D.S.) or doctor of dental medicine (D.M.D.). Learning a specialty requires at least 2 more years. The courses necessary for admission to most dental schools include English, biology, general and organic chemistry, and physics. Students may earn a degree in any major that Iowa State University offers as they meet the admission requirements; they should choose their major to reflect their own interests and abilities. Highly qualified students may be accepted into dental school after 3 years of preprofessional study without earning a baccalaureate degree.

Health Information Management

Health information managers serve as supervisors of medical records departments in hospitals, clinics, nursing homes, and other healthcare institutions. Certified registered record administrators (R.R.A.) must have completed a program leading to a bachelor's degree in medical record administration. Most professional programs are 2 years in length and follow 2 years of college study in chemistry, biology, the humanities, social sciences, languages, and philosophy. Students may take the preprofessional courses at Iowa State University and then transfer to a university offering the professional program or they may earn a bachelor's degree at Iowa State University before entering a health information management program.

Hospital and Health Administration

Administrators of health care organizations manage and guide the varied activities in hospitals, clinics, nursing homes, and mental health facilities. The professional requirement may be for a master's degree or a bachelor's degree, depending upon the size of the institution and whether an upper or middle entry-level position is desired. Students at Iowa State may take general education courses for two or more years and then transfer to a university offering a bachelor's degree in health administration, or they may spend four years earning a bachelor's degree in any department before entering a master's degree program at the University of Iowa or other university. Courses required for admission to master's degree programs in hospital and health administration vary, but may include introductory accounting, management, statistics, and economics.

Human Medicine

Physicians study, diagnose, and treat illness and injury. They may work in offices, clinics, hospitals, or laboratories, in private practice or for government or industry. Their professional training usually consists of 4 years of study in a college of medicine to earn the doctor of medicine (M.D.) degree, and then 3 or more years in hospital residency learning a specialty such as family medicine, pediatrics, surgery, obstetrics, or psychiatry. A degree of doctor of osteopathy (D.O.) is awarded to those students who complete 4 years in a college of osteopathic medicine before their residency. All medical schools recommend a broad preprofessional education that includes courses in biology, chemistry, physics, mathematics, English, the social sciences, arts and humanities. The degree of a premedical student can be from any college and in any curriculum or major offered by the university. The major should reflect the student's interests and provide appropriate preparation for an alternative career.

Law

An attorney offers assistance, often where a third-party neutral arbiter is required to resolve conflicts. Many attorneys work in private practice, but others secure positions in the public sector, e.g., federal or state governmental agencies. At least 3 years (a J.D. is completed in 3 years, with 90 credits. It may be completed earlier if the student attends summer school) are needed to complete a law degree, a Doctor of Jurisprudence (J.D.). A bachelor's degree is required for admission to all accredited law schools. A student planning to enter law school may major in any discipline. Courses taken as an undergraduate should be designed to assist the student in the development of critical thinking skills, including analytical written and oral skills. An understanding of social structures and institutions is invaluable. Perhaps most valuable are courses in philosophy, English language and literature, the social sciences, including political science, psychology, criminal justice, economics, and history. Courses in mathematics, particularly statistics, are also helpful in developing analytical skills.

Library and Information Science

Librarians are essential in educational institutions, medical facilities, government agencies, industries, and public information centers. The professional preparation for library administration is provided by master's degree programs. Admission requirements for the University of Iowa's program, for example, include a bachelor's degree with at least 85 semester credits in the arts and humanities and the natural and social sciences. Iowa State students may choose majors that reflect their own interests and that may provide a foundation for working in medical, law, or other specialized libraries.

Nursing

A professional nurse may do clinical nursing, teaching, or research, in hospitals, private practice, public health centers, schools, or industry. Although becoming a registered nurse (R.N.) does not require a bachelor's degree, the student who completes the bachelor of science degree in nursing (B.S.N.) has college-level preparation for clinical nursing and an essential base for graduate study. Iowa State University does not offer a nursing degree. Students may take prenursing courses for two years at Iowa State University and, if accepted, transfer to the BSN program at another college or university.

Occupational Therapy

Occupational therapists provide purposeful activities to help those who have been disabled by physical illness or injury, birth defects, emotional disorder, aging, drug abuse, or other problems to learn to cope with everyday living. Therapists treat patients in hospitals, school systems, and rehabilitation centers. Students may complete a bachelor's degree in a related area at Iowa State University, and then enter a certification, master's or doctoral degree program at another university; or they may complete 1 or 2 years of preoccupational therapy courses at Iowa State and then transfer to another university to complete the requirements for a bachelor's degree in occupational therapy. The prerequisites for admission to an occupational therapy program usually include

English, art, biology, chemistry, physics, psychology, sociology, anthropology, and statistics, but vary from one school to another.

Optometry

Optometrists examine, diagnose, treat and manage diseases of the visual system, the eye and associated structures. Treatment may include corrective glasses or contacts, vision therapy and therapeutic drugs. Optometrists usually set up their own offices or work in group practice. Professional study requires 4 years in a school or college of optometry and leads to the doctor of optometry (O.D.) degree. All optometry schools require at least 90 semester credits of preprofessional courses, including biology, chemistry, physics, mathematics, and English. Certain optometry schools require a bachelor's degree. Students wishing to earn the bachelor's degree from Iowa State University may choose any major and take the courses required for graduation with that major as they take the courses required for admission to a professional optometry program.

Pharmacy

Pharmacists prepare and dispense therapeutic drugs; educate health care professionals, patients and the general public about the appropriate use of drugs; conduct pharmaceutical research and work in industrial settings which involve the manufacture, marketing and advertising of pharmaceutical. Students may complete prepharmacy courses within two years at Iowa State University. Upon admission, the student will then transfer to a Pharm. D. program of study which will entail three or four years of study.

Physical Therapy

Physical therapists work with people who have been disabled by injury, illness, or birth defects. They assist in evaluating the physical problems and administer therapeutic agents such as massage and exercise, heat, baths, ultrasonics, and electricity; they work in hospitals, clinics, nursing homes, schools, rehabilitation centers, and private practice. Students may complete three years of undergraduate courses including prerequisites before transferring to a three-year professional curriculum such as the master's degree program at St. Ambrose University or the doctoral degree program at Creighton University. Usually, students earn a bachelor's degree in a related field at ISU before entering professional school to earn a master's degree or doctoral. Admission to the master's degree program at the University of Iowa requires a bachelor's degree. The bachelor's degree from ISU may be earned in any department, provided that the physical therapy prerequisites are completed. Earning a bachelor's degree prior to entering professional school allows a student to apply to a range of graduate level programs and builds a strong liberal arts foundation. Courses required for admission to a professional program include biology, chemistry, physics, psychology, mathematics, and statistics.

Physician Assistant

A physician assistant provides medical services under the supervision of a licensed physician. PAs conduct physical examinations, order and interpret laboratory tests, make diagnostic and treatment decisions, and are allowed to prescribe medication in most states. Certification as a physician assistant requires 2 years in a professional program at the master's or bachelor's degree level. Students applying to a bachelor's degree program must have completed at least 60 semester credits of college work including general and organic chemistry, zoology, behavioral science, and humanities. Applicants who have had health-care experience with direct patient contact are preferred. Admission to a master's degree program requires similar coursework and clinical experience in addition to a bachelor's degree.

Podiatry

Podiatrists diagnose, and treat diseases and disorders of the human foot and ankle. They treat patients in private and group practice, hospitals, and, increasingly, in industrial and sports-related positions. Professional training requires 4 years in a college of podiatric medicine and leads to the degree of doctor of podiatric medicine (D.P.M.). This is usually followed by 1 to 3 years in a hospital residency. All podiatric colleges require at least 3 years of preprofessional study, including courses in biology, general and organic chemistry, physics, and English. Most entrants have a bachelor's degree, which may be in any major. A few students may complete the admission requirements and most of the bachelor's degree requirements in 3 years. If so, a maximum of 32 semester credits may be transferred to Iowa State University from the first year in an accredited podiatric college in order to complete the requirements for the bachelor's degree.

Theology or Religious Studies

The professional education of a student of religion can follow one of two paths. The path to a profession as a pastor, priest, rabbi or other leadership position in a religious tradition usually requires 3 years in a program leading to the master of divinity (M.Div.) offered at a school of divinity or of theology. The path to a profession as a teacher of religious studies at the college level requires 4-7 years in a program leading to the Ph.D. at a graduate school of Religious Studies. Both seminaries and graduate schools require a bachelor's degree for admission. The American Association of Theological Schools recommends the following areas of study as the best preparation for theological studies: English language and literature; history, including non-Western culture; philosophy; natural sciences, social sciences, especially psychology, sociology and anthropology; the fine arts; Biblical and modern languages; and religion, both Western and Eastern. Although students in a variety of major fields may qualify for admission to a theological school, interested persons are advised to review their proposed programs with a representative of the Religious Studies Program in the Department of Philosophy and Religious Studies.

Veterinary Medicine

About 75% of all veterinarians are engaged in private practice. In a mixed practice, they diagnose and treat health problems among a variety of animals. Others specialize in one species (e.g., feline, pet bird) and still others specialize in a specific discipline within veterinary medicine (e.g., cardiology, ophthalmology). Veterinarians may also choose public and corporate practice (e.g., public health, education, research, food safety, industry, laboratory animal medicine, aquatic animal medicine, poultry medicine, and military veterinary medicine).

The professional program requires four years at a college of veterinary medicine and leads to the doctor of veterinary medicine degree (D.V.M.).

Admission to a veterinary college involves at least two years of preprofessional college education. Candidates must take courses in biology, chemistry, genetics, physics, English, humanities, social sciences, speech, anatomy and physiology, and biochemistry. (For Iowa State University see *Veterinary Medicine, Admission Requirements*; for most recent information, consult the College of Veterinary Medicine Web site: www.vetmed.iastate.edu.)

Students may pursue their preveterinary preparation in any college at Iowa State University. A major (preveterinary medicine is not a major) should be selected that is allied to each student's vocational interests in veterinary medicine or that otherwise offers vocational satisfaction in the event that plans for entry into the College of Veterinary Medicine change. Students are encouraged to pursue a bachelor's degree; the most effective progress toward a bachelor's degree is made when a major is selected upon entry and no change occurs before graduation. However, students who have not even considered a career other than veterinary medicine may need some time to explore possibilities before selection of a major.

To assist students who have indicated interest in the preveterinary program for the College of Veterinary Medicine and are undecided about a major, an advising category is available known as GENPV (General Undergraduate Studies Pre Vet). Orientation and advising services for these students are designed to help students fulfill preveterinary course requirements, to introduce available majors and careers allied to veterinary medicine, and to introduce career options in veterinary medicine. GENPV students must select a major by the end of their second semester. Some Iowa State University majors allow, by careful planning, the opportunity for a student to earn the bachelor's degree by combining credits from three years of preprofessional study and one year of professional study in the College of Veterinary Medicine.

Professional Agriculture

www.proag.iastate.edu/

(Interdepartmental Program administered by the Department of Agricultural Education and Studies)

Graduate Study

The Professional Agriculture major is an off-campus non-thesis program leading to the Master of Agriculture (M.Ag.) degree. It is available to students wishing to pursue graduate studies in agriculture, or natural resources through distance education. It is considered to be a professional degree and not preparation for a doctoral program. The program emphasizes agriculture/natural resource information and technology transfer in a variety of settings including education, extension, agencies, and industry training/development.

Graduates have a broad base of knowledge in one or more agriculture disciplines. They have the ability to communicate effectively and make decisions based on knowledge. To earn the 32 credits necessary for graduation, students must complete 28 semester credits of formal coursework, and 4 credits of creative component. Courses are delivered through distance education via the WWW and DVD. On-campus workshops are offered during summer sessions. Specific courses offered in the program are listed on the College of Agriculture's distance education website: www.agde.iastate.edu/.

Psychology

www.psychology.iastate.edu/

Douglas Bonett, Chair of Department

Distinguished Professors: Anderson, Wells

Distinguished Professor (Emeritus): Ahmann

University Professor: Lorenz

University Professor (Emeritus): Brown

Professors: Andre, D. Bonett, Cutrona, Dark, Larson, Phye, Prieto

Professors (Emeritus): Bath, Borgen, Charles, Edwards, Hannum, Hughes, Karas, Layton, Lewis, Peters, Strahan, Wolins, Zytowski

Professors (Collaborators): Conger, Gerrard

Associate Professors: Cooper, Cross, Cunnick, Madon, Scott, Venkatagiri, Vogel, Wei, West

Assistant Professors: Armstrong, Blankenship, Carpenter, Chan, Gentile, Guyll, Krizan, Morris, Wade, Weber

Assistant Professor (Adjunct): Mason

Assistant Professor (Collaborators): Day

Senior Lecturers: R. Bonett, Hanisch, Konar, Phillips, Scheel

Lecturers: Gilbert, Harms, Jenks, Shi, Sweet

Undergraduate Study

For college-level requirements in undergraduate curricula leading to the degrees of bachelor of arts and bachelor of science, see Liberal Arts and Sciences, Curriculum.

An undergraduate major in psychology may be taken as liberal arts education, as preparation for graduate study in psychology, or as background for professional education in law and in the health professions. A student with a bachelor's degree in psychology may qualify for a variety of positions including those in social sciences, mental health, corrections, rehabilitation, developmental disability centers, business, management, and public opinion surveying. Depending on professional goals, a minor in another discipline may be desirable. Students should consult with their academic advisers early in their undergraduate curriculum. The requirements of the program enable graduates to understand and apply the scientific principles, facts, and basic methods of psychology in their personal and professional activities. Graduates learn to think scientifically about human behaviors and mental processes. They can communicate effectively in speech and in writing, respect individual and cultural differences in behaviors, and appreciate ethical issues in both the science and practice of psychology. Professional work with a job title of psychologist in academic, business, clinical, government, and school settings requires graduate degrees.

The major must include the following psychology courses: 101, 102, 111, 201, 301, and 440, each with a minimum grade of C-. The major also must include four courses distributed across at least four of the following five areas: Area A – 230, 250; Area B – 280, 380; Area C – 310, 315; Area D – 312, 313, 316, 318(x); Area E – 360, 460. Three additional 3-credit courses in psychology must be taken. Area courses may be used to meet this requirement, but variable credit courses (470, 490, 491, and 492) may not. In accordance with college requirements, a C or better average is required in the courses used to satisfy the major.

Departmental requirements for the B.A. and B.S. include the following supporting courses: six credits in philosophy including 201; two of the following: Biol 101, 155 or 211; Chem 163; Gen 260 or Biol 258; one of the following: Stat 101, 104 or 226, with a minimum grade of C-; and a Math course, excluding 105, acceptable in LAS General Education Natural Sciences and Mathematics Discipline Area.

Students electing a B.S. degree also must complete Psych 302 with a minimum grade of C- and a minimum of 10 additional supporting credits in supporting courses from the list of courses in the LAS Gen Ed Natural Sciences and Mathematical Disciplines Area (or approved departmental list) as follows: three credits in mathematics, six credits in natural sciences, and one additional credit in a laboratory course.

Students electing a B.A. degree also must complete an ISU approved minor.

The department offers a minor in psychology. The minor requires completing 18 credits in psychology, including 101 and 301, each with a minimum grade of C-. At least 9 of the 18 credits must be in 300 level courses (or above), but no more than three credits total may be from Psych 490, 491, and 492. A C- or better is required in each course used to satisfy the minor and a C average or better is required in courses used to satisfy the minor. Contact the psychology advising office for more information.

Communication Proficiency requirement: The department requires a grade of C- or better in Engl 150 and in Engl 250 (or 250H) and a C- or better in Psych 302 or Psych 490 (2 credits minimum) or Engl 302, 309, or 314.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy in psychology, and for a minor for students with a major in other departments.

Within the major of psychology, the department offers a doctoral specialization in counseling psychology (APA accredited) and doctoral areas of concentration in cognitive psychology and social psychology.

Students seeking a graduate major in psychology must have graduated from an accredited college in a curriculum substantially equivalent to the undergraduate curriculum in Liberal Arts and Sciences at Iowa State University. Prerequisite to admission is at least 15 credits of basic psychology, which should include a laboratory course, a measurement course, and a statistics course.

Graduates function as academic psychologists in higher education or as professional psychologists in applied settings. They have an extensive knowledge of psychological principles and the conceptual and quantitative skills to conduct psychological research, communicating the results to the scientific community, students in the classroom, and the general public. Graduates in applied programs have specialized knowledge in counseling and program development. They are skilled in delivering such programs and services to diverse clientele in a variety of settings.

The department also participates in the interdepartmental programs in human computer interaction and neuroscience, and in the interdepartmental minor in gerontology (see Index).

A formal class and a supervised practicum in the teaching of psychology is recommended for all doctoral students whose future plans may include teaching at the college level. A 12-month internship in a training site or agency approved by the faculty is required of all doctoral students in counseling psychology.

Communication Disorders (CmDis)

(Administered by the Department of Psychology)

Courses primarily for undergraduate students

CmDis 170. Speech Improvement for Nonnative Speakers. (2-0) Cr. 2. For nonnative speakers of English only. Development of effective English vowel and consonant productions, accommodation processes that occur in context, intelligibility in conversational English, and appropriate stress patterns. Satisfactory-fail only.

CmDis 275. Introduction to Communication Disorders. (Cross-listed with Ling). (3-0) Cr. 3. Survey of nature, causes, and types of major communication disorders including phonological, adult and child language, voice, cleft palate, fluency, and hearing disorders.

CmDis 286. Basic Sign Language. (Cross-listed with Ling). (3-0) Cr. 3. Development of basic skills in the use and understanding of signed English, a modification of American Sign Language. Overview of the types, causes and consequences of hearing impairment, deaf culture and the education of hearing-impaired children.

CmDis 371. Phonetics and Phonology. (Cross-listed with Ling). (3-0) Cr. 3. *Prereq: 275 or Engl 219.* Analysis of speech through study of individual sounds, their variations, and relationships in context; English phonology; practice in auditory discrimination and transcription of sounds of American English; description of speech sounds in terms of their production, transmission, and perception.

CmDis 471. Language Development. (Cross-listed with Ling). (3-0) Cr. 3. *Prereq: 275 or Psych 230 or Engl 219.* Definition of components of language. Overview of theories and developmental processes related to each component of linguistic skill (semantics, lexicon, syntax, morphology, phonology, pragmatics). Overview of normative information available for infants, children, adolescents, and adults. Attention to metalinguistic skills and the complementary nonlinguistic and paralinguistic skills. Nonmajor graduate credit.

Courses primarily for undergraduate students

Psych 101. Introduction to Psychology. (3-0) Cr. 3. F.S.SS. Fundamental psychological concepts derived from the application of the scientific method to the study of behavior and mental processes. Applications of psychology.
H. Honors section. (2-2) F. (For students in the University Honors Program only.)

Psych 102. Laboratory in Introductory Psychology. (0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in 101.* Laboratory to accompany 101.

Psych 111. Orientation to Psychology. Cr. 0.5. F.S. Program requirements and degree/career options. Required of psychology majors. Satisfactory-fail only.

Psych 131. Academic Learning Skills. (0-2) Cr. 1. F.S. Efficient methods of study and reading. Satisfactory-fail only.

Psych 230. Developmental Psychology. (3-0) Cr. 3. F.S.SS. Life-span development of physical traits, cognition, intelligence, social and emotional behavior, personality, and adjustment.

Psych 280. Social Psychology. (3-0) Cr. 3. F.S.SS. Individual human behavior in social contexts. Emphasis on social judgments and decisions, attitudes, perceptions of others, social influence, aggression, stereotypes, and helping.

Psych 301. Research Design and Methodology. (3-0) Cr. 3. F.S.SS. *Prereq: Stat 101; 1 course in psychology.* Survey of the principal research techniques used in psychology with an emphasis on the statistical analysis of psychological data.

Psych 302. Research Methods in Psychology. (2-2) Cr. 3. F.S. *Prereq: 301.* Discussion of and experience in designing research studies, collecting and analyzing data, and preparing research reports in psychology.

Psych 310. Brain and Behavior. (3-0) Cr. 3. F.S. *Prereq: 101.* Survey of basic concepts in the neurosciences with emphasis on brain mechanisms mediating sensory processes, arousal, motivation, learning, and abnormal behavior.

Psych 312. Sensation and Perception. (3-0) Cr. 3. F.S. *Prereq: 101.* Survey of the physiology and psychology of human sensory systems including vision, audition, smell, taste, the skin senses, and the vestibular senses.

Psych 313. Learning and Memory. (3-0) Cr. 3. F.S. *Prereq: 101.* Fundamental concepts and theories of learning and memory derived from human and animal research.

Psych 314. Motivation. (3-0) Cr. 3. F.S. *Prereq: 101.* Concepts and topics of motivation including curiosity, pain, emotion, sex, aggression, love, play, addiction, sleep, fatigue, and work.

Psych 315. Drugs and Behavior. (3-0) Cr. 3. F.S. *Prereq: 101, Biol 155 or 211.* A biological perspective on fundamentals of psychoactive drugs and their use in experimental, therapeutic, and social settings.

Psych 316. Cognitive Processes. (3-0) Cr. 3. F.S. *Prereq: 101.* The study of the human mind, addressing the processes by which people perceive the world, remember information, access and use knowledge, understand language, make decisions, reason, learn and solve problems.

Psych 333. Educational Psychology. (Cross-listed with C I). (3-0) Cr. 3. F.S. *Prereq: Psych 230 or HD FS 102, application to the teacher education program or major in psychology.* Classroom learning with emphasis on theories of learning and cognition, and instructional techniques. Major emphasis on measurement theory and the classroom assessment of learning outcomes.

Psych 346. Psychology of Women. (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: 2 courses in psychology including 101.* Survey of psychological literature relating to biological, developmental, interpersonal, and societal determinants of the behavior of women.

Psych 348. Psychology of Religion. (Cross-listed with Relig). (3-0) Cr. 3. *Prereq: Nine credits in psychology.* Survey of psychological theory and research investigating religious and spiritual attitudes, beliefs and practices.

Psych 360. Psychology of Normal Personality. (3-0) Cr. 3. F.S.SS. *Prereq: 101.* Theories and research in the study of development and functioning of normal personality.

Psych 380. Social Cognition. (3-0) Cr. 3. *Prereq: 101 or 280.* How people understand themselves and others, including attribution, social categories and schemas, the self, social inference, stereotypes, and prejudice.

Psych 381. Social Psychology of Small Group Behavior. (Cross-listed with Soc). (3-0) Cr. 3. S. *Prereq: 280 or Soc 305.* A survey of small group theory and research from an interdisciplinary, social psychological perspective.

Psych 401. History of Psychology. (3-0) Cr. 3. F.S. *Prereq: 4 courses in psychology.* Philosophy and science backgrounds of psychology. Development of theories and causes of events in academic and applied psychology. Nonmajor graduate credit.

Psych 411. Evolutionary Psychology. (3-0) Cr. 3. S. *Prereq: Junior classification, three courses in psychology; biology 211.* This course examines the application of the principles of evolutionary biology to the understanding of human behavior. Evolutionary perspectives on brain development, cognition, language, mating behavior, sex differences, altruism, artistic behavior, and criminal behavior are explored. Arguments by those critical of the evolutionary approach to psychology are examined as well.

Psych 413. Psychology of Language. (Cross-listed with Ling). (3-0) Cr. 3. *Prereq: Psych 101.* Introduction to psycholinguistics. Topics may include origin of language, speech perception, language comprehension, reading, bilingualism, brain bases of language, and computational modeling of language processes. Nonmajor graduate credit.

Psych 422. Counseling Theories and Techniques. (3-0) Cr. 3. F. *Prereq: 3 courses in psychology.* Overview of the major counseling theories and techniques, with emphasis on the key concepts of each theory, the role of the counselor, therapetuic goals, and the main techniques derived from each theory. Nonmajor graduate credit.

Psych 422L. Laboratory in Counseling Theory and Techniques. (0-2) Cr. 1. F. *Prereq: Three classes in psychology and credit or enrollment in Psych 422..* Learn basic counseling skills such as active listening, reflecting feelings, empathy, confrontation, immediacy and self-disclosure. Supervised practice using basic counseling skills.

Psych 440. Psychological Measurement I. (2-2) Cr. 3. F.S.SS. *Prereq: 301 and 9 credits in psychology, Stat 101.* Principles of psychological measurement, including concepts of reliability and validity; interpretation of scores; factors influencing performance; construction and use of measures of ability, achievement, and personality. Nonmajor graduate credit.

Psych 450. Industrial Psychology. (3-0) Cr. 3. F.S. *Prereq: 2 courses in psychology including 101, Stat 101.* Content and methods of industrial psychology including the different approaches used to select employees, how to conduct performance appraisals, and how to train employees in organizations. Work attitudes and behaviors of employees, work schedules, safety and human factors as well as relevant legal issues are discussed. Statistics including regression and correlation are used in the course. Nonmajor graduate credit.

Psych 460. Abnormal Psychology. (3-0) Cr. 3. F.S.SS. *Prereq: 3 courses in psychology including 101.* Description of major forms of maladaptation including anxiety, mood disorders, personality disorders, substance dependence, and schizophrenia. Factors in the development of behavior deviations. Research pertinent to the description, development, and maintenance of abnormal behavior. Nonmajor graduate credit.

Psych 470. Seminar in Psychology. (1-0) Cr. arr. Repeatable. *Prereq: 12 credits in psychology.* Current topics in psychological research and practice.
A. Counseling
B. Experimental
C. Individual Differences
D. Social

Psych 484. Psychology of Close Relationships. (3-0) Cr. 3. *Prereq: 9 credits in psychology including 280.* Theories and research concerning the functions, development, and deterioration of close relationships. Influence of psychological processes on friendship, romantic, marital, and family relationships. Topics include mate selection, interdependence, trust and commitment, power and dominance in relationships, sexuality, divorce, gender roles, and family interaction. Nonmajor graduate credit.

Psych 485. Health Psychology. (3-0) Cr. 3. F. *Prereq: Junior classification, 6 credits in psychology.* Application of psychological theory and research methods to issues in physical health. Psychological factors in illness prevention, health maintenance, treatment of illness, recovery from injury and illness, and adjustment to chronic illness. Nonmajor graduate credit.

Psych 488. Cultural Psychology. (3-0) Cr. 3. *Prereq: 280 and 301; junior classification.* Examination of the ways that cultural beliefs, values, and ideologies shape cognitive, developmental, social and other psychological phenomena. Nonmajor graduate credit.

Psych 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior classification, 6 credits in psychology, and permission of instructor.* Supervised reading in an area of psychology. Writing requirement.

No more than 9 credits of Psych 490 may be counted toward a degree in psychology.

Psych 491. Research Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior classification, permission of instructor, and credit or enrollment in 301.* Supervised research in an area of psychology. Primarily for students intending to pursue graduate education. No more than 9 credits of Psych 491 may be counted toward a degree in psychology.

Psych 492. Fieldwork Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior classification, 12 credits in psychology, and permission of instructor.* Supervised fieldwork in a human service agency or other appropriate setting. No more than 9 credits of Psych 492 may be counted toward a degree in psychology. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Psych 508. Research Methods in Applied Psychology. (3-0) Cr. 3. *Prereq: 440, Stat 401.* Methods and issues in applied psychological research. Role of theory in research, fidelity of measurement, selection of subjects, sampling, ethical issues, experimenter bias, data collection methods, power analysis, and professional standards for writing research articles. Emphasis on research methodological issues, not statistical issues.

Psych 512. Advanced Perception. (3-0) Cr. 3. *Prereq: 312.* Survey of current theory and research in perception with an emphasis on vision.

Psych 514. Advanced Human Learning and Memory. (3-0) Cr. 3. *Prereq: 313 or 316 and Stat 101.* Theoretical and empirical research in human learning and memory.

Psych 516. Advanced Cognition. (3-0) Cr. 3. F.S. *Prereq: 316.* Theoretical models and empirical research in human cognition within the domains of perception, attention, memory, language, concepts/categorization and spatial cognition.

Psych 517. Psychopharmacology. (3-0) Cr. 3. *Prereq: 310, 315, or equivalent and permission of instructor.* Fundamentals of drug-behavior interactions with emphasis on psychoactive drugs and their use in experimental, therapeutic, and social settings.

Psych 519. Cognitive Neuropsychology. (3-0) Cr. 3. *Prereq: 310 and 316 or 313.* Psychological models and related neurological substrates underlying cognition in normal and brain-damaged individuals.

Psych 521. Cognitive Psychology of Human Computer Interaction. (Cross-listed with HCI). (3-0) Cr. 3. *Prereq: Graduate classification or instructor approval.* Biological, behavioral, perceptual, cognitive and social issues relevant to human computer interactions.

Psych 522. Scientific Methods in Human Computer Interaction. (Cross-listed with HCI). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Psych 521 and Stat 101 or equivalent.* Basics of hypothesis testing, experimental design, analysis and interpretation of data, and the ethical principles of human research as they apply to research in human computer interaction.

Psych 530. Advanced Developmental Psychology. (3-0) Cr. 3. *Prereq: Psych 230, 301, 302 and Stat 401, or graduate classification.* Theory and research on infant and child development, with an emphasis on perceptual development, cognitive development and social development.

Psych 533. Educational Psychology of Learning Cognition, and Motivation. (Cross-listed with C I). (3-0) Cr. 3. F. *Prereq: 333 or teacher licensure.* Learning, cognition, and memory in educational/training settings.

Psych 538. Developmental Disabilities in Children. (Cross-listed with HD FS). (3-0) Cr. 3. F. *Prereq: 9 credits in human development and family studies or psychology.* Theories, research, and current issues regarding development in children with disabilities. Investigation of interventions with children and families.

Psych 542. Introduction to Psychological Assessment. (3-0) Cr. 3. F. *Prereq: 440.* Theory and research concerning assessment of intelligence and achievement with emphasis on developmental patterns and diagnosis of learning problems. Critical examination of current assessment practices in clinical and educational settings.

Psych 544. Practicum in Assessment. (2-1) Cr. 2. *Prereq: 542 and admission into the PhD program in counseling psychology.* Supervised practice in designing and implementing observational systems and in administering, scoring, interpreting, and reporting individual tests.
A. Behavioral Assessment
B. Individual Tests: Children
C. Testing: Adult Ages

Psych 550. Advanced Industrial and Organizational Psychology. (3-0) Cr. 3. *Prereq: 440, Stat 402.* Critical examination of theories, methods, and applications in industrial and organizational psychology. History and legal issues, predictor and criteria relationships, employee attitudes and behaviors, employee training and motivation, and human factors.

Psych 560. Advanced Personality Psychology. (3-0) Cr. 3. *Prereq: 4 courses in psychology, including 360.* Analysis of theories of personality, concepts, methods, and current research issues.

Psych 561. Psychopathology and Behavior Deviations. (3-0) Cr. 3. *Prereq: 460.* Examination of theoretical perspectives and current research pertinent to the major forms of adult dysfunction including: adjustment, anxiety, mood, somatoform, dissociative, sexual and gender identity, personality, schizophrenic, eating, and substance abuse disorders.

Psych 562. Personality Assessment. (3-0) Cr. 3. *Prereq: 360, 440, 542, and Stat 401 and admission to the PhD program in counseling psychology.* Principles, concepts, and methods of personality assessment. Though not a practicum course, exposure is given to a variety of objective, projective, and situational tests.

Psych 563. Developmental Psychopathology. (3-0) Cr. 3. *Prereq: 230 and 460 or graduate classification.* Theory and research related to major disorders of childhood and adolescence with an emphasis on assessment, etiology, and developmental processes, and multimodal interventions.

Psych 580. Advanced Social Psychology: Psychological Perspectives. (3-0) Cr. 3. *Prereq: 4 courses in psychology, including 280.* Current theories, methods, and research in social psychology with an emphasis on cognitive and interpersonal processes such as attribution, social cognition, attitude change, attraction, aggression, and social comparison.

Psych 581. Applications of social Psychology Theories. (3-0) Cr. 3. *Prereq: 12 credits in psychology, including 280.* Application of social psychological theory to various applied topics, including physical and mental health, stress, and coping.

Psych 586. Research Methods in Social Psychology. (3-0) Cr. 3. *Prereq: Stat 402 and permission of instructor.* Ethical issues, generating testable hypotheses, operationalizing independent and dependent variables, sampling and design issues, laboratory procedures, and interpretation of results in experimental research. Issues in analysis of variance, Bayesian reasoning, and effect size estimation will be emphasized, as will writing and publication strategies.

Psych 590. Special Topics. Cr. arr. Repeatable. *Prereq: 12 credits in psychology, and permission of instructor.* Guided reading on special topics or individual research projects.
A. Counseling
Q. Cognitive
R. Social
Z. General

Psych 592. Seminar in Psychology. (1-0) Cr. arr. Repeatable. *Prereq: 12 hours in psychology. Psych 592A also requires admission into the doctoral program in counseling psychology.*
A. Counseling
B. Industrial-Organizational
M. Professional Issues and Ethics
P. Research Methods and Psychometrics
Q. Cognitive
R. Social
Z. General

Psych 597. Internship in Psychology. Cr. R. *Prereq: M.S. degree candidacy; permission of instructor.* Full-time, non-clinical, supervised experience in a setting relevant to psychology. Intended for master's degree level internships.

Psych 599. Creative Component. Cr. arr. Satisfactory-fail only.

Courses for graduate students

Psych 601. History of Philosophy of Psychology. (3-0) Cr. 3. *Prereq: 4 courses in psychology.* Origins of psychology in philosophical, medical, and related thought. Development as an independent discipline in the nineteenth and twentieth centuries as a science and as a practice including traditional and contemporary theory and philosophy.

Psych 605. Multi-level Modeling for social and Behavioral Sciences. (Cross-listed with HD FS). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 404.* Rationale for and interpretation of random coefficient models. Strategies for the analysis of multi-level and panel data including models for random intercepts, random slopes, and growth curves. Applications including HLM, SAS, PROCMIX, and MPLUS.

Psych 621. Psychological Counseling: Theory and Process. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Overview of major counseling theories with emphases upon: key concepts of theories, the role of the counselor, and applications of theory in fostering client change.

Psych 621L. Techniques in Counseling. (0-6) Cr. 3. F. *Prereq: 621 or concurrent enrollment in 621 and admission into the doctoral program in counseling psychology.* Development of basic counseling skills and techniques through observation, role-playing, case studies, and supervised counseling sessions.

Psych 623. Vocational Behavior. (3-0) Cr. 3. *Prereq: 3 courses in psychology and admission to the PhD program in counseling psychology.* Theoretical views, research, and issues in career development through the life span. Methods of career counseling, including appraisal interviewing, assessment, test interpretation, and use of information sources.

Psych 626. Group Counseling. (2-2) Cr. 3. *Prereq: 621L, 691A and admission to the PhD program in counseling psychology.* Theory, research, ethical issues, and therapeutic considerations relevant to group counseling. Participation in lab exercises for development of group counseling skills and observation of ongoing groups.

Psych 633. Teaching of Psychology. (3-0) Cr. 3. *Prereq: Enrollment in doctoral degree program in psychology, completion of at least 1 year of graduate study, permission of instructor.* Orientation to teaching of psychology at college level: academic issues and problems, instructional and evaluative techniques.

Psych 635. Interventions with Children and Adolescents. (3-0) Cr. 3. *Prereq: Graduate classification.* Research and theory underlying application of behavioral and cognitive psychology to the treatment of childhood and adolescent psychopathology with an emphasis on internalizing disorders, developmental processes, and multimodal interventions.

Psych 691. Practicum in Psychology. Cr. arr. *Prereq: Permission of instructor.* Supervised practice and experience in the following fields of specialization in applied psychology:
A. Counseling (Beginning).
B. Intermediate Counseling.
E. Group Counseling. Prereq: 626, 691A
F. Advanced Counseling. Prereq: 691A
T. Teaching. Prereq: 633 (satisfactory-fail basis grading only)
Z. General

Psych 692. Research Seminar. (1-0) Cr. arr. Repeatable. *Prereq: Permission of instructor.*

A. Counseling
Q. Cognitive
R. Social
Z. General

Psych 697. Internship in Counseling Psychology. Cr. R. *Prereq: Ph.D. candidacy in the Counseling Psychology program, approved dissertation proposal, and permission of instructor.* Full time supervised predoctoral internship experience in a setting relevant to counseling psychology.

Psych 699. Research. Cr. arr. Repeatable. Satisfactory-fail only.

Seed Technology and Business

(Interdepartmental Graduate Major)

www.seeds.iastate.edu/

Manjit Misra. Seed Science Center Director (Administration), Gary Munkvold, Program Chair; Paul Christensen, Program Coordinator

Advisory Committee: David Acker, Sanjeev Agarwal, Paul Christensen, Ana Correia, Michael Crum, Susana Goggi, Kendall Lamkey, Jeff Iles, Manjit Misra, Gary Munkvold, Gaylan Scofield

Faculty: Sanjeev Agarwal, Rajeev Arora, Jennifer Blackhurst, Paul Christensen, Anne Clem, Ana Correia, Michael Crum, Fredrick Dark, David Dornbos, Susana Goggi, Brian Mennecke, Manjit Misra, Gary Munkvold, Russell Mullen, Brad Shrader, James Werbel, John Wong

On-Line Graduate Study

The Graduate Program in Seed Technology and Business offers students advanced study in the seed science and technology and business management appropriate for application in the seed sector. The program is offered by nine departments in the Colleges of Business and Agriculture and Life Sciences: Accounting; Agronomy; Finance; Horticulture; Logistics, Operations, and Management Information Systems; Management; Marketing; and Plant Pathology. This multidisciplinary program offers a focused on-line curriculum for a Master of Science in Seed Technology and Business, along with Graduate Certificates in Seed Science and Technology and in Seed Business Management. Courses are available to students in other majors.

The curriculum offers a set of scientific and technical courses that are focused on seed, with a set of basic management courses, similar to those in the core courses of an MBA program. The business courses will use examples drawn from the seed industry. A creative component is required for the Master of Science degree.

Prerequisite for the program is a bachelor's degree in business, agriculture, other biological discipline, or related degrees. Graduate training in these disciplines will also be considered.

Graduates of the Graduate Program in Seed Technology and Business will be prepared for roles in management and leadership within private and public seed and seed-related organizations.

All of the courses listed below are required for the Master of Science degree, and the students are expected to go through the curriculum in order. The pace of the course sequence is designed to allow the students with work and other commitments to participate. Students will complete the creative component under the guidance of their Program of Study Committee. In many cases, the creative component topic will be associated with the student's work.

Graduates of the Master of Science curriculum will be prepared for roles in management and leadership within seed related organizations, private and public.

The program offers two graduate certificates: a graduate certificate in Seed Science and Technology, which consists of 9 courses (STB/Agron 535, STB/Agron 536, STB/Agron 510, STB/Hort 543, STB/Pl P 592, STB/Agron 547, STB/Agron 534, STB/Agron 539, and STB/Agron 595), and a graduate certificate in Seed Business Management, which consists of 7 courses (STB/Agron 535, BusAd 501, BusAd 503, BusAd 504, BusAd 507, BusAd 508, and BusAd 509). Graduate certificate courses may be applied to the Master of Science in Seed Technology and Business. Those interested in these graduate certificates should contact the Program for details.

Information on application procedures and specific requirements of the major can be obtained from the following internet addresses: http://www.seedgrad.iastate.edu, or http://www.distance.iastate.edu/ or by writing to seedgrad@iastate.edu.

Courses for graduate students

STB 510. Crop Improvement. (Cross-listed with Agron). (3-0) Cr. 3. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* A study of the basic principles and methods in the genetic improvement of crop plants. Methods used in manipulating genomes through the use of biotechnology. Methods of cultivar development. Quantitative procedures for describing response to selection. Analysis of the relationship of reproductive characters and growth characteristics to response to selection.

STB 534. Seed and Variety, Testing and Technology. (Cross-listed with Agron). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* The components of seed quality and how they are assessed in the laboratory, including traits derived from modern biotechnology. The impact of new technologies on seed quality testing. Variety maintenance procedures and breeder seed. Variety identification: phenotype and grow-out trials, isozyme testing, and DNA marker testing. Procedures for evaluating varieties. The variance tests appropriate for fixed effects analysis of variance. Statistical inference and stratification for yield trials. Use of strip plot testing.

STB 535. Introduction to the Seed Industry. (Cross-listed with Agron). Cr. 1. *Prereq: Curriculum requires undergraduate specialization in a business or biological science.* An analysis of the defining characteristics of the seed industry and introduction to the Master in Seed Technology and Business curriculum. The tasks of crop improvement and seed production will be analytically related to basic management functions and classifications of management activities that are used in the study of business administration. Management tasks and roles will be analyzed in related to the public policy issues that shape the seed industry, including ethical and economical approaches to biotechnology, intellectual property, and corporate responsibility.

STB 536. Quantitative Methods for Seed. (Cross-listed with Agron). (1-0) Cr. 1. F. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Quantitative Methods for analyzing and interpreting agronomic and business information for the seed industry. Principles of experimental design and hypothesis testing, regression, correlation and graphical representation of data. Use of spreadsheets for manipulating, analyzing and presenting data.

STB 539. Seed Conditioning and Storage. (Cross-listed with Agron). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* The technical operations which may be carried out on a seed lot from harvest until it is ready for marketing and use. The opportunities for quality improvement and the risks of deterioration which are present during that time. Analysis of the costs of and benefits of operations. Evaluation of equipment based on benefits to the customer and producer. Interpretation of the role of the conditioning plant and store as a focal points within the overall operations of a seed company.

STB 543. Seed Physiology. (Cross-listed with Hort). (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: Admission to the Graduate Seed Technology and Business Program or approval of the instructor.* Brief introduction to plant physiology. Physiological aspects of seed development, maturation, longevity, dormancy and germination. Links between physiology and seed quality.

STB 547. Seed Production. (Cross-listed with Agron). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Survey of crop production; including management of soil fertility, planting dates, populations, weed control, and insect control. Analysis of the principles of seed multiplication and the key practices which are used to ensure high quality in the products. Field inspection procedures and production aspects that differ from other crop production. Foundation seed production. Analysis of the typical organization of field production tasks. Resources and capabilities required. Survey of differences in seed production strategies between crops and impact of differences on management of seed production.

STB 592. Seed Health Management. (Cross-listed with Pl P). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Admission to the Graduate Program in Seed Technology and Business/Consent of instructor.* Occurrence and management of diseases during seed production, harvest, conditioning, storage, and planting. Emphasis on epidemiology, disease management in the field, seed treatment, effects of conditioning on seed health, and seed health testing.

STB 595. Seed Quality, Production, and Research Management. (Cross-listed with Agron). (3-0) Cr. 3. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Advanced survey of the organization, staff capabilities and management characteristics typical in seed production and crop improvement in seed enterprises. Analysis of the use of quality information in the management of seed operations and sales. Process management applications for seed. Production planning for existing capacity. Analysis of the manager's tasks in the annual cycle and how the tasks of these managers relate to the general categories of business management roles. Difference in management strategies used with different situations and groups of employees.

STB 599. Creative Component. Cr. arr. *Prereq: Admission to the Master's in Seed Technology and Business degree program and permission of the instructor.* A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

Sociology

www.soc.iastate.edu

R. Paul Lasley, Chair of Department

Distinguished Professor: C. Flora

Distinguished Professor (Emeritus): Beal

University Professors: Lorenz, Woodman

University Professor (Emeritus): Goudy

Professors: Besser, Dobratz, J. Flora, Jones-Johnson, Keith, Korsching, Lasley, Sapp, Sawyer, Wells

Professors (Emeritus): Blake, Bruton, Butler, Cohen, Hoiberg, Hraba, Klonglan, Miller, Mulford, Oulman, Padgitt, Ryan, Schafer, Tait

Professor (Collaborator): Simons

Associate Professors: Allen, Bird, Cast, Delisi, Harrod, Hochstetler, Mazur, Morton, Roberts, Schweingruber, Stewart

Associate Professor (Adjunct): Waggoner

Assistant Professors: Arbuckle, Bain, Downing-Matibag, Krier, Maldonado-Pabon, Monahan, Peters, Prokos

Assistant Professor (Adjunct): Emery

Lecturer: Conis, Reger

Undergraduate Study

Sociology graduates will understand and demonstrate: 1) general knowledge of sociology; 2) research methods in sociology; 3) critical thinking skills; 4) application of sociology to pressing social issues; 5) sociological and professional values; 6) information technology; 7) communication skills; and 8) personal and career development.

The department offers course work leading to either a bachelor of arts or bachelor of science in sociology. Additionally, a bachelor of science in Public Service and Administration in Agriculture is offered. The department offers course work for the Interdisciplinary Studies major in Criminology and Criminal Justice and a minor in Criminal Justice Studies. Programs of study in sociology offered in both the College of Agriculture and the College of Liberal Arts and Sciences are outlined in this section. For the undergraduate curriculum in Liberal Arts and Sciences, with a major in sociology leading to the degrees of bachelor of arts and bachelor of science, see Liberal Arts and Sciences, Curricula. For the undergraduate curriculum in agriculture, with major in public service and administration in agriculture, leading to the degree bachelor of science, see Agriculture, Curriculum in Public Service and Administration in Agriculture. For the undergraduate curriculum in Liberal Arts and Sciences, with a minor in criminal justice studies, see Liberal Arts and Sciences, Curriculum.

Graduates understand how social institutions, communities, and organizations work and change; they can examine the causes and consequences of conformity, deviance, and inequality. They can apply sociological understanding of human behavior to practical work situations and everyday life. Graduates can read critically, think independently, and communicate effectively about social issues and social policy.

College of Liberal Arts and Sciences—Sociology

A major in sociology can serve as a liberal arts education; as preparation for various positions in social service and related occupations in business and industry; as background for professional education in such areas as law and theology or as a basis for graduate professional training as a sociologist in academic, government, business, and industrial settings.

Departmental requirements for sociology majors include the following supporting course: Philosophy including 230 and one upper level Philosophy course; English 302 or 309 or 314; One of the following courses: Statistics101 or 104; At least three additional credits with a Mathematics designator.

A program of study that meets the needs and interests of the student and department requirements will be developed in consultation with the major adviser. Programs of study will include 115; 130 or 134; 202; three credits from 310, 380 or 420; 302; 305; three credits from 327, 330, 331 or 332; 401; 9 credits of upper level electives. Majors must receive grades of C or better in Engl 150 and 250, and a grade of C or better in either Engl 302 or 309 or 314. Programs leading to a bachelor of arts degree will emphasize additional coursework in groups I, II and IV of the general education requirements. Programs leading to a bachelor of science degree will emphasize additional coursework in groups III and IV of the general education requirements. Some of the possible fields of concentration are criminal justice systems, community (urban and rural) sociology, family sociology, sociology of work, social science teaching, research methods and statistics, social change and development, complex organizations, human population and ecology, social inequality, social psychology, and sociological theory.

In consultation with their advisers, students may gain work experience and develop their skills in their field of concentration through the field observation and practice options of 460.

The department offers a minor in sociology which may be earned by completing 15 credits in sociology including: Sociology 130 or 134; 3 credits from 310, 380 or 420; 3 credits from 264, 305 or 381; an additional 6 credits in sociology courses. At least 9 of the 15 credits must be at the 300 level or higher, 6 of these credits must be taken at ISU with a minimal grade of C.

College of Agriculture—Public Service and Administration in Agriculture

The curriculum in public service and administration in agriculture is designed for students who desire an interdisciplinary education to pursue a career with agriculturally related governmental and nonprofit agencies, or with businesses and industries that are concerned with public services in agriculture, natural resources or rural communities. Students will explore the planning and implementing of rural and agriculturally related programs in organizations, communities (town, city, or county), multicounty areas, states, regions, and at the federal level.

The curriculum has a broad base of general education subjects including credits in communications, mathematics, physical and biological sciences, social sciences, and humanities. The technical subjects represent a combination of sociology, economics, public administration and agriculture, with emphases on social and economic change, history of public services, complex organizations, interagency relationships, community leadership, community action, adoption and diffusion, group dynamics, and political and legal behavior as they relate to agriculture and rural areas. For the Interdisciplinary Studies major in Criminology and Criminal Justice, see *Liberal Arts and Sciences, Curriculum*.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in sociology and rural sociology and minor work for students majoring in other departments. For M.S. and Ph.D. departmental requirements, see Program of Graduate Study for Degrees in Sociology and Rural Sociology, available from the department office. The department offers concentrations in a number of areas, e.g., community studies and development; sociology of families, inequality, food systems, agriculture and environment; methodology; social change and development; criminology; the economy, organizations and work; and social psychology. The Department of Sociology does not offer a nonthesis master's program.

Graduates have a broad understanding of sociology, address complex societal problems, and communicate effectively with scientific colleagues and the general public in both formal and informal settings. They understand sociological theory, conduct research, and are prepared to educate college students and contribute to public policy. Although the department stipulates no language requirement for either the degree master of science or the degree doctor of philosophy, specifying competence in one or more languages may be desirable in some instances.

The department also participates in the interdepartmental program in interdepartmental majors in sustainable agriculture, transportation and water resources, and interdepartmental minors in gerontology (see *Index*).

Courses primarily for undergraduate students

Soc 110. Orientation to Public Service and Administration in Agriculture. Cr. R. F. Survey of public service and administration in agriculture. Exploration of career tracks and career planning. Recommended during first semester of freshman year or as soon as possible after transfer into the department.

Soc 115. Orientation to Sociology. Cr. R. F.S. Orientation to sociology. A familiarization with University and LAS College requirements and procedures. Occupational tracks and career options open to sociology; introduction to career planning. Recommended during first semester of freshman year, or as soon as possible after transfer into the department. Satisfactory-fail only.

Soc 130. Rural Institutions and Organizations. (3-0) Cr. 3. F.S. An introductory analysis of sociological concepts and theories as they relate to rural institutions and organizations. Emphasis on the static structure and function of these institutions and organizations and on their dynamic adaptation to changing societal, environmental, and economic conditions. General sociological principles and perspectives. Credit for only Soc 130 or 134 may be applied toward graduation.

Soc 134. Introduction to Sociology. (3-0) Cr. 3. F.S.SS. Social interaction and group behavior with emphasis on the scientific study of contemporary U.S. society, including issues relating to socialization, inequality, and changing rural and urban communities. Analysis of relationships among the institutions of family, religion, political participation, work, and leisure. Credit for only Soc 130 or 134 may be applied toward graduation.
H. Honors.

Soc 202. Introduction to Research Methods. (3-0) Cr. 3. F.S. *Prereq: 130 or 134, credit in Stat 101 or concurrent enrollment in Stat 101.* A survey of the principal research methods used in sociological analysis.

Soc 219. Sociology of Intimate Relationships. (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* Analysis of intimate relationships among couples using a sociological perspective. Attention is given to singlehood; dating and courtship; sexuality; mate selection, cohabitation, and marriage. Relationship quality, communication, conflict and dissolution of these types of relationship will also be explored.

Soc 235. Social Problems and American Values. (3-0) Cr. 3. F.S. *Prereq: 130 or 134.* Sociological concepts, theories and methods to analyze the causes and consequences of social problems. Social problems discussed may include crime, substance abuse, income inequalities, discrimination, poverty, race relations, health care, family issues, and the environment. How American culture and values shape societal conditions, public discourse and policy.

Soc 241. Youth and Crime. (Cross-listed with CJ St). (3-0) Cr. 3. F. *Prereq: 130 or 134.* An examination of delinquency that focuses on the relationship between youth as victims and as offenders, social and etiological features of delinquency, the role of the criminal justice system, delinquents' rights, and traditional and alternative ways of dealing with juvenile crime.

Soc 264. Small Group Dynamics. (3-0) Cr. 3. F.S. *Prereq: 130 or 134.* An introduction to intra- and intergroup dynamics in small groups. Group decision-making, coalitions, conformity, intergroup relations, status and role effects, leadership, group development and group conflict. Includes student participation in small group processes.

Soc 302. Advanced Research Methods. (3-0) Cr. 3. F.S.Alt. SS., offered 2010. *Prereq: 202; Stat 101; Sociology or PSA Major.* Experience in designing research projects, collecting and analyzing data and reporting results.

Soc 305. Social Psychology: A Sociological Perspective. (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* Examination of human behavior in a social environment with emphasis on development of the self, interpersonal relations, attitudes, and small groups.

Soc 310. Community. (3-0) Cr. 3. F.S. *Prereq: 130 or 134.* Analysis of evolving theory and research of community as an ideal type, an ecological system, a political economy, and an interactional field; examination of the impact of economic, cultural, social and political infrastructures on community power structures and change processes in a global era.

Soc 325. Transition in Agriculture. (3-0) Cr. 3. S. *Prereq: 130 or 134 or permission of instructor.* The impacts of agricultural changes on farm families, rural communities, and consumers. Past, present, and future trends in family farms and their social implications.

Soc 327. Sex and Gender in Society. (Cross-listed with W S). (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* How the biological fact of sex is transformed into a system of gender stratification. The demographics and social positions of women and men in the family, education, media, politics, and the economy. Theories of the social-psychological and sociological bases for behavior and attitudes of women and men. The relationship between gender, class, and race.

Soc 328. Sociology of Masculinities and Manhood. (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: Soc 130, 134, or W S 201.* Examination of socially constructed and idealized images of manhood, the nature of social hierarchies and relations constructed on the basis of imagery, ideologies, and norms of masculinity. Theories on gender (sociological, psychological, and biological). Particular attention given to theory and research on gender variations among men by race, class, ethnicity, sexual orientation, physical ability and age.

Soc 330. Ethnic and Race Relations. (Cross-listed with Af Am). (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* Analysis of ethnic and race relations, particularly in America; emphasis on the sociology and psychology of race and ethnic relations.

Soc 331. Social Class and Inequality. (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* Social stratification and processes resulting in social and economic inequalities; implications of status, class, and poverty for people of different races, ethnicities, and gender.

Soc 332. The Latino/Latina Experience in U.S. Society. (3-0) Cr. 3. F. *Prereq: 130 or 134.* Examination of the social, historical, economic and political experience of varied Latino ethnic groups in the U.S. - primarily focusing on Mexican, Puerto Ricans, and Cubans.

Soc 334. Politics and Society. (Cross-listed with Pol S). (3-0) Cr. 3. F. *Prereq: A course in political science or sociology.* The relationship between politics and society with emphasis on American society. Discussion of theories of inequality, power, social movements, elites, ruling classes, democracy, and capitalism.

Soc 340. Deviant and Criminal Behavior. (Cross-listed with CJ St). (3-0) Cr. 3. S.SS. *Prereq: 130 or 134.* Theory and research on the etiology of types of social deviance; issues relating to crime, antisocial behavior and social policies designed to control deviant behavior.

Soc 341. Criminology. (Cross-listed with CJ St). (3-0) Cr. 3. F. *Prereq: 130 or 134.* The nature of crime and criminology; the concept of crime; statistics and theories of criminality; major forms of crime; official responses to crime and control of crime.

Soc 345. Population and Society. (Cross-listed with Env S). (3-0) Cr. 3. F. *Prereq: 130 or 134.* Human population growth and structure; impact on food, environment, and resources; gender issues; trends of births, deaths, and migration; projecting future population; population policies and laws; comparison of the United States with other societies throughout the world.

Soc 351. Police and Society. (Cross-listed with CJ St). (3-0) Cr. 3. F.S. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of law enforcement in the United States. Theory and research on police history, function, and organization; constitutional issues of policing; and critical topics, such as community policing, officer discretion and decision-making, corruption, use of force, and racial profiling. The course illustrates the interconnections between communities, police organizations, citizens, and criminal offenders.

Soc 352. Punishment, Corrections, and Society. (Cross-listed with CJ St). (3-0) Cr. 3. F.S. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of corrections in the United States. Theory and research on probation, parole, intermediate sanctions, prison, inmate society, inmate behavior and misconduct, capital punishment, recidivism, correctional treatment, rehabilitation, and offender reintegration into society.

Soc 362. Applied Ethics in Agriculture. (Cross-listed with Econ). (3-0) Cr. 3. F. *Prereq: Econ 101 or Soc 130 or Soc 134, junior or senior status in the College of Agriculture.* Identify major ethical issues and dilemmas in the conduct of agricultural and agribusiness management and decision making. Discuss and debate proper ethical behavior in these issues and situations and the relationship between business and personal ethical behavior.

Soc 377. Social Dimensions of Religion. (Cross-listed with Relig). (3-0) Cr. 3. *Prereq: Prior course work in Religious Studies or Sociology required.* The influence of religion in society, both as a conservator of values and as a force for social change. Nonmajor graduate credit.

Soc 380. Sociology of Work. (3-0) Cr. 3. F.S. *Prereq: 130 or 134.* Inequalities (gender, race, class) related to jobs, occupations, firms, and industries. Satisfactions, rewards, alienation, discrimination, and other topics of importance to workers are examined.

Soc 381. Social Psychology of Small Group Behavior. (Cross-listed with Psych). (3-0) Cr. 3. S. *Prereq: Soc 305 or Psych 280.* A survey of small group theory and research from an interdisciplinary, social psychological perspective.

Soc 382. Environmental Sociology. (Cross-listed with Env S). (3-0) Cr. 3. F.S. *Prereq: Soc 130, 134 or 3 credits of Env S.* Environment-society relations; social construction of nature and the environment; social and environmental impacts of resource extraction, production, and consumption; environmental inequality; environmental mobilization and movements; U.S. and international examples.

Soc 401. Contemporary Sociological Theories. (3-0) Cr. 3. F.S.SS. *Prereq: 9 credits in sociology.* Both historical and modern social theories as applied to understanding and researching the social world. Nonmajor graduate credit.

Soc 402. White-Collar Crime. (Cross-listed with CJ St). (3-0) Cr. 3. S. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of white-collar crime as a form of deviance. Theory and research on occupational, corporate, and organizational offending; prevalence, costs, and consequences of white-collar crime; predictors and correlates of white-collar crime; and political, business, and public policy responses to white-collar crime.

Soc 411. Social Change in Developing Countries. (3-0) Cr. 3. S. *Prereq: 130 or 134 plus 3 credits in social sciences.* Social change and development in developing countries; international interdependence; causes and consequences of persistent problems in agriculture, city growth, employment, gender equality, basic needs; local and worldwide efforts to foster social change and international development. Nonmajor graduate credit.

Soc 412. Senior Seminar on Career Development. (1-0) Cr. 1. F. *Prereq: Most of major core courses, senior classification.* Transition from student to professional. Career development procedures including self-assessment, short- and long-term goals, strategies for the job search, development of contacts and sources, resumes and interviews. Enrollment preferred in first semester as senior. Satisfactory-fail only.

Soc 415. Sociology of Technology. (3-0) Cr. 3. F. *Prereq: 130 or 134 plus 3 credits in social sciences.* Review of physical, biological, and social approaches to technology evaluation. Examination of public responses to complex and controversial technology. Strategies for gaining adoption/rejection of technology. Applications to topics in agriculture, development, and marketing. Credit for only Soc 415 or 515 may be applied toward graduation. Nonmajor graduate credit.

Soc 420. Complex Organizations. (3-0) Cr. 3. F.SS. *Prereq: 130 or 134 plus 3 credits in social sciences.* Study of bureaucracies and other large organizations as social systems through the perspective of basis social processes and structural variables. Incorporates topics of organizational effectiveness, power and change. Nonmajor graduate credit.

Soc 431. Chicanos/Chicanas in Contemporary Society. (3-0) Cr. 3. S. *Prereq: 130 or 134.* An interdisciplinary examination of Chicanos/as, the largest U.S. Latino ethnic group. Special attention will be given to social conflict and social transformation as it relates to contemporary Chicano/a issues, particularly in the Midwest.

Soc 435. Urban Society. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 130 or 134 plus 3 credits in social sciences.* Development of cities and urban systems; human and spatial ecology; urban transformation, decline, and revitalization; poverty; immigration; homelessness; residential segregation; housing policy; urban social movements; local governance; alternative solutions and planning for cities; international comparisons.

Soc 460. Criminal and Juvenile Justice Practicum. (Cross-listed with CJ St). Cr. arr. Repeatable. F.S.SS. *Prereq: Junior or senior classification; permission of criminal justice studies coordinator; major or minor in sociology, or criminal justice studies minor.* Study of the criminal and juvenile justice systems and social control processes. Supervised placement in a police department, prosecutor's office, court, probation and parole department, penitentiary, juvenile correctional institution, community-based rehabilitation program, or related agency. Not more than a total of 12 credits of field experience (Soc 454 and 460) may be counted toward graduation. No credits in Soc 460 may be used to satisfy minimum sociology requirements for sociology majors. Satisfactory-fail only.

Soc 464. Community Action and Leadership. (3-0) Cr. 3. S.SS. *Prereq: 6 credits in sociology.* Methods of planning, organizing, and conducting planned social change and other action programs in communities. Strategies of change, change agent roles, client need identification, community organization strategies, citizen participation, leadership identification and development, program planning and evaluation.

Soc 484. Topical Studies in Criminal and Juvenile Justice. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits in sociology and permission from instructor.* Thematic or topical issues and studies dealing with the sociology of police, judiciary, institutional and community-based corrections, gender/ethnicity and crime/delinquency, criminal and delinquent gangs, and crime and delinquency prevention.

Soc 485. Sociology of the Family. (3-0) Cr. 3. S. *Prereq: 6 credits in sociology.* The contemporary family in developing, industrial, and post-industrial societies. Effects of modernization, cultural change, and family policies on family dynamics, structures, and functions.

Soc 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in sociology and permission of instructor.* Students in the College of Agriculture must be of junior or senior classification and may use no more than 6 credits of Soc 490 toward the total of

128 credits required for graduation. Students in the College of Liberal Arts and Sciences may count no more than 9 credits of 490 toward graduation.
A. General Sociology
B. Rural Sociology
H. Honors E. Senior Seminar

Courses primarily for graduate students, open to qualified undergraduate students

Soc 505. History of social Thought. (3-0) Cr. 3. F. *Prereq: 401.* Reviews the historical origins of social ideas about society how social thought has evolved throughout history, and how these affect modern sociological thinking.

Soc 506. Classical Sociological Theory. (3-0) Cr. 3. S. *Prereq: Soc 401 or 505.* The origins of the canonical works of sociology in the mid-Industrial Revolution period including Karl Marx, Max Weber, Emile Durkheim and others.

Soc 509. Agroecosystem Analysis. (Cross-listed with Agron, Anthr, SusAg). (3-4) Cr. 3. F. *Prereq: Senior or above classification.* Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (agronomic, economic, ecological, social, etc.), and scales of operation.

Soc 511. Intermediate Research Methods. (3-0) Cr. 3. S. *Prereq: 302 and Stat 401.* Research methods in sociology including problem selection, research design, hypothesis formulation, sampling, alternative data collection techniques. Designing a research strategy appropriate for a variety of social science questions, and assessing the appropriateness, validity, and generalizability of published sociological research.

Soc 512. Factor Analysis. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Soc 511 and Stat 401.* Reliability and validity for observed and latent variables. Exploratory and confirmatory factor analysis in the construction and evaluation of measurement models. Second-level factor analysis; factor analysis with means and intercepts; multi-trait, multi-method models. Applications using SPSS, SAS, LSIREL, AMOS, R, and Mplus.

Soc 513. Qualitative Research Methods. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 511.* Applied qualitative research methods in sociology. Design and implementation of a course-based research project including data collection, analysis, and presentation of results. Qualitative data gathering techniques using observational, historical, in-depth interviewing or content analysis approaches. Laboratory emphasis on completion of data gathering, analysis, and report writing.

Soc 515. Sociology of Technology. (3-0) Cr. 3. *Prereq: 6 hours of social science.* Off campus and non majors only - offered as demand warrants. Linkages among science, technology, and society. Physical, life, and social science approaches to technology evaluation. Public responses to complex and controversial technologies. Strategies for gaining adoption/rejection of technology. Required in the Master of Agriculture program. Only one of Soc 415 or 515 may be counted toward graduation credits.

Soc 520. Social Psychology: A Sociological Perspective. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 305 or Psych 280.* Examination of cognitive, symbolic interaction, exchange, role-reference group, and dramaturgical approaches. Assessment of contemporary issues in social psychology.

Soc 525. Seminar in Social Psychology. (3-0) Cr. 3. Alt F., offered 2009. *Prereq: 305 or Psych 280.* Examination of alternative theoretical models and methods of studying small groups.
A. Small Groups
B. Attitudes and Attitude Change

Soc 527. Seminar in Social Inequality. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 credits in sociology.* Analysis of racial and ethnic inequality in the United States and the world; focus on the implications of the changing world social and economic order for differences in racial and ethnic groups relative to wealth, status, and power; a critical examination of majority-group domination of minority groups in various societies.
A. Sociology of Race and Ethnicity
B. Sociology of Gender

Soc 533. Models of Community. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in sociology.* Emphasis on different models or frames of reference used in community analysis. Theoretical and methodological tools, current views of community problems, and explanation of social and cultural change are presented for each model.

Soc 534. Race, Class and Gender Inequality. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits in sociology.* Critical examination of the causes and consequences of social stratification and inequality; classical theories, contemporary frameworks, and recent empirical studies; international stratification patterns.

Soc 536. Seminar in Community Studies and Development. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in sociology.*
A. Urban Sociology
B. Strategies of Community Engagement

Soc 540. Comparative Social Change. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 graduate credits in sociology.* Contemporary theories of social change, modernization, dependency, and development are critically examined; methodological issues identified; supporting research explored; applicability of theoretical models, concepts, and strategies to current national and international needs are evaluated.

Soc 543. Seminar in Social Change and Development. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in sociology.*
A. Rural Development in Industrialized Countries
B. Sociology of Adoption and Diffusion
C. Technological Innovation, Social Change and Development

Soc 544. Sociology of Food and Agricultural Systems. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in sociology.* Social organization of food and fiber production, processing, and distribution systems. Sociological comparison of conventional and alternative production systems; gender roles in agriculture and food systems; local, national and global food systems; perspectives on food and agricultural research and policy.

Soc 549. Sociology of the Environment. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in sociology.* Social causes and social consequences of environmental problems. Interrelationship between social inequality and environmental inequality. Social construction and social experience of the environment. Contemporary developments in the social theory of the environment. International and domestic implications.

Soc 550. Sociology of Economic Life. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 credits in sociology.* Social construction of economic activity in non-industrial and industrial societies with special attention on variations of industrial societies (capitalism and socialism), economic globalization, and economic development. Interaction of economic systems with human values, ideology, organizations, work and individual welfare.

Soc 551. Seminar in Economy, Organization, and Work. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in sociology.*
A. Sociology of Work
B. Complex Organizations

Soc 582. Theories of social Deviance. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits in sociology.* Theory and research regarding causes of and reactions to deviant behavior. Mental illness, homicide, family violence, and property crime are among the types of deviant behavior considered.

Soc 584. Current Issues in Crime and Justice. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in sociology.* Discussion of current research and theory in crime and delinquency; topics include the purpose and role of law in social life; emerging theoretical directions in criminology; recent work on specific forms of criminality; controversies in the criminal justice system.

Soc 585. Current Research in Family Sociology. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in sociology.* Course presents a general overview of the field of family sociology. Topics to be covered include demographic trends, family theory and empirical research, as well as current debates in the discipline.

Soc 590. Special Topics. Cr. arr. Repeatable. *Prereq: 6 credits in sociology; senior or graduate classification.*
A. General Sociology
B. Rural Sociology

Soc 591. Orientation to Sociology. (1-0) Cr. 1. F. *Prereq: Formal admission into the sociology graduate program.* Introduction to the department, current graduate student policies at department and university levels, departmental administrative procedures. Required of graduate students. Satisfactory-fail only.

Soc 599. Research for Master's Thesis. Cr. arr. Repeatable.
A. General Sociology
B. Rural Sociology

Courses for graduate students

Soc 607. Contemporary Sociological Theory. (3-0) Cr. 3. S. *Prereq: 6 graduate credits in sociology.* Provides a review of modern sociological thought, issues, and controversies as they affect current research and discourse in the discipline.

Soc 610. Foundations of Sustainable Agriculture. (Cross-listed with SusAg, A E, Agron, Anthr). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging systems of agriculture in terms of core concepts of sustainability and their theoretical contexts.

Soc 613. Advanced Theory Construction and Causal Modeling. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 512 and Stat 404.* Formal strategies of research design and analysis using structural equations with latent variables. Strategies for the analysis of multi-informant and panel data, with emphasis on distributional problems and diagnostics. Applications using SPSS, SAS, LISREL, AMOS, R, and Mplus.

Soc 675. Current Topics in Family Sociology. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. Current developments in a selected field in the sociology of family and the life course.

Soc 698. Seminars in Sociology. (3-0) Cr. 3.

L. Community Studies and Development
M. Criminology
N. The Economy, Organizations, and Work
O. Food Systems, Agriculture, and the Environment
P. Methodology
Q. Social Change and Development
R. Social Inequality
S. Social Psychology
T. Sociology of Families
U. Theory

Soc 699. Dissertation Research. Cr. arr. Repeatable.
A. General Sociology
B. Rural Sociology

Software Engineering

www.se.iastate.edu

(A joint program administered by the Department of Electrical and Computer Engineering and the Department of Computer Science.)

Undergraduate Study

For the undergraduate curriculum in software engineering leading to the degree bachelor of science, see College of Engineering and College of Liberal Arts and Sciences.

This curriculum is jointly administered by the Electrical and Computer Engineering Department and the Computer Science Department at Iowa State University and it provides undergraduate students with the opportunity to learn software engineering fundamentals, to study applications of the state-of-the art software technologies, and to prepare for the practice of software engineering. The student-faculty interaction necessary to realize this opportunity occurs within an environment that is motivated by the principle that excellence in undergraduate education is enhanced by an integrated commitment to successful, long-term research and outreach programs.

The software engineering curriculum offers emphasis areas in software engineering principles, process, and practice. Students may also take elective courses in computer engineering and computer science.

The objective of the software engineering program at Iowa State University is that its graduates should demonstrate expertise, engagement, learning, leadership, and teamwork within five years after graduation.

• Expertise: Graduates should establish peer-recognized expertise together with the ability to articulate that expertise and use it for problem solving in the planning, design, development, validation, and evolution of software using contemporary practices.

• Engagement: Graduates should be engaged in the professional practice, locally and globally, contributing through the ethical, competent, and creative practice of Software engineering in industry, academia, or the public sector, or graduates may use the program as a foundation for interdisciplinary careers in business, law, medicine, or public service.

• Learning: Graduates should demonstrate sustained learning through graduate work or professional improvement opportunities and through self study, and they should demonstrate the ability to adapt to rapid technological changes.

• Leadership: Graduates should exhibit leadership and initiative to advance professional and organizational goals, facilitate the achievements of others, and obtain results.

• Teamwork: Graduates should demonstrate effective teaming and commitment to working with others of diverse cultural and interdisciplinary background by applying software engineering abilities, communication skills, and knowledge of contemporary and global issues.

As a complement to the instructional activity, the Electrical and Computer Engineering and Computer Science Departments provide opportunities for each student to have experience with broadening activities. Through the cooperative education and internship program, students have the opportunity to gain practical industry experience. See College of Engineering, Cooperative Programs. Students have the opportunity to participate in advanced research activities; and through international exchange programs, students learn about engineering practices in other parts of the world.

Courses primarily for undergraduate students

S E 101. Software Engineering Orientation. Cr. R. Introduction to the procedures, policies, and resources of Iowa State University and the department of Computer Science and Electrical and Computer Engineering. Information on engineering and computer-based professions.

S E 166. Careers in Software Engineering. Cr. R. Overview of the nature and scope of the software engineering profession. Relationship of coursework to careers. Departmental rules, student services operations, degree requirements, program of study planning, career options, and student organizations.

S E 185. Problem Solving in Software Engineering. (3-1) Cr. 3. *Prereq: Credit or enrollment in Math 142.* Introduction to software engineering and computer programming. Systematic thinking process for problem solving in the context of software engineering. Group problem solving. Solving software engineering problems and presenting solutions through computer programs, written documents and oral presentations. Introduction to principles of programming, software design, and extensive practice in design, writing, running, debugging, and reasoning about programs.

S E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

S E 319. Software Construction and User Interfaces. (Cross-listed with Com S). (3-0) Cr. 3. F. *Prereq: Com S 228.* Basic theory of grammars, parsing. Language paradigms. State-transition and table-based software design. Rapid system prototyping. Review of principles of object orientation, object oriented analysis using UML. Event-driven and clock-driven simulation. Software construction methods. Frameworks and APIs. User interface architecture, evaluation of user interface. Design of windows, menus, and commands. Introduction to format specification and model-based software design. Introduction to domain-specific software engineering. Nonmajor graduate credit.

S E 329. Software Project Management. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Com S 309.* Process-based software development. Capability Maturity Model (CMM), Project planning, cost estimation, and scheduling. Project management tools. Factors influencing productivity and success. Productivity metrics. Analysis of options and risks. Version control and configuration management. Inspections and reviews. Managing the testing process. Software quality metrics. Modern software engineering techniques and practices. Nonmajor graduate credit.

S E 339. Software Architecture and Design. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: S E 319.* Modeling and design of software at the architectural level. Architectural styles. Basics of model-driven architecture. Object-oriented design and analysis. Iterative development and unified process. Design patterns. Design by contract. Component based design. Product families. Measurement theory and appropriate use of metrics in design. Designing for qualities such as performance, safety, security, reliability, reusability, etc. Analysis and evaluation of software architectures. Introduction to architecture definition languages. Basics of software evolution, reengineering, and reverse engineering. Case studies. Introduction to distributed system software. Nonmajor graduate credit.

S E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Career Services.* Summer professional work period.

S E 397. Software Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Career Services.* One semester maximum per academic year professional work period.

S E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

S E 409. Software Requirements Engineering. (Cross-listed with Com S). (3-0) Cr. 3. *Prereq: Com S 309, 319.* The requirements engineering process, including identification of stakeholders, requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Non-functional requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports, and oral presentations will be required. Nonmajor graduate credit.

S E 412. Formal Aspects of Specification and Verification. (Cross-listed with Com S, Cpr E). (3-0) Cr. 3. *Prereq: 319, Com S 309.* Introduction to prepositional/predicate/temporal logic, program verification using theorem proving, model-based verification using model checking, and tools for verification. Nonmajor graduate credit.

S E 416. Software Evolution and Maintenance. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Com S 309, 319.* Fundamental concepts in software evolution and maintenance; practical software evolution processes; legacy systems, program comprehension, impact analysis, program migration and transformation, refactoring. Tools for software evolution and maintenance. Case studies, experimental software projects. Written reports and oral presentation. Nonmajor graduate credit.

S E 417. Software Testing. (Cross-listed with Com S). (3-0) Cr. 3. *Prereq: Com S 309, 319.* Comprehensive study of software testing, principles, methodologies, management strategies and techniques. Test models, test design techniques (black box and white-box testing techniques), integration, regression, system testing methods, and software testing tools. Nonmajor graduate credit.

S E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Senior classification in software engineering.* Investigation of an approved topic.

S E 491. Senior Design Project I and Professionalism. (2-3) Cr. 3. *Prereq: 329, completion of 29 credits in the S E core professional program, Engl 314.* Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; project poster. First of two-semester team-oriented, project design and implementation experience.

S E 492. Senior Design Project II. (1-3) Cr. 2. *Prereq: 491.* Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in S E 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements.

S E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Speech Communication

(Administered by the College of Liberal Arts and Sciences)

www/Engl.iastate.edu/programs/speech_comm

Program Faculty: Goodwin, LaWare, Ringlee, Slagell

As a unit within the LAS College, the Program in Speech Communication provides students opportunities to develop their understanding and appreciation of the human communication process and to enhance their oral and written communication practice. More specifically, speech communication students develop an awareness of the importance of oral communication and listening for success in their personal, civic, and professional lives; become familiar with behavioral research in persuasion; understand how language is used to create social change; develop competent delivery skills; assess the quality of arguments; evaluate information found in research and public discourse; and cultivate rhetorical sensitivity in order to better connect with individuals and audiences. In this way, the program contributes to the humanistic, aesthetic, and critical development of liberally educated students in order to prepare them for full and effective participation in society.

Undergraduate Study

The cross-disciplinary program in speech communication offers introductory courses designed for all students as part of their general education and as a complement to professional training. It also offers a major or minor in speech communication as well as an additional endorsement for secondary teachers who already have an endorsement in another content area.

Students who major or minor in speech communication will prepare themselves for a wide variety of employment opportunities in business, industry and government, as well as in non-profit and educational organizations. With their effective oral communication, listening, teamwork, problem-solving and leadership skills, speech communication students find positions in general business management: human resources, benefits, sales and marketing and serve various organizations as recruiters, trainers, promotions managers, communication specialists, community outreach personnel and event planners. The program also prepares students for the study of law, theology, and for graduate level work in speech communication or related disciplines.

The program participates in the following interdisciplinary undergraduate minor programs: the interdisciplinary program in linguistics and the interdisciplinary program in technology and social change.

Speech Communication Major

A student electing to major in speech communication must earn at least 120 credits with 45 credits at the 300/400 level. A minimum of 33 of those credits must be earned in Speech Communication courses where the student earns a grade of C or better. Our flexible curriculum with few prerequisites can help you meet the 33 hour requirement in a timely way.

Core Requirements (18 credits)
3 ComSt 101 Intro to Communication
3 Sp Cm 212 Fundamentals of Public Speaking
3 Sp Cm 305 Language, Thought and Action
3 Sp Cm 327 Persuasion
3 Sp Cm 412 Rhetorical Criticism
3 Sp Cm 497 Capstone Course

Additional Coursework (Choose at least 5 of the following for 15 credits)
3 Sp Cm 110 Listening
3 Sp Cm 205 Popular Culture Analysis
3 Sp Cm 213 Computers in the Study of English--NO LONGER OFFERED (2-09)
3 Sp Cm 312 Business and Professional Speaking
3 Sp Cm 313 Communication for the Classroom Teacher
3 Sp Cm 322 Argumentation, Debate and Critical Thinking
3 Sp Cm 323 Gender and Communication
3 Sp Cm 324 Legal Communication
3 Sp Cm 325 Nonverbal Communication
3 Sp Cm 350 Rhetoric and the History of Ideas
3 Sp Cm 410 Persuasion in the Athenian Democracy
3 Sp Cm 416 American Public Address
3 Sp Cm 417 Campaign Rhetoric

Credits in Sp Cm 290, 499, or 590 cannot be applied toward the minimum required credits for the major.

The Communication Proficiency requirement may be met by (1) completion of Engl 150, 250 (or 250H), or its equivalent, with a grade in each of C or better; (2) one additional writing course beyond Engl 250 with a grade of C or better from the following approved list: Engl 302, 303, 304, 305, 309, 314, 415; JI MC 201.

Speech Communication Minor

The area's courses also provide a minor concentration for students in various majors such as business, English, journalism, world languages and cultures, and the social sciences. The requirements for a minor in speech communication may be fulfilled by credit in Sp Cm 212 plus at least 15 additional hours from the lists above, of which 9 credits are in courses numbered 300 or above. No credits in 290, 490, 499, and 590 may apply toward the minor.

Speech Communication Education

Students seeking a secondary endorsement in speech communication as an additional area prepare to teach speech, dramatic arts, and media at the secondary school level. In addition, they prepare to direct co-curricular and extra curricular activities such as drama, speech and debate.

Each student seeking an additional endorsement in speech communication must meet a 29 hour requirement by taking the following courses: Sp Cm 110 or ComSt 102, Sp CM 212, Sp Cm 313, Sp Cm 322, Sp Cm 412, Sp Cm 495A, Sp Cm 495B, Thtre 255, Thtre 358 and JI MC 101.

Graduate Study

The program offers courses for a graduate minor in speech communication as well as supporting work for other disciplines. The Program of Speech Communication also participates in the interdepartmental program leading to a master's degree in Interdisciplinary Graduate Studies.

Courses open for nonmajor graduate credit: Sp Cm 305, 323, 324, 327, 412, 416, and 417.

Speech Communication (Sp Cm)

Courses primarily for undergraduate students

Sp Cm 110. Listening. (3-0) Cr. 3. F.S.SS. Theory, principles, and competency development in comprehensive, therapeutic, critical, consumer, and appreciative listening. The impact of listening in relationships and partnerships.

Sp Cm 205. Popular Culture Analysis. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Credit in or exemption from Engl 150.* Analysis of how information and entertainment forms persuade and manipulate audiences. Study of several forms that may include newspapers, speeches, television, film, advertising, fiction, and magazines. Special attention to verbal and visual devices.

Sp Cm 212. Fundamentals of Public Speaking. (3-0) Cr. 3. F.S.SS. Theory and practice of basic speech communication principles applied to public speaking. Practice in the preparation and delivery of extemporaneous speeches.

Sp Cm 223. Intercollegiate Debate and Forensics. Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.* Participation in intramural and intercollegiate debate and other forensic events.

Sp Cm 290. Special Projects. Cr. arr. Repeatable. F.S.SS. *Prereq: 3 credits in speech communication; permission of department chair.*

Sp Cm 305. Language, Thought and Action. (Cross-listed with Ling, ComSt). (3-0) Cr. 3. F.S.SS. *Prereq: Engl 250.* The study of symbolic processes and how meaning is conveyed in words, sentences, and utterances; discussion of modern theories of meaning; and an exploration of relationships among language, thought and action. Nonmajor graduate credit.

Sp Cm 312. Business and Professional Speaking. (3-0) Cr. 3. F.S.SS. *Prereq: 212.* Theory, principles, and competency development in the creation of coherent, articulate business and professional oral presentations.

Sp Cm 313. Communication for the Classroom Teacher. (3-0) Cr. 3. *Prereq: 212.* Communication in the teaching profession; training in classroom-oriented communication activities; use of video recorder for analysis of presentation.

Sp Cm 322. Argumentation, Debate, and Critical Thinking. (3-0) Cr. 3. *Prereq: 212.* Practice in preparing and presenting argumentative and debate speeches; emphasis on critical thinking and ethical and logical duties of the advocate; analysis, evidence, reasoning, attack, defense, research, case construction, and judging.

Sp Cm 323. Gender and Communication. (Cross-listed with W S, ComSt). (3-0) Cr. 3. *Prereq: 212.* The rhetorical strategies women and men use to succeed in oral communication; the theory, principles, and practice of effective gender communication in a variety of settings. Nonmajor graduate credit.

Sp Cm 324. Legal Communication. (3-0) Cr. 3. *Prereq: 212.* Speech communication in the legal system inside and outside the trial process: interviewing and counseling, negotiating and bargaining, voir dire, opening statements, examination of witnesses, closing arguments, judge's instructions, jury behavior, and appellate advocacy. Nonmajor graduate credit.

Sp Cm 325. Nonverbal Communication. (Cross-listed with ComSt). (3-0) Cr. 3. *Prereq: ComSt 101 or 102, 203, 301.* Theory and research in nonverbal communication; exploration of nonverbal subcodes; function of nonverbal communication in various contexts; student-designed investigations.

Sp Cm 327. Persuasion. (3-0) Cr. 3. F.S.SS. *Prereq: 212.* Examination of persuasive theories, strategies and research in persuasion. Emphasis on application and analysis; logical, emotional, and ethical proofs. Nonmajor graduate credit.

Sp Cm 350. Rhetorical Theories and Issues in Context. (Cross-listed with Engl, Cl St). (3-0) Cr. 3. S. *Prereq: Engl 250.* Ideas about the relationship between rhetoric and society in contemporary and historical contexts. An exploration of classical and contemporary rhetorical theories in relation to selected topics that may include politics, gender, race, ethics, education, science, or technology.

Sp Cm 404. Seminar. (Dual-listed with 504). Cr. 3. Repeatable. *Prereq: 15 credits in speech communication.*
A. Speech Communication
B. Speech Education

Sp Cm 412. Rhetorical Criticism. (3-0) Cr. 3. S. *Prereq: 212 and 6 credits in speech communication.* Development of rhetorical theory and practice from Corax to modern times. Application of principles of criticism to current public speaking practices. Nonmajor graduate credit.

Sp Cm 416. American Public Address. (3-0) Cr. 3. S. Relationship between public persuasions and leaders; process of preparing major public addresses; selected speakers and speeches as linked with political or historical events. Nonmajor graduate credit.

Sp Cm 417. Campaign Rhetoric. (Cross-listed with Pol S). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Sp Cm 212.* Backgrounds of candidates for state and national elections; selected speeches and issues; persuasive strategies and techniques of individual speakers. Nonmajor graduate credit.

Sp Cm 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: 18 credits in speech communication, junior classification, permission of department chair.* Only one independent study enrollment is permitted within the department per semester.

Sp Cm 495A. Directing Speech Activities. (1-0) Cr. 1. S. *Prereq: C I 301; 9 credits in speech communication; minimum grade point of 2.5 in speech communication courses.* Problems, methods, and materials related to directing speech activities in secondary schools.

Sp Cm 495B. Teaching Speech. (Cross-listed with C I). (3-0) Cr. 3. F. *Prereq: Sp Cm 313; 9 credits in speech communication; minimum grade point average of 2.5 in speech communication courses.* Problems, methods, and materials related to teaching speech, theatre, and media in secondary schools.

Sp Cm 497. Capstone Seminar. (3-0) Cr. 3. *Prereq: 15 credits in speech communication; junior or senior classification.* Students synthesize relevant theory and research culminating in a capstone project/paper.

Sp Cm 499. Communication Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: 18 credits in speech communication courses, other courses deemed appropriate by faculty adviser; 2nd semester junior or senior standing; cumulative GPA of at least 2.5 overall and 3.0 in speech communication; and permission of the internship committee.* Applications should be submitted in the term prior to the term in which the internship is desired. Supervised application of speech communication in professional settings.

Courses primarily for graduate students, open to qualified undergraduate students

Sp Cm 504. Seminar. (Dual-listed with 404). (3-0) Cr. 3. Repeatable. F.S.SS. Topics may include the following:
A. Speech Communication
B. Speech Education

Sp Cm 513. Proseminar: Teaching Fundamentals of Public Speaking. (1-0) Cr. 1. Repeatable, maximum of 3 credits. F. Required of all new Speech Communication 212 teaching assistants. Introduction to the teaching of public speaking. Support and supervision of teaching assistants of Sp Cm 212. Discussion of lesson planning, teaching methods, development of speaking assignments, and evaluation of student speaking.

Sp Cm 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of department chair.*

Statistics

www.stat.iastate.edu

Kenneth Koehler, Chair of Department

Distinguished Professors: Athreya, Meeker

Distinguished Professors (Emeritus): H. A. David, Fuller

University Professors: Koehler, Lorenz, Shelley, Stephenson, Vardeman

University Professors (Emeritus): D. Cox, Herbert T. David, Groeneveld, Hinz

Professors: Bailey, Bonett, Brendel, Carriquiry, Chen, Cook, Dixon, Isaacson, Kaiser, Morris, Nettleton, Nusser, Rollins

Professors (Emeritus): C. Cox, Harville, Hickman, Hotchkiss, Kennedy, Pollak, Strahan, Wolins

Professor (Collaborator): Therneau

Associate Professors: Adams, Dorman, Froelich, Hofmann, Kim, Larsen, Maiti, Maitra, Marasinghe, Roberts, Shao, Sherman, Wilson, Wu

Associate Professor (Emeritus): Sukhatme

Assistant Professors: Caragea, Ghosh, Liu, Nordman, Roy, Yu

Assistant Professors (Collaborators): Sargent, Sloan

Lecturers: Bhattacharyya, Genschel, Meyers

Undergraduate Study

For the undergraduate curriculum in liberal arts and sciences, major in statistics, leading to the degree bachelor of science, see *Liberal Arts and Sciences, Curriculum*.

The curriculum in liberal arts and sciences with a major in statistics is designed to prepare students for (1) entry level statistics positions requiring the B.S. degree in statistics in business, industry or commerce, nonprofit institutions, and in state or federal government; (2) graduate study in statistics. Entry-level positions include the following types of work: statistical design, analysis and interpretation of experiments and surveys; data processing and analysis using modern computation facilities and statistical computing systems; application of statistical principles and methods in commercial areas such as finance, insurance, industrial research, marketing, manufacturing, and quality control. Nonprofit organizations such as large health study institutions have entry-level positions for B.S. graduates in statistics. Also, there are opportunities for work in statistics that require a major in a subject-matter field and a minor in statistics.

Students completing the undergraduate degree in statistics should have a broad understanding of the discipline of statistics. They should have a clear comprehension of the theoretical basis of statistical reasoning and should be proficient in the use of modern statistical methods and computing. Such graduates should have an ability to apply and convey statistical concepts and knowledge in oral and written form. They should be aware of ethical issues associated with polling and surveys and in the summarization of the outcomes of statistical studies.

Undergraduate majors in this department usually include in their programs: (a) Statistics 101 or an alternative introductory course (104 or 226), (b) Mathematics 165, 166, 265 (or 165H, 166H, 265H), 307 (or 317) and Computer Science 207, and (c) Statistics 341, 342, 401, 402, 421, 479, 480.

These courses plus at least two additional courses in statistics at the 400 level or above constitute the major. With the permission of the department, I E/Stat 361 may be substituted for one of these 400 level courses. It is advisable to have a minor in a field of application.

The department offers a minor in statistics which may be earned by completing an introductory course in statistics plus additional courses from 341, 342, 361, and 400 level or above to yield a total of at least 15 credits in statistics courses.

English and Speech proficiency requirement: The department requires a grade of C– or better in each of Engl 150 and 250 (or 250H), and completion of one of Engl 302 or 314 with a grade of C- or better. The department requires a passing grade in ComSt 102 or Sp Cm 212.

Students intending to do graduate work in statistics normally will take additional courses in mathematics.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with a major in statistics, and for a minor for students majoring in other departments. Within the statistics major the student choose to emphasize topics such as experimental design, probability, statistical methods, statistical theory, statistical computing, survey sampling, quality control, spatial statistics, time series, reliability, or applied statistics (e.g., bioinformatics, biometrics, econometrics, environmental statistics, psychometrics, sociometrics, etc.). A major in operations research leading to a master of science degree is offered in cooperation with the Department of Industrial and Manufacturing Systems Engineering. The doctor of philosophy degree is offered as a co-major with other graduate programs. Such programs have included graduate majors in Agronomy, Animal Ecology, Animal Science, Bioinformatics, Chemical and Biological Engineering, Computer Science, Electrical Engineering, Ecology, Evolution and Organismal Biology (EEOB), Economics, Educational Leadership and Policy Studies, Food Science and Human Nutrition, Genetics, Development and Cell Biology (GDCB), Industrial and Manufacturing Systems Engineering, Mathematics, Meteorology, Psychology and Sociology.

M.S. graduates have a basic understanding of statistical theory and methods. Elective courses in statistics provide the opportunity for the student to emphasize particular areas within the field of statistics, based on interest and future career goals. Communication skills are developed through course projects, assistantship duties and creative components. Ph.D. graduates study advanced theory and methods and are able to do independent research in statistics and collaborative research outside of statistics.

Prerequisite to major graduate work is the completion of an undergraduate curriculum essentially equivalent to the curriculum in liberal arts and sciences at this institution including at least a year of calculus.

The degree master of science may be earned on either a thesis or nonthesis basis. The nonthesis option requires the completion of at least 34 credits of acceptable graduate work, including the completion of a creative component and satisfactory performance on a written examination. The thesis option requires the completion of 30 credits of acceptable graduate work, including the completion of a thesis and satisfactory performance on a written examination. Ph.D. candidates must complete at least 72 semester credits (half or more from Iowa State) with a minimum 3.0 (B) average and submit an original thesis representing a substantial contribution to statistics as a science.

The department encourages students to prepare themselves in foreign languages and in computer languages, but specific requirements for the degrees master of science and doctor of philosophy are at the discretion of the student's advisory committee.

The department participates in the interdepartmental programs in bioinformatics and computational biology, ecology and evolutionary biology, forensic research, genetics, human computer interaction, and nutrition.

Courses primarily for undergraduate students

Stat 100. Orientation in Statistics. (1-0) Cr. R. F. Opportunities, challenges, and the scope of the curriculum in statistics. For students planning or considering a career in this area.

Stat 101. Principles of Statistics. (3-2) Cr. 4. F.S.SS. *Prereq: 1 1/2 years of high school algebra.* Statistical concepts in modern society; descriptive statistics and graphical displays of data; the normal distribution; data collection (sampling and designing experiments); elementary probability; elements of statistical inference; estimation and hypothesis testing; linear regression and correlation; contingency tables. Credit for only one of the following courses may be applied toward graduation: Stat 101, 104, 105, 226.

Stat 104. Introduction to Statistics. (2-2) Cr. 3. F.S.SS. *Prereq: 1 1/2 years of high school algebra.* Statistical concepts and their use in science; collecting, organizing and drawing conclusions from data; elementary probability; binomial and normal distributions; regression; estimation and hypothesis testing. For students in the agricultural and biological sciences. Credit for only one of the following courses may be applied toward graduation: Stat 101, 104, 105, 226.

Stat 105. Introduction to Statistics for Engineers. (3-0) Cr. 3. F.S. *Prereq: Math 165 (or 165H).* Statistical concepts with emphasis on engineering applications. Data collection; descriptive statistics; probability distributions and their properties; elements of statistical inference; regression; statistical quality control charts; use of statistical software; team project involving data collection, description and analysis. Credit for only one of the following courses may be applied toward graduation: Stat 101, 104, 105, 226. Credit for both Stat 105 and 305 may not be applied for graduation.

Stat 226. Introduction to Business Statistics I. (3-0) Cr. 3. F.S.SS. *Prereq: Math 150 or 165.* Obtaining, presenting, and organizing statistical data; measures of location and dispersion; the Normal distribution; sampling and sampling distributions; elements of statistical inference; estimation and confidence intervals; hypothesis testing; inference for simple linear regression analysis; use of computers to visualize and analyze data. Credit for only one of the following courses may be applied toward graduation: Stat 101, 104, 105, 226.

Stat 231. Probability and Statistical Inference for Engineers. (4-0) Cr. 4. F.S. *Prereq: Credit or enrollment in Math 265.* Emphasis on engineering applications. Basic probability; random variables and probability distributions; joint and sampling distributions. Descriptive statistics; confidence intervals; hypothesis testing; simple linear regression; multiple linear regression; one way analysis of variance; use of statistical software.

Stat 305. Engineering Statistics. (3-0) Cr. 3. F.S.SS. *Prereq: Math 165 (or 165H).* Statistics for engineering problem solving. Principles of engineering data collection; descriptive statistics; elementary probability distributions; principles of experimentation; confidence intervals and significance tests; one-, two-, and multi-sample studies; regression analysis; use of statistical software; team project involving engineering experimentation and data analysis. Credit for both Stat 105 and 305 may not be applied for graduation.

Stat 322. Probabilistic Methods for Electrical Engineers. (Cross-listed with E E). (3-0) Cr. 3. F.S. *Prereq: E E 224.* Introduction to probability with applications to electrical engineering. Sets and events, probability space, conditional probability, total probability and Bayes' rule. Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, moments, moment generating functions, multiple random variables, functions of random variables. Elements of statistics, hypothesis testing, confidence intervals, least squares. Introduction to random processes.

Stat 326. Introduction to Business Statistics II. (2-2) Cr. 3. F.S. *Prereq: 226.* Multiple regression analysis; regression diagnostics; model building; applications in analysis of variance and time series; random variables; distributions; conditional probability; statistical process control methods; use of computers to visualize and analyze data.

Stat 330. Probability and Statistics for Computer Science. (3-0) Cr. 3. F.S. *Prereq: Math 166.* Topics from probability and statistics applicable to computer science. Basic probability; Random variables and their distributions; Elementary probabilistic simulation; Queuing models; Basic statistical inference; Introduction to regression. Nonmajor graduate credit.

Stat 332. Visual Communication of Quantitative Information. (Cross-listed with Engl). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Stat 101, 104 or 226; Engl 250.* Communicating quantitative information using visual displays; visualizing data; interactive and dynamic data displays; evaluating current examples in the media; color, perception, and representation in graphs; interpreting data displays. Nonmajor graduate credit.

Stat 341. Introduction to the Theory of Probability and Statistics I. (Cross-listed with Math). (3-0) Cr. 3. F.S. *Prereq: Math 265 (or 265H).* Probability; distribution functions and their properties; classical discrete and continuous distribution functions; multivariate probability distributions and their properties; moment generating functions; simulation of random variables and use of the R statistical package. Credit for both Stat 341 and 447 may not be applied toward graduation.

Stat 342. Introduction to the Theory of Probability and Statistics II. (Cross-listed with Math). (3-0) Cr. 3. S. *Prereq: Stat 341; Math 307 or 317.* Transformations of random variables; sampling distributions; confidence intervals and hypothesis testing; theory of estimation and hypothesis tests; linear model theory; enumerative data; use of the R statistical package for simulation and data analysis.

Stat 361. Statistical Quality Assurance. (Cross-listed with I E). (2-2) Cr. 3. F.S. *Prereq: Stat 231 or 401.* Statistical methods for process improvement. Simple quality assurance principles and tools. Measurement system precision and accuracy assessment. Control charts. Process capability assessment. Experimental design and analysis for process improvement. Significant external project in process improvement. Nonmajor graduate credit.

Stat 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair.* Off-campus work periods for undergraduate students in a field of statistics.

Stat 401. Statistical Methods for Research Workers. (3-2) Cr. 4. F.S.SS. *Prereq: 101 or 104 or 105 or 226.* Graduate students without an equivalent course should contact the department. Methods of analyzing and interpreting experimental and survey data. Statistical concepts and models; estimation; hypothesis tests with continuous and discrete data; simple and multiple linear regression and correlation; introduction to analysis of variance and blocking. Nonmajor graduate credit.

Stat 402. Statistical Design and the Analysis of Experiments. (3-0) Cr. 3. F.S. *Prereq: 401.* The role of statistics in research and the principles of experimental design. Experimental units, randomization, replication, blocking, subdividing and repeatedly measuring experimental units; factorial treatment designs and confounding; extensions of the analysis of variance to cover general crossed and nested classifications and models that include both classificatory and continuous factors. Determining sample size. Nonmajor graduate credit.

Stat 404. Regression for social and Behavioral Research. (2-2) Cr. 3. F. *Prereq: 401.* Lorenz, Roberts. Applications of generalized linear regression models to social science data. Assumptions of regression; diagnostics and transformations; analysis of variance and covariance; path analysis; logistic, multinomial and Poisson regression. Nonmajor graduate credit.

Stat 406. Statistical Methods for Spatial Data. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Six hours of statistics at the 400-level.* The analysis of spatial data; geostatistical methods and spatial prediction; discrete index random fields and Markov random field models; models for spatial point processes. Emphasis on application and practical use of spatial statistical analysis. Nonmajor graduate credit.

Stat 407. Methods of Multivariate Analysis. (2-2) Cr. 3. F. *Prereq: 401, knowledge of matrix algebra.* Carriquiry, Cook. Techniques for displaying and analyzing multivariate data including plotting high-dimensional data using interactive graphics, comparing group mean vectors using Hotelling's T2, multivariate analysis of variance, reducing variable dimension with principal components, grouping/classifying observations with cluster analysis and discriminant analysis. Imputation of missing multivariate observations. Nonmajor graduate credit.

Stat 415. Advanced Statistical Methods for Research Workers. (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 401.* Advanced statistical methods using modern computer methods for modeling and analyzing data. Examples from a wide variety of scientific and engineering disciplines. Nonmajor graduate credit.

Stat 416. Statistical Design and Analysis of Microarray Experiments. (3-0) Cr. 3. S. *Prereq: Stat 401.* Introduction to two-color microarray technology and single-channel platforms (Affymetrix GeneChips); the role of blocking, randomization, and biological and technical replication in microarray experiments; design of single-channel and two-color microarray experiments with factorial treatment structure; normalization methods for single-channel and two-color microarray data; methods for identifying differentially expressed genes including mixed linear model analyses, empirical Bayes analyses, and resampling based approaches; procedures for controlling false discovery rate for multiple testing; clustering and classification problems for microarray data; testing gene categories; emphasis on practical use of methods. Nonmajor graduate credit.

Stat 421. Survey Sampling Techniques. (2-2) Cr. 3. S. *Prereq: 231 or 328 or 401.* Concepts of sample surveys and the survey process; methods of designing sample surveys, including: simple random, stratified, and multistage sampling designs; methods of analyzing sample surveys including ratio, regression, domain estimation and nonresponse. Nonmajor graduate credit.

Stat 430. Empirical Methods for Computer Science. (3-0) Cr. 3. F. *Prereq: Stat 330 or an equivalent course, Math 166, knowledge of linear algebra..* Programs and systems as objects of empirical studies; exploratory data analysis; selected topics from analysis of designed experiments - analysis of variance, hypothesis testing, interaction among variables; linear regression, logistic regression, Poisson regression; parameter estimation, prediction, confidence regions, dimension reduction techniques, model diagnostics and sensitivity analysis; Markov chains and processes; simulation techniques and bootstrap methods; applications to performance assessment - comparison of multiple systems; communicating results of empirical studies. Statistical software: R. Nonmajor graduate credit.

Stat 432. Applied Probability Models. (3-0) Cr. 3. F. *Prereq: 231 or 341 or 447.* Probabilistic models in biological, engineering and the physical sciences. Markov chains; Poisson, birth-and-death, renewal, branching and queing processes; applications to bioinformatics and other quantitative problems. Nonmajor graduate credit.

Stat 447. Statistical Theory for Research Workers. (4-0) Cr. 4. F.S.SS. *Prereq: Math 151 and permission of instructor, or Math 265.* Primarily for graduate students not majoring in statistics. Emphasis on aspects of the theory underlying statistical methods. Probability, probability density and mass functions, distribution functions, moment generating functions, sampling distributions, point and interval estimation, maximum likelihood and likelihood ratio tests, introduction to posterior distributions and Bayesian analysis, linear model theory, use of simulation. Credit for both Stat 341 and 447 may not be applied toward graduation. Nonmajor graduate credit.

Stat 451. Applied Time Series. (3-0) Cr. 3. S. *Prereq: 231 or 328 or 401.* Meeker. Methods for analyzing data collected over time; review of multiple regression analysis. Elementary forecasting methods: moving averages and exponential smoothing. Autoregressive-moving average (Box-Jenkins) models: identification, estimation, diagnostic checking, and forecasting. Transfer function models and intervention analysis. Introduction to multivariate time series methods. Nonmajor graduate credit.

Stat 457. Applied Categorical Data Analysis. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Stat 401 (or equivalent).* Statistical methods for the analysis of categorical data: estimation of proportions, chi-square tests, sample size determination, measures of association and relative risk, measures of agreement, logistic regression, Poisson regression and log-linear models, matched-pair and repeated measures designs, conditional inference. Applications to social, behavioral, and health sciences. Nonmajor graduate credit.

Stat 479. Computer Processing of Statistical Data. (3-0) Cr. 3. F. *Prereq: 401.* Marasinghe. Structure, content and programming aspects of the Statistical Analysis System (SAS) software package. Advanced techniques in the use of SAS for data analysis including statistical graphics, regression diagnostics, and complex analysis of variance models. If time permits, the SAS macro programming language will be introduced. Nonmajor graduate credit.

Stat 480. Statistical Computing Applications. (3-0) Cr. 3. S. *Prereq: 231 or 328 or 401.* Modern statistical computing. Data management; spread sheets, verifying data accuracy, transferring data between software packages. Data and graphical analysis with statistical software packages. Algorithmic programming concepts and applications. Simulation. Software reliability. Nonmajor graduate credit.

Stat 490. Independent Study. Cr. arr. Repeatable. *Prereq: 10 credits in statistics.* No more than 9 credits in Stat 490 may be counted toward graduation. H. Honors.

Stat 493. Workshop in Statistics. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 101 or 104 or 226.* Off-Campus only. Introduction to methods for analyzing data from surveys and experiments. Summarizing data, analysis of data from simple random samples and more complex survey designs, experimental design, estimation and hypothesis testing for data from simple experiments, good and bad graphical presentations of results. Designed for master of agriculture program only. Nonmajor graduate credit.

Stat 495. Applied Statistics for Industry I. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 101 or 104 or 105 or 226; Math 166 (or 166H).* Graduate students without an equivalent course should consult the department. Statistical thinking applied to industrial processes. Assessing, monitoring and improving processes using statistical methods. Analytic/enumerative studies; graphical displays of data; fundamentals of six sigma; process monitoring; control charts; capability analysis. Nonmajor graduate credit.

Stat 496. Applied Statistics for Industry II. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 495.* Statistical design and analysis of industrial experiments. Concepts of control, randomization and replication. Simple and multiple regression; factorial and fractional factorial experiments; application of ideas of six sigma; reliability; analysis of lifetime data. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Stat 500. Statistical Methods. (3-2) Cr. 4. F. *Prereq: 101.* Introduction to methods for analyzing data from experiments and observational data. Design-based and model-based inference. Estimation, hypothesis testing, and model assessment for 2 group and k group studies. Experimental design and the use of pairing/blocking. Analysis of discrete data. Correlation and regression, prediction, model selection and diagnostics. Simple mixed models including nested random effects and split plot experimental designs. Use of the SAS statistical software.

Stat 501. Multivariate Statistical Methods. (3-0) Cr. 3. S. *Prereq: 500 or 402; 447 or 542; knowledge of matrix algebra.* Statistical methods for analyzing and displaying multivariate data: simultaneous analysis of multiple responses, multivariate analysis of variance; summarizing high dimensional data with principal components, factor analysis, canonical correlations, multidimensional scaling; grouping similar items with cluster analysis; classification methods; dynamic graphics. Statistical software: SAS, S-Plus or R, and GGobi.

Stat 503. Exploratory Methods and Data Mining. (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 401, 341 or 447.* Approaches to finding the unexpected in data; pattern recognition, classification, association rules, graphical methods, classical and computer-intensive statistical techniques, and problem solving. Emphasis is on data-centered, non-inferential statistics for large or high-dimensional data, topical problems, and building report writing skills.

Stat 505. Environmental Statistics. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 341 or 447; 401.* Statistical methods and models for environmental applications. Emphasis on environmental toxicology. Analysis of data with below detection-limit values. Dose-response curve modeling, including overdispersion and estimation of safe doses. Trend analysis; analysis of autocorrelated data. Equivalence testing.

Stat 506. Statistical Methods for Spatial Data. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 447 or 542.* The analysis of spatial data; geostatistical methods and spatial prediction; discrete index random fields and Markkov random field models; models for spatial point processes.

Stat 511. Statistical Methods. (3-0) Cr. 3. S. *Prereq: 500 or 402 or 404; 447 or 542 and current enrollment in 543; knowledge of matrix algebra.* Introduction to the general theory of linear models, least squares and maximum likelihood estimation, hypothesis testing, interval estimation and prediction, analysis of unbalanced designs. Models with both fixed and random factors. Introduction to non-linear and generalized linear models, bootstrap estimation, local smoothing methods. Requires use of R statistical software.

Stat 512. Design of Experiments. (3-0) Cr. 3. F. *Prereq: 511.* Basic ideas of experimental design and analysis; completely randomized, randomized complete block, and Latin Square designs; factorial experiments, confounding, fractional replication; split-plot and incomplete block designs.

Stat 513. Response Surface Methodology. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 402 or 512, knowledge of elementary matrix theory and matrix formulation of regression.* Morris. Analysis techniques for locating optimum and near-optimum operating conditions: standard experimental designs for first- and second-order response surface models; design performance criteria; use of data transformations; mixture experiments; optimization for multiple-response problems. Requires use of statistical software with matrix functions.

Stat 515. Theory and Applications of Nonlinear Models. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 447 or 543, 511.* Construction of nonlinear statistical models; random and systematic model components, additive error nonlinear regression with constant and non-constant error variances, generalized linear models, transform both sides models. Iterative algorithms for estimation and asymptotic inference. Basic random parameter models, beta-binomial and gamma-Poisson mixtures. Requires use of instructor-supplied and student-written R functions.

Stat 516. Statistical Design and Analysis of Microarray Experiments. (3-0) Cr. 3. S. *Prereq: Stat 500; 447 or 542.* Introduction to two-color microarray technology including cDNA and oligo microarrays; introduction to single-channel platforms (Affymetrix GeneChips); the role of blocking, randomization, and biological and technical replication in microarray experiments; design of single-channel and two-color microarray experiments with factorial treatment structure; normalization methods; methods for identifying differentially expressed genes including mixed linear model analyses, empirical Bayes analyses, and resampling based approaches; adjustments for multiple testing; clustering and classification problems for microarray data; emphasis on current research topics in microarray statistics.

Stat 521. Theory and Applications of Sample Surveys. (3-0) Cr. 3. S. *Prereq: 401; 447 or 542.* Practical aspects and basic theory of design and estimation in sample surveys for finite populations. Simple random, systematic, stratified, cluster multistage and unequal-probability sampling. Horvitz-Thompson estimation of totals and functions of totals: means, proportions, regression coefficients. Linearization technique for variance estimation. Model-assisted ratio and regression estimation. Two-phase sampling and sampling on two occasions. Non-response effects. Imputation.

Stat 522. Advanced Applied Survey Sampling. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 521 or both Stat 421 and Stat 477.* Advanced topics in survey sampling and methodology: clustering and stratification in practice, adjustments and imputation for missing data, variance estimation in complex surveys, methods of panel and/or longitudinal surveys, procedures to increase response rates, and computing. Examples are taken from large, well-known surveys in various subject areas. Prior exposure to mathematical statistics, probability, and at least one course in survey sampling theory is assumed.

Stat 528. Applied Business Statistics. (2-2) Cr. 3. F.SS. *Prereq: enrollment in MBA program, not for STAT majors.* Application of statistical methods to problems in business and economics; simple and multiple linear regression; residual analysis; model building; analysis of variance; introduction to experimental design concepts; time series analysis and forecasting.

Stat 531. Quality Control and Engineering Statistics. (Cross-listed with I E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Stat 401; 342 or 447.* Wu. Statistical methods and theory applicable to problems of industrial process monitoring and improvement. Statistical issues in industrial measurement; Shewhart, CUSUM, and other control charts; feedback control; process characterization studies; estimation of product and process characteristics; acceptance sampling, continuous sampling and sequential sampling; economic and decision theoretic arguments in industrial statistics.

Stat 533. Reliability. (Cross-listed with I E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 342 or 432 or 447.* Meeker. Probabilistic modeling and inference in engineering reliability; lifetime models, product limit estimator, probability plotting, maximum likelihood estimation for censored data, Bayesian methods in reliability, system reliability models, competing risk analysis, acceleration models and analysis of accelerated test data; analysis of recurrence data; planning studies to obtain reliability data.

Stat 534. Ecological Statistics. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 447 or 542.* Dixon. Statistical methods for non-standard problems, illustrated using questions and data from ecological field studies. Specific topics include: Estimation of abundance and survival from mark-recapture studies. Deterministic and stochastic matrix models of population trends. Estimation of species richness and diversity. Ordination and analysis of complex multivariate data. Statistical methods discussed will include randomization and permutation tests, spatial point processes, bootstrap estimation of standard error, partial likelihood and Empirical Bayes methods.

Stat 536. Statistics for Population Genetics. (Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 401, 447; Gen 320 or Biol 313.* Statistical models for population genetics covering: selection, mutation, migration, population structure, and linkage disequilibrium. Applications to gene mapping (case-control, TDT), inference about population structure, DNA and protein sequence analysis, and forensic and paternity identification.

Stat 537. Statistics for Molecular Genetics. (Cross-listed with GDCB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 401, 447; Gen 320 or Biol 313.* Statistical models, inference, and computational tools for linkage analysis, quantitative trait analysis, and molecular evolution. Topics include; quantitative trait models, variance component mapping, interval and composite-interval mapping, and phylogenetic tree reconstruction.

Stat 542. Theory of Probability and Statistics I. (4-0) Cr. 4. F. *Prereq: 341; Math 414 or 465.* Sample spaces, probability, conditional probability; Random variables, univariate distributions, expectation, median, and other characteristics of distributions, moment generating functions; Joint distributions, conditional distributions and independence, correlation and covariance; Probability laws and transformations; Introduction to the Multivariate Normal distribution; Sampling distributions, order statistics; Convergence concepts, the law of large numbers, the central limit theorem and delta method; Basics of stochastic simulation.

Stat 543. Theory of Probability and Statistics II. (3-0) Cr. 3. S. *Prereq: 542.* Point estimation including method of moments, maximum likelihood estimation, exponential family, Bayes estimators, Loss function and Bayesian optimality, unbiasedness, sufficiency, completeness, Basu s theorem; Interval estimation including confidence intervals, prediction intervals, Bayesian interval estimation; Hypothesis testing including Neyman-Pearson Lemma, uniformly most powerful tests, likelihood ratio tests; Bayesian tests; Nonparametric methods, bootstrap.

Stat 544. Bayesian Statistics. (3-0) Cr. 3. S. *Prereq: 543.* Specification of probability models; subjective, conjugate, and noninformative prior distributions; hierarchical models; analytical and computational techniques for obtaining posterior distributions; model checking, model selection, diagnostics; comparison of Bayesian and traditional methods.

Stat 546. Nonparametric Methods in Statistics. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 511, 542.* Chen, Opsomer. Overview of parametric versus nonparametric methods of inference; introduction to nonparametric smoothing methods for estimating density and regression functions; smoothing parameter selection; applications to semiparametric models and goodness-of-fit tests of a parametric model.

Stat 551. Time Series Analysis. (3-0) Cr. 3. F. *Prereq: 447 or 542.* Concepts of trend and dependence in time series data; stationarity and basic model structures for dealing with temporal dependence; moving average and autoregressive error structures; analysis in the time domain and the frequency domain; parameter estimation, prediction and forecasting; identification of appropriate model structure for actual data and model assessment techniques. Possible extended topics include dynamic models and linear filters.

Stat 554. Introduction to Stochastic Processes. (Cross-listed with Math). Cr. 3. F. *Prereq: Stat 542.* Markov chains on discrete spaces in discrete and continuous time (random walks, Poisson processes, birth and death processes) and their long-term behavior. Optional topics may include branching processes, renewal theory, introduction to Brownian motion.

Stat 557. Statistical Methods for Counts and Proportions. (3-0) Cr. 3. F. *Prereq: 500 or 401; 543 or 447.* Statistical methods for analyzing simple random samples when outcomes are counts or proportions; measures of association and relative risk, chi-squared tests, loglinear models, logistic regression and other generalized linear models, tree-based methods. Extensions to longitudinal studies and complex designs, models with fixed and random effects. Use of statistical software: SAS, S-Plus or R.

Stat 565. Methods in Biostatistics. (Cross-listed with Tox). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 500 or 401; Stat 543 or 447.* Statistical methods useful for biostatistical problems. Topics include analysis of cohort studies, case-control studies and randomized clinical trials, techniques in the analysis of survival data and longitudinal studies, approaches to handling missing data, and meta-analysis. Examples will come from recent studies in cancer, AIDS, heart disease, psychiatry and other human and animal health studies. Use of statistical software: SAS, S-Plus or R.

Stat 566. Survival Analysis for Biomedical Applications. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Stat 543 and Stat 511.* Statistical methods for analyzing time to event and survival data. Estimation of survivor and hazard functions, proportional hazards models, diagnostic procedures, time dependent covariates. Extensions to cases with multiple or correlated end points. Applications to medical studies involving cancer treatments, liver and bladder diseases, autoimmune disorders, bone fractures, surgery mortality rates. Implementation of SAS, S Plus, and R.

Stat 568. Bioinformatics II (Advanced Genome Informatics). (Cross-listed with BCB, GDCB, Com S). (3-0) Cr. 3. S. *Prereq: BCB 567, BBMB 301, Biol 315, Stat 430, credit or enrollment in Gen 411.* Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

Stat 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology). (Cross-listed with BCB, GDCB, Com S, Cpr E). (3-0) Cr. 3. S. *Prereq: BCB 567, Biol 315, Com S 311 and either 208 or 228, Gen 411, Stat 430.* Algorithmic and statistical approaches in computational functional genomics and systems biology. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Ontology-driven, network based, and probabilistic approaches to information integration.

Stat 579. An Introduction to R. (0-2) Cr. 1. F. *Prereq: Enrollment in 500.* An introduction to the logic of programming, numerical algorithms, and graphics. The R statistical programming environment will be used to demonstrate how data can be stored, manipulated, plotted, and analyzed using both built-in functions and user extensions. Concepts of modularization, looping, vectorization, conditional execution, and function construction will be emphasized.

Stat 580. Statistical Computing. (3-0) Cr. 3. S. *Prereq: 579 and 447 or 542.* Introduction to scientific computing for statistics using tools and concepts in R: programming tools, modern programming methodologies, modularization, design of statistical algorithms. Introduction to C programming for efficiency; interfacing R with C. Building statistical libraries. Use of algorithms in modern subroutine packages, optimization and integration. Implementation of simulation methods; inversion of probability integral transform, rejection sampling, importance sampling. Monte Carlo integration.

Stat 590. Special Topics. Cr. arr. Repeatable.
A. Theory
B. Methods
C. Design of Experiments
D. Sample Surveys

Stat 598. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department chair.* Off-campus work periods for graduate students in a field of statistics.

Stat 599. Creative Component. Cr. arr.

Courses for graduate students

Stat 601. Advanced Statistical Methods. (3-2) Cr. 4. F. *Prereq: 511, 543.* Emphasis on the approaches statisticians take toward the statistical formulation of scientific problems. Students should develop an understanding of the way that various concepts of probability are used in problem formulation, analysis, and inference, and the ability to develop one or more appropriate analyses for a variety of problems. Specific methodological topics include permutation procedures and design-based analysis; model building with single and multiple stochastic components; estimation based on least-squares, likelihood functions, modified likelihood functions, sample reuse, and Bayesian analysis; inference in the sample space, parameter space, and belief space. Development of various analyses for real problems, including statistical formulation and necessary computations.

Stat 606. Advanced Spatial Statistics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 506, 642.* Consideration of advanced topics in spatial statistics, including areas of current research. Topics may include construction of nonstationary covariance structures including intrinsic random functions, examination of edge effects, general formulation of Markov random field models, spatial subsampling, use of pseudo-likelihood and empirical likelihood concepts in spatial analysis, the applicability of asymptotic frameworks for inference, and a discussion of appropriate measures for point processes.

Stat 611. Theory and Applications of Linear Models. (3-0) Cr. 3. F. *Prereq: 500 or 402 or 404, 542 or 447, a course in matrix algebra.* Wu. Matrix preliminaries, estimability, theory of least squares and of best linear unbiased estimation, analysis of variance and covariance, distribution of quadratic forms, extension of theory to mixed and random models, inference for variance components.

Stat 612. Advanced Design of Experiments. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 512.* General theory of factorial experiments. Design optimality criteria, approximate design and general equivalence theory, computational approaches to constructing optimal designs for linear models. Advanced topics of current interest in the design of experiments, including one or more of: distance based design criteria and construction of spatial process models, screening design strategies for high-dimensional problems, and design problems associated with computational experiments.

Stat 615. Mixed Models: Theory, Methods and Applications. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Stat 601 and Stat 611.* The linear mixed effects (LME) model, the generalized linear mixed effects model (GLMM), quasilikelihood estimation, generalized estimating equations, nonlinear mixed effects (NLME) model, application in longitudinal data analysis, growth curve analysis and small area estimation, method of model diagnostics and influential analysis. The knowledge of general statistical inference is assumed.

Stat 621. Advanced Theory of Survey Statistics. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 521.* Advanced topics of current interest in the design of surveys and analysis of survey data, including: asymptotic theory for design and model-based estimators, use of auxiliary information in estimation, variance estimation techniques, small area estimation, non-response modeling and imputation.

Stat 642. Advanced Probability Theory. (Cross-listed with Math). (4-0) Cr. 4. F. *Prereq: 542.* Measure spaces, extension theorem and construction of Lebesgue-Stieljes measures on Euclidean spaces, Lebesgue integration and the basic convergence theorems, Lp-spaces, absolute continuity of measures and the Radon Nikodym theorem, absolute continuity of functions on R and the fundamental theorem of Lebesgue integration, product spaces and Fubini-Tonelli Theorems, convolutions. Fourier series and transforms, probability spaces; Kolmogorov's existence theorem for stochastic processes; expectation; Jensen's inequality and applications, independence, Borel-Cantelli lemmas; weak and strong laws of large numbers and applications, renewal theory.

Stat 643. Advanced Theory of Statistical Inference. (4-0) Cr. 4. S. *Prereq: 543, 642.* Weak convergence; characteristic functions; continuity theorem; Lindberg-Feller central limit theorem and its ramifications; conditional expectation and probability; Martingale central limit theorems; sufficiency, completeness; Elements of decision theory; Statistical information; Neyman-Pearson theory of testing hypotheses. Uniformly most powerful tests, likelihood ratio tests. Goodness of fit tests. Asymptotic theory of maximum likelihood estimation and likelihood ratio tests; Bayesian models; Invariance.

Stat 645. Advanced Stochastic Processes. (Cross-listed with Math). (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Weak convergence. Random walks and Brownian motion. Martingales. Stochastic integration and Ito's Formula. Stochastic differential equations and applications.

Stat 647. Multivariate Analysis. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 543, knowledge of matrix algebra.* Multivariate normal distribution, estimation of the mean vector and the covariance matrix, multiple and partial correlation, Hotelling's T2 statistic, Wishart distribution, multivariate regression, principle components, discriminant analysis, high dimensional data analysis, latent variables.

Stat 648. Seminar on Theory of Statistics and Probability. Cr. arr. F. *Prereq: 643.*

Stat 651. Time Series. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 551, 642.* Stationary and nonstationary time series models, including ARMA, ARCH, and GARCH. Covariance and spectral representation of time series. Fourier and periodogram analyses. Predictions. CLT for mixing processes. Estimation and distribution theory. Long range dependence.

Stat 680. Advanced Statistical Computing. (3-0) Cr. 3. F. *Prereq: 543 and 580.* Normal approximations to likelihoods. The delta-method and propagation of errors. Topics in the use of the E-M algorithm including; its use in the exponential family, computation of standard errors, acceleration. Resampling methods: brief theory and application of the jackknife and the bootstrap. Randomization tests. Stochastic simulation: Markov Chain, Monte Carlo, Gibbs' sampling, Hastings-Metropolis algorithms, critical slowing-down and remedies, auxiliary variables, simulated tempering, reversible-jump MCMC and multi-grid methods.

Stat 690. Advanced Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
A. Theory
B. Methods
C. Design of Experiments
D. Sample Surveys
E. Statistical Computing
F. Graphics

Stat 699. Research. Cr. arr. Repeatable.

Supply Chain Management

(Administered by the Department of Logistics, Operations and Management Information Systems)

Graduate Study

The Department of Logistics, Operations, and Management Information Systems participates in three graduate degree programs: the M.S. in Business, the M.B.A. full-time and part-time programs and the Ph.D. program in Business and Technology. The M.S. degree in Business is a 30-credit curriculum culminating in a thesis. The M.B.A. program is a 48-credit, nonthesis, noncreative component curriculum. Twenty-four of the 48 credits are core courses and the remaining 24 are graduate electives. The Ph.D. program is a 56-credit curriculum that culminates in a dissertation. The department also participates in the interdepartmental transportation major.

Students can obtain a Specialization in Supply Chain Management in the MBA program by taking 12 credits of graduate courses from a selected set of courses.

Students can also obtain a Ph.D. in Business and Technology with Supply Chain Management as the major area of specialization. They need to take 9 credits of the Ph.D. core curriculum 12 credits of doctoral seminars in the area of specialization, 9 credits in a minor area of the student's choice, and 12 credits from a recommended list of research methods courses.

Supply chain management is a program of study concerned with the efficient and timely flow of materials, products, and information within and among organizations. It involves the integration of business processes across organizations, from material sources and suppliers through manufacturing and processing to the final customer. Supply chain management encompasses a wide variety of activities that have a significant influence on customer service, including the planning, control, and implementation of the processes used to transform inputs into finished goods and services, transportation, warehousing, facility location analysis, packaging, materials handling, parts and service support, and product returns.

The study of Supply Chain Management prepares students for professional careers with manufacturers, distributors, logistics service providers, transportation carriers, and consulting firms. The curriculum provides the required theoretical/conceptual base and analytical methods for making sound operational and strategic supply chain management decisions.

Courses primarily for graduate students, open to qualified undergraduate students

SCM 502. Supply Chain Management. (2-0) Cr. 2. Prereq*: Graduate classification.* Introduction to the fields of operations and logistics. The managerial issues and challenges of developing and implementing a firm's supply chain strategy. Inbound and outbound logistics, inventory, warehousing, manufacturing, materials handling, transportation and sourcing.

SCM 502. Supply Chain Management. (2-0) Cr. 2. *Prereq: Graduate classification.* Introduction to the fields of operations and logistics. The managerial issues and challenges of developing and implementing a firm's supply chain strategy. Inbound and outbound logistics, inventory, warehousing, manufacturing, materials handling, transportation and sourcing.

SCM 520. Decision Models for Supply Chain Management. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* The application of decision models for supply chain management. Topics include business applications of decision theory, inventory theory, business forecasting, optimization models, transportation and network models, routing problems, and project management.

SCM 522. Supply Chain Planning and Control Systems. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* An integrated analysis of planning and control systems for supply chains. Master production scheduling, material requirements planning, enterprise resource planning, capacity planning, shop floor control, competitive analyses of modern supply chain systems, and implementation of information technologies related to these topics.

SCM 524. Strategic Process Analysis and Improvement. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* Analysis, management, and improvement of the business processes used to produce and deliver products and services that satisfy customer needs. Process attributes that managers can control to influence the key operational performance measures of throughput time, inventory, cost, quality, and flexibility are discussed. Topics such as theory of constraints, lean production, and six sigma are included.

SCM 560. Strategic Logistics Management. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* Positions logistics vis-a-vis supply chain management (SCM). Presents different perspectives on SCM vs. logistics. Describes primary logistics functions: transportation, warehousing, facility location, customer service, order processing, inventory management and packaging. Benefits of and obstacles to the integration of these functions.

SCM 561. Transportation Management and Policy. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* Analysis of contemporary issues and strategies in transportation management and policy. Emphasis on evaluation of the impacts of transportation policies, new technologies, and strategic carrier and shipper management practices on the freight transportation industry and logistics systems.

SCM 563. Purchasing and Supply Management. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* Mechanics, procedures and tools used in purchasing. Recruiting, selecting, developing and managing supply chain partners in order to achieve competitive advantage via superior supply chain management. Factors and information needs for making supply management decisions.

SCM 585. Strategic Demand Planning. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* Synchronizes demand with manufacturing and distribution. Emphasis on the strategic advantages of linking business plans and demand forecasts, both vertically within the organization and collaboratively among supply chain partners.

SCM 590. Special Topics. Cr. arr. Repeatable. *Prereq: Graduate classification and permission of instructor.* For students who wish to do individual research in a particular area of supply chain management.

SCM 601. Theoretical Foundations of Supply Chain Management. (3-0) Cr. 3. *Prereq: Mgmt 601 or permission of instructor.* An overview of the development of supply chain management (SCM) theory, including review of seminal articles in logistics, operations, and purchasing management and theories from allied disciplines (e.g., economics, marketing, sociology, strategic management). Analysis of trends in SCM research topics and methodologies. Identification of emerging and future areas for research and theory development.

SCM 602. Seminar in Supply Chain Strategy. (3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment.* Review of research literature on supply chain strategy, including the impact of technology, global economic and social factors, and intra- and inter-organizational integration on supply chain strategy formation. The role of SCM in overall corporate strategy and the impact of SCM on firm performance will also be addressed.

SCM 603. Seminar in Purchasing. (3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment.* Review of classic purchasing theories. Discussion of contemporary supply management strategy; the role of supply management and its relationship with other functional areas; its impact on logistics and transportation issues; management of supply uncertainties.

SCM 604. Seminar in Logistics Management. (3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment.* Integration of network, economic, and systems theory in the design, management, and control of logistics systems in the context of integrated supply chain management. Functional areas addressed include transportation, inventory order fulfillment, distribution, and warehousing. Facility location analysis will also be covered.

SCM 605. Seminar in Operations Management. (3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment.* Review of the research literature on methods of organizing, planning, controlling, and improving manufacturing systems to achieve the desired performance objectives related to cost, quality, speed, and flexibility. The relationship between the performance of the manufacturing system and the performance of the supply chain system will also be discussed.

SCM 650. Research Practicum I. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

SCM 651. Research Practicum II. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

SCM 699. Dissertation. Cr. 12. *Prereq: Graduate classification, permission of dissertation supervisor.* Research.

Sustainable Agriculture

(Interdepartmental Graduate Major)

www.sust.ag.iastate.edu/gpsa/

Program Leadership: M. Duffy, Chair and Director of Graduate Education.

The Graduate Faculty Members in Sustainable Agriculture: Al-Kaisi, Allen, Anderson, Anex, Asbjornsen, Bain, Bhandari, Brumm, Cambardella, Clapp, Colletti, Cruse, Danielson, de Laplante, Delate, Deutsch, DeWitt, Duffy, C. Flora, J. Flora, Ford, Gardner, Gleason, Goggi, Grudens-Schuck, Hatfield, Hayes, Helmers, Honeyman, Hurburgh, Kaleita, Kanwar, Karlen, Kirschenmann, Kliebenstein, Liebman, Logsdon, Loynachan, Maldonado, Mallarino, Martin, Mazur, Miller, Miranowski, Morton, Mullen, Nutter, O'Neal, Owusu, Potoski, Randall, Robertson, Russell, Sandor, Sauer, Schulte, Schultz, Soupir, Steward, Thompson, Tyndall, Urbatsch, Wang, Wells, Wiedenhoeft, Wolf, Xin, Yang.

The graduate program in sustainable agriculture is an interdepartmental major offered through faculty in sixteen participating departments: Agricultural and Biosystems Engineering; Agricultural Education and Studies; Agronomy; Animal Science; Community and Regional Planning; Ecology, Evolution and Organismal Biology; Economics; Entomology; Food Science and Human Nutrition; Horticulture; Landscape Architecture; Natural Resource Ecology and Management; Philosophy and Religious Studies; Plant Pathology; Political Science; and Sociology. Both M.S. and Ph.D. degrees are offered within the major.

Master's students must have a bachelor's degree in one of the life, social, or engineering sciences, or a bachelor's degree plus equivalent experience in these areas. Doctoral students must have a master's degree and either an undergraduate or master's degree in one of the majors in the College of Agriculture and Life Sciences or its equivalent. Graduates of the program will be able to design and manage agricultural systems that increase food security, enhance human communities, and protect environmental quality. To acquire these abilities, students learn agroecological principles, study social relations underlying sustainable farming and food systems, and gain experience with practical techniques of sustainable agriculture. The program seeks to balance depth in disciplinary knowledge and perspectives with broader, system-level thinking. It integrates technical and social sciences through a sequence of team-taught interdisciplinary core courses emphasizing higher-order critical thinking skills and active, collaborative approaches to learning.

Graduates of the program are qualified to work in a variety of settings, including university research, education, extension, agribusiness, governmental and non-governmental organizations, and farming.

Information on applications procedures, research interests of the faculty, and specific requirements of the major may be obtained at http://www.sust.ag.iastate.edu/gpsa/ or by contacting gpsa@iastate.edu.

Courses for graduate students

SusAg 509. Agroecosystem Analysis. (Cross-listed with Agron, Anthr, Soc). (3-4) Cr. 4. F. *Prereq: Senior or above classification.* Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (agronomic, economic, ecological, social, etc), and scales of operation.

SusAg 515. Integrated Crop and Livestock Production Systems. (Cross-listed with A E, Agron, An S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: SusAg 509.* Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

SusAg 530. Ecologically Based Pest Management Strategies. (Cross-listed with Agron, Ent, Pl P). (3-0) Cr. 3. Alt. F., offered 2010. Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

SusAg 546. Organizational Strategies for Diversified Farming Systems. (Cross-listed with Agron, Hort, Soc). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: SusAg 509.* Examination of the organization and operation of complex, diversified farming systems using tools and perspectives drawn from ecology, agronomy, and sociology. The course includes a significant field component focused on an Iowa farm.

SusAg 571. Agroforestry Systems. (Cross-listed with NREM). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in biological science at 300-level or above.* Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry.

SusAg 584. Organic Agricultural Theory and Practice. (Cross-listed with Agron, Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 9 cr. in biological or physical sciences.* Delate & DeWitt. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

SusAg 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification, permission of instructor.* For students wishing to conduct in-depth study of a particular topic in sustainable agriculture.

SusAg 599. Creative Component. Cr. arr. F.S.SS. Pre-enrollment contract required. For MS students pursuing the non-thesis degree option. Final product is a creative component.

SusAg 600. Sustainable Agriculture Colloquium. (1-0) Cr. 1. Repeatable. F.S. Weekly seminar for graduate students in the Sustainable Agriculture program.

SusAg 610. Foundations of Sustainable Agriculture. (Cross-listed with Agron, A E, Anthr, Soc). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging agricultural systems in terms of the core concepts of sustainability and their theoretical contexts.

SusAg 699. Research. Cr. arr. Repeatable. F.S.SS. MS and PhD thesis and dissertation research.

Systems Engineering

(Interdepartmental Graduate Major)

Supervisory Committee: D. Gemmill (Chair), D. Jacobson, and A. Mann

Work is offered for the master of engineering with a major in systems engineering. The graduate major in Systems Engineering is primarily an off-campus program. It is an interdisciplinary program that allows students to take courses across a variety of departments. Graduates of the program will possess the analytical abilities needed to design, evaluate, and build complex systems involving many components and demanding specifications. They will have the ability to work across disciplinary boundaries, as the practice of modern engineering often requires. Graduates will have developed management capabilities and extended their disciplinary knowledge.

The program is broadly based and uses courses in the various departments of the College of Engineering and courses in other departments of the university. The 30 credits necessary for graduation includes 27 semester credits of formal coursework and 3 credits for a creative component. Completion of the program requires two courses in systems engineering, two courses in the major discipline of the student, three engineering courses with a systems engineering emphasis, two courses outside of the college, and a creative component. Courses are delivered to off-campus students both with the instructor present and through various distance education systems, including video-streaming, podcasting, ftp downloading and CD-ROMs.

The program of study committee, in consultation with the student, determines the courses to be taken and the acceptability of transfer credits. The major professor should be selected from the discipline where a concentration of coursework will be taken.

Admission to the program requires a baccalaureate degree in engineering and admission to the graduate college. Students with degrees in other areas will be considered on an individual basis.

The degree awarded is a Master of Engineering in Systems Engineering.

For additional information students should contact the Chair of the Supervisory Committee, 2019 Black Engineering Building, ISU, Ames, Iowa 50011.

Teacher Education

David Whaley, Associate Dean, Teacher Education

Teacher Education Faculty: Geoff Abelson (C I), Linda Quinn Allen (WLC), Thomas Andre (C I), Alex Andreotti (C I), Janice Baker (KIN), EunJin Bang (CI), Leslie Bloom (C I), Jackie Blount (C I), Warren Blumenfield (C I), Mary Jane Brotherson (HD FS), Katherine Richardson Bruna (C I), Patricia Carlson (C I), Mike Clough (C I), James Colbert (BIO), Karen Colbert (HD FS), Ana Correia (C I), Sedahlia Crase (HD FS), Corey Drake (C I), Dianne Draper (HD FS), Rich Engelhorn (KIN), Levon Esters (AgEds), Anne Foegen (C I), Michael Golemo (Music), Thomas Greenbowe (Chem), Connie Hargrave (C I), Cheryl Hausafus (AESHM), Sue Hegland (HD FS), Beth Herbel-Eisenmann (C I), Kere Hughes (HD FS), Leah Keino (AESHM), Mimi Lee (CI), Patricia Leigh (C I), John Levis (Engl), Gayle Luze (HD FS), Robert Martin (AgEds), James McShay (C I), Donna Merkley (C I), Greg Miller (AgEds), Wade Miller (AgEds), Kouider Mokhtari (CI), Susan Maude (HD FS), Sylvia Munsen (Music), Donna Niday (Engl), Dale Niederhauser (C I), Lori Norton-Meier (C I), Joanne Olson (C I), Carla Peterson (HD FS), Gary Phye (C I), Mark Rectanus (WLC), Michael Retallick (Music), James Rodde (Music), Connie Ringlee (Engl), Marcia Rosenbusch (C I), Elizabeth Schabel (Engl), Frank Schabel (KIN), Kevin Schilling (Music), Denise Schmidt (C I), Jennifer Seymour (C I), Carl Smith (C I), Katherine Thomas (KIN), Ann Thompson (C I), Margaret Torrie (HD FS), Robert Tremmel (Engl), Michael Tremmel (Engl), Roberta Vann (Engl), Kerry Whisnant (Phys), Kenneth Windom (Geol)

The mission of University Teacher Education is to develop educators who are caring, competent, and certified. Students who successfully complete the requirements for any of the endorsement areas offered at ISU must demonstrate the skills and knowledge required of beginning teachers. (See Iowa Teaching Standards and Criteria section.)

University Teacher Education is a shared responsibility that spans three colleges. For most licensure areas, students major in a content area while taking additional education courses. All students who are recommended by Iowa State University for teacher licensure must meet the requirements of University Teacher Education and be recommended by their department, college, and the ISU recommending official.

Undergraduate Teacher Licensure Areas

An undergraduate student seeking a bachelor's degree must be enrolled in the department in which he or she plans to major and must meet the graduation requirements of that department and college.

Currently, there are sixteen undergraduate teacher licensure areas offered at Iowa State University. These areas and their corresponding grade levels are listed below:

Early Childhood Education (birth-grade 3)
Elementary Education (grades K-6)
Agricultural Education (grades 5-12)
Biology (grades 5-12)
Chemistry (grades 5-12)
Earth Science (grades 5-12)
English (grades 5-12)
Family and Consumer Sciences (grades 5-12)
Health Education (grades 5-12)
History-Social Sciences (grades 5-12)
Mathematics (grades 5-12)
Music (grades K-12)
Physical Education (grades K-12)
Physical Science (grades 5-12)
Physics (grades 5-12)
World Languages and Cultures (French, German, Latin, Russian, and Spanish) (grades 5-12)

Additional Endorsements

Students must fulfill the requirements for one of the licensure areas listed above to add any of the following endorsements:

Art (K-8)
Basic Science (K-8)
Coaching Interscholastic Athletics (grades K-12)
English and Language Arts (K-8)
English as a Second Language (grades K-12)
General Science (grades 5-12)
Health (K-8)
History (K-8)
Instructional Strategist I: Mild/Moderate Disabilities (grades K-8 or 5-12)
Instructional Strategist II: Behavior Disorders/Learning Disabilities (K-12)
Mathematics (K-8)
Middle School (5-8)
Reading (grades K-8 or 5-12)
Social Sciences (K-8)
Speech Communication (grades 5-12)
World Languages and Cultures (French, German, Latin, Russian, and Spanish) (grades K-8)

Post-Bachelor's Teacher Licensure Areas

Students already holding an appropriate bachelor's degree may pursue teacher licensure in any of the undergraduate licensure areas listed above. Interested students should consult with the coordinator of the area in which they plan to specialize so that an individualized program of study can be developed.

Graduate Teacher Licensure Areas

Currently, there are five graduate initial teacher licensure programs. These programs are designed for students who do not currently hold a teaching license. The programs are listed below:

Agricultural Education (M.S.)

Family and Consumer Sciences Education (M.Ed. or M.S.)

Mathematics Education (M.Ed.)

Physical Education (M.S.)

Secondary Sciences Education (M.A.T.)

Iowa State University also offers Master's programs for practicing teachers. The Mathematics Department offers a Masters in School Mathematics. (See Mathematics in Courses and Programs section of this catalog.) The Curriculum and Instruction Department offers a Master's degree program and a certificate program that lead to a special education endorsement. (See Curriculum and Instruction in Courses and Programs section of this catalog.)

Graduate programs are also available for those who seek licensure in Educational Administration as PK-12 school principals or PK-12 superintendents. (See Educational Administration in Courses and Programs section of this catalog.)

Standards

University Teacher Education has a rigorous standards-based curriculum. Two sets of standards are used throughout the program, one that is targeted for pre-service teachers (Standards for University Teacher Education Programs/Candidates which originates from the Iowa Administrative Code, Chapter 79, Standards for Practitioner Preparation Programs) and the other set that is targeted for in-service teachers (the Iowa Teaching Standards and Model Criteria adopted by the State Board of Education). Both are listed below in full.

Standards for University Teacher Education Programs/Candidates

a. Content/subject matter specialization. The candidate demonstrates an understanding of the central concepts, tools of inquiry, and structure of the discipline(s) the candidate teaches, and creates learning experiences that make these aspects of the subject matter meaningful for students. This is evidenced by a completion of a 30-semester-hour teaching major which must minimally include the requirements for at least one of the basic endorsement areas, special education teaching endorsements, or secondary level occupational endorsements. Each elementary candidate must also complete a field of specialization in a single discipline or a formal interdisciplinary program of at least twelve semester hours.

b. Student learning. The candidate demonstrates an understanding of human growth and development and of how students learn, and receives learning opportunities that support intellectual, career, social and personal development.

c. Diverse learners. The candidate demonstrates an understanding of how students differ in their approaches to learning and creates instructional opportunities that are equitable and adaptable to diverse learners.

d. Instructional planning. The candidate plans instruction based upon knowledge of subject matter, students, the community, curriculum goals, and state curriculum models.

e. Instructional strategies. The candidate demonstrates an understanding and use of a variety of instructional strategies to encourage students development of critical and creative thinking, problem-solving, and performance skills.

f. Learning environment/classroom management. The candidate uses an understanding of individual and group motivation and behavior; creates a learning environment that encourages positive social interaction, active engagement in learning, and self-motivation; maintains effective classroom management; and is prepared to address behaviors related to substance abuse and other high-risk behaviors.

g. Communication. The candidate uses knowledge of effective verbal, nonverbal, and media communication techniques, and other forms of symbolic representation, to foster active inquiry, collaboration, and support interaction in the classroom.

h. Assessment. The candidate understands and uses formal and informal assessment strategies to evaluate the continuous intellectual, social, and physical development of the student, and effectively uses both formative and summative assessment of students, including student achievement data, to determine appropriate instruction.

i. Foundations, reflective practice and professional development. The candidate develops knowledge of the social, historical, and philosophical foundations of education. The candidate continually evaluates the effects of the candidate's choices and actions on students, parents, and other professionals in the learning community; actively seeks out opportunities to grow professionally; and demonstrates an understanding of teachers as consumers of research and as researchers in the classroom.

j. Collaboration, ethics and relationships. The candidate fosters relationships with parents, school colleagues, and organizations in the larger community to support students learning and development; demonstrates an understanding of

educational law and policy, ethics, and the profession of teaching, including the role of boards of education and education agencies; and demonstrates knowledge and dispositions for cooperation with other educators, especially in collaborative/co-teaching as well as in other educational team situations.

k. Technology. The candidate effectively integrates technology into instruction to support student learning.

Iowa Teaching Standards and Criteria

Standard 1: Demonstrates ability to enhance academic performance and support for implementation of the school district student achievement goals.

The teacher:

a. Provides evidence of student learning to students, families, and staff.

b. Implements strategies supporting student, building, and district goals.

c. Uses student performance data as a guide for decision-making.

d. Accepts and demonstrates responsibility for creating a classroom culture that supports the learning of every student.

e. Creates an environment of mutual respect, rapport, and fairness.

f. Participates in and contributes to a school culture that focuses on improved student learning.

g. Communicates with students, families, colleagues, and communities effectively and accurately.

Standard 2: Demonstrates competence in content knowledge appropriate to the teaching position.

The teacher:

a. Understands and uses key concepts, underlying themes, relationships, and different perspectives related to the content area.

b. Uses knowledge of student development to make learning experiences in the content area meaningful and accessible for every student.

c. Relates ideas and information within and across content areas.

d. Understands and uses instructional strategies that are appropriate to the content area.

Standard 3: Demonstrates competence in planning and preparing for instruction.

The teacher:

a. Uses student achievement data, local standards, and the district curriculum in planning for instruction.

b. Sets and communicates high expectations for social, behavioral, and academic success of all students.

c. Uses student developmental needs, background, and interests in planning for instruction.

d. Selects strategies to engage all students in learning.

e. Uses available resources, including technologies, in the development and sequencing of instruction.

Standard 4: Uses strategies to deliver instruction that meet the multiple learning needs of students.

The teacher:

a. Aligns classroom instruction with local standards and district curriculum.

b. Uses research-based instructional strategies that address the full range of cognitive levels.

c. Demonstrates flexibility and responsiveness in adjusting instruction to meet student needs.

d. Engages students in varied experiences that meet diverse needs and promote social, emotional, and academic growth.

e. Connects students' prior knowledge, life experiences, and interests in the instructional process.

f. Uses available resources, including technologies, in the delivery of instruction.

Standard 5: Uses a variety of methods to monitor student learning.

The teacher:

a. Aligns classroom assessment with instruction.

b. Communicates assessment criteria and standards to all students and parents.

c. Understands and uses the results of multiple assessments to guide planning and instruction.

d. Guides students in goal setting and assessing their own learning.

e. Provides substantive, timely, and constructive feedback to students and parents.

f. Works with other staff and building and district leadership in analysis of student progress.

Standard 6: Demonstrates competence in classroom management.

The teacher:

a. Creates a learning community that encourages positive social interaction, active engagement, and self-regulation for every student.

b. Establishes, communicates, models, and maintains standards of responsible student behavior.

c. Develops and implements classroom procedures and routines that support high expectations for student learning.

d. Uses instructional time effectively to maximize student achievement.

e. Creates a safe and purposeful learning environment.

Standard 7: Engages in professional growth.

The teacher:

a. Demonstrates habits and skills of continuous inquiry and learning.

b. Works collaboratively to improve professional practice and student learning.

c. Applies research, knowledge, and skills from professional development opportunities to improve practice.

d. Establishes and implements professional development plans based upon the teacher's needs aligned to the Iowa Teaching Standards and district/building student achievement goals.

Standard 8: Fulfills professional responsibilities established by the school district.

The teacher:

a. Adheres to board policies, district procedures, and contractual obligations.

b. Demonstrates professional and ethical conduct as defined by state law and individual district policy.

c. Contributes to efforts to achieve district and building goals.

d. Demonstrates an understanding of and respect for all learners and staff.

e. Collaborates with students, families, colleagues, and communities to enhance student learning.

Standards Assessments

The State Board of Education requires each teacher candidate to demonstrate acquisition of the knowledge, skills and dispositions designated by the standards above for an Iowa teaching license at a level appropriate for a novice teacher. See licensure area coordinator for requirements.

The General Education Requirement

All prospective teachers are required to meet general education requirements as a part of their preparation.

Undergraduate Students

Undergraduate students must complete studies in the following general education groups. General education courses may be found in many departments. Credits listed are minimum requirements. Specific departments and/or colleges may require additional credits. Credits used to satisfy these general education requirements typically satisfy department and college general education requirements. (See licensure area coordinator for more information.)

Cr.	
6	Natural sciences
3	Mathematics or Statistics
9	Social Sciences
6	Humanities
9	Communication Skills
0.5	Library Skills (Lib 160)
33.5	Total

The above requirements must include:

(1). Engl 150 and 250, or equivalent
(2). One course that develops interpersonal or group presentation
(3). HD FS 102 or Psych 230
(4). One course in American history or government (see approved list.)

Post-Bachelor's Students

Students holding an appropriate bachelor's degree who wish to pursue teaching licensure must have at least one course in each of the following five general education groups identified for undergraduate students in the preceding section: Natural Sciences, Mathematics or Statistics, Social Sciences, Humanities, and Communication Skills. Individual departments preparing teachers may require additional credits in general education. (See licensure area coordinator for more information.)

Master's Students

Each Master's program will determine what, if any, general education requirements Master's students must fulfill beyond a bachelor's degree from a regionally accredited institution. (See licensure area coordinator for more information.)

Professional Teacher Education Requirement (Professional Core)

Field Experience Requirement

All students must satisfactorily complete a minimum of 80 hours of pre-student teaching laboratory experience. This requirement may be met through a pre-student teaching course (e.g., C I 280, C I 480, C I 580) or, in certain endorsement areas, a course designated to provide an equivalent experience. Students complete a background check before initial placement in schools and other appropriate locations.

Undergraduate Students

Prospective teachers must complete certain studies related directly to the profession of teaching. All undergraduate students in teacher education must take the following courses prior to student

teaching, unless the student's licensure area has an approved content-area course deemed to be equivalent (see specific Licensure Area Requirements section below for details.)

Early Childhood Education and Elementary Education:

Cr.
3 CI 201-Digital Learning in the PK-6 Classroom
3 C I 204—Social Foundations of American Education
2 C I 245 —Strategies in Teaching
1 C I 268 —Strategies Practicum
3 C I 332 – Educational Psychology of Young Learners
3 CI 406-Multicultural Foundations of Schools and Society: Introduction
3 Sp Ed 250—Education of the Exceptional Learner in a Diverse Society
16 Student teaching (16 weeks)

Secondary Education and K-12:

Cr.

3 CI 202: Digital Learning in the 7-12 Classroom
3 C I 204—Social Foundations of American Education
3 C I 333 -- Educational Psychology
3 CI 406-Multicultural Foundations of Schools and Society: Introduction
3 Sp Ed 450 —Teaching Secondary Students with Exceptionalities in General Education Classrooms
14-16 Student teaching (minimum 14 weeks)
(See teacher licensure area coordinator for more information).

Students in K-12 licensure areas and secondary education (grades 5-12) licensure areas must also complete the course listed below unless the student's licensure area has an approved equivalent. Areas with approved equivalents include: Agricultural Education, Physical Education and all Secondary Sciences. (See licensure area coordinator for more information).

Cr.
3 C I 426—Principles of Secondary Education

Post-Bachelor's Students
Students who hold an appropriate bachelor's degree and seek a teaching license must complete the professional education requirements listed above through course work or examination.

Master's Students
Prospective teachers must complete certain studies related directly to the profession of teaching. All students enrolled in Master's programs that lead to initial licensure must take the following courses prior to student teaching, unless the student's licensure area has an approved content area course deemed to be equivalent. (See Master's Programs section below for details.)

Cr.
3 Sp Ed 501—Teaching Students with Exceptionalties in General Education
3 C I 505 —Using Technology in Learning and Teaching
3 HPC 504—Studies in the Foundations of American Education
3 C I 506—Multicultural Foundations of School and Society: Advanced
3 C I 526—Principles of Secondary Education
3 C I 529—Educational Psychology in the Secondary Classroom
14-16 Student teaching (minimum 14 weeks)
(See teacher licensure area coordinator for more information).

Admission to University Teacher Education (Checkpoint 1)

The University Teacher Education Office monitors the progress of teacher education students. Admission to University Teacher Education is the first of three checkpoints. At this time, the requirements listed below will be checked. Students will not be able to progress to Student Teaching (Checkpoint 2) and Licensure (Checkpoint 3) without full admission to University Teacher Education (Checkpoint 1). Departments may have higher eligibility requirements for each checkpoint (see licensure area coordinator for more information).

Students transferring from other institutions with a minimum of 2.50 GPA or above may be admitted tentatively; full admission may be granted upon completion of nine semester credits averaging 2.50 or above at Iowa State University. Students who receive tentative admission are required to reapply the following semester by using the application for admission. A minimum of 20 semester credits averaging 2.50 or above must be earned at Iowa State University to receive institution licensure approval (nine of the required 20 semester hours must precede student teaching).

A student seeking admission to University Teacher Education must be accepted by a selection committee for the specific licensure area which the student seeks to enter. Factors considered in evaluating applications (in addition to the requirements listed below) may include professional dispositions, scholarship, interest in teaching, character, interpersonal skills, and physical and mental health.

Recommendations by selection committees must be confirmed by the University Teacher Education Coordinating Council before admission is granted. Students may apply as early as four semesters before the one in which they plan to enroll for student teaching; however, they must be fully admitted into University Teacher Education at least one year prior to the semester they complete the Request for Student Teaching Placement. Students in accelerated graduate programs must be fully admitted by mid-semester prior to their planned student teaching semester.

Requirements for full admission to University Teacher Education as an undergraduate:

1. A minimum 2.5 cumulative grade point average.

2. Successful completion of one of the following basic skills tests:

A composite Praxis I (PPST) score of 522, with a minimum of 170 for each test (reading, writing, and mathematics.

Minimum scores for the basic skills tests may be subject to change. Details regarding the scores, dates and fees for these tests are available online: www.teacher.hs.iastate.edu.

3. Documented completion of ISU approved 10 hours of pre-student teaching field experience.

4. All Curriculum and Instruction (C I), Human Development and Family Studies (HD FS) and Special Education (Sp Ed) courses required for licensure have a minimum grade requirement of a C (pedagogy coursework). Courses in the department of the major specifically required for teacher licensure have a minimum grade requirement of a C- (content coursework).

5. A report from a criminal background check initiated by ISU's recommending official.

Requirements for full admission to University Teacher Education as a post-bachelor's student:

1. A bachelor's degree from a regionally accredited institution and a minimum 2.5 cumulative grade point average from that institution.

2. Successful completion of one of the following basic skills test:

—Minimum GRE scores (400 on each of the Verbal and Quantitative sections.)

OR

—A composite Praxis I (PPST) score of 522, with a minimum of 170 for each test (reading, writing, and mathematics.) Some licensure areas may require higher Praxis I scores.

Minimum scores for the basic skills tests may be subject to change. Details regarding the scores, dates and fees for these tests are available online: www.teacher.hs.iastate.edu

3. Documented completion of ISU approved 10 hours of pre-student teaching field experience.

4. All Curriculum and Instruction (C I), Human Development and Family Studies (HD FS) and Special Education (Sp Ed) courses required for licensure have a minimum grade requirement of a C (pedagogy coursework). Courses in the department of the major specifically required for teacher licensure have a minimum grade requirement of a C- (content coursework).

5. A report from a criminal background check initiated by ISU's recommending official.

Requirements for full admission to University Teacher Education as a Master's student:

1. Full admission to an appropriate Master's degree program.

2. Minimum GRE scores (400 on each of the Verbal and Quantitative sections).

3. Documented completion of ISU approved 10 hours of pre-student teaching field experience.

4. All Curriculum and Instruction (C I), Human Development and Family Studies (HD FS) and Special Education (Sp Ed) courses required for licensure have a minimum grade requirement of a C (pedagogy coursework). Courses in the department of the major specifically required for teacher licensure have a minimum grade requirement of a C- (content coursework).

5. A report from a criminal background check initiated by ISU's recommending official.

Students who do not meet the requirements for admission to University Teacher Education may choose to appeal to the University Teacher Education Coordinating Council. The description of the appeals process is available online: www. teacher.hs.iastate.edu.

Maintaining Program Eligibility

Standards Assessments: In order to be recommended for licensure, all students must have demonstrated satisfactory performance across the teacher education competencies, as defined by their specific area. (See the teacher licensure area coordinator for more information.) Students' progress is monitored throughout the program Standards are assessed multiple times. More information is available online: www.teacher.hs.iastate.edu.

GPA: All students admitted to the University Teacher Education Program must maintain a minimum of a 2.5 cumulative grade point average through completion of their licensure requirements.

Grades: For teacher education students, all Curriculum and Instruction (C I), Human Development and Family Studies (HD FS) and Special Education (Sp Ed) courses required for licensure have a minimum grade requirement of a C. Courses in the department of the major specifically required for teacher licensure have a minimum grade requirement of a C-. Note: Individual departments preparing teachers may have higher eligibility requirements (see teacher licensure area coordinator for more information).

Student Teaching (Checkpoint 2)

Student teaching is the culminating experience. To ensure that students are prepared for this experience, the following requirements must be met prior to submitting your "Request for Student Teaching Placement" form:

1. Full admission to University Teacher Education is required a minimum of 1 year before the start of the student teaching semester. Students in accelerated graduate programs must be fully admitted by mid-semester prior to the student teaching semester.

2. Completion of the "'Request for Student Teaching Placement" by the deadline in the fall semester for spring student teaching and by the deadline in the spring semester for fall student teaching. Details regarding this application are available in the University Teacher Education Office.

3. A minimum 2.5 cumulative grade point average.

4. A passing grade as determined by the licensure area must have been earned in all required professional teacher education requirement courses and selected courses in the student's licensure area. All Curriculum and Instruction (C I), Human Development and Family Studies (HD FS) and Special Education (Sp Ed) courses required for licensure have a minimum grade requirement of a C (pedagogy coursework). Courses in the department of the major specifically required for teacher licensure have a minimum grade requirement of a C- (content coursework).

Teacher Licensure (Checkpoint 3)

The Iowa Board of Educational Examiners issues teaching licenses that are valid for specific ages or grades (e.g., Birth-3 for early childhood teachers, K-6 for elementary teachers and 5-12 for secondary teachers). Endorsements on a teaching license indicate which subject areas a teacher is qualified to teach. Completion of student teaching and required coursework does NOT guarantee recommendation for a teaching license. The Iowa License may be recommended for students who hold a bachelor's degree from Iowa State University or another regionally accredited institution and who have completed the following:

1. All requirements of an approved licensure area, including the general education requirement and professional teacher education requirement listed above. Note: Specific courses to be used for licensure may not be taken pass/not pass.

2. Additional requirements as designated by the State of Iowa that include, but are not limited to, a special education component and 50 hours of pre-student teaching field experience, 40 of which are to be taken after admission to the University Teacher Education Program.

3. A minimum ISU cumulative grade point average of 2.50 or higher through graduation (or completion of the University Teacher Education Program). (Some licensure areas may require a higher cumulative grade point average.)

4. A minimum grade of C (not C-) must be earned in student teaching to be recommended for licensure.

5. Documentation from the student teaching supervisor that the student has successfully completed the final assessment documenting the student's mastery of the skills and knowledge included in the Iowa Teaching Standards.

Undergraduate and Post-Bachelor's (non-Master's) Teacher Licensure Area Requirements

Certain competencies are required of those who plan to teach at the early childhood, elementary or secondary level. Those preparing to teach at the secondary level must develop a depth of understanding in one or more subject matter areas. For full-time teaching in secondary schools a major in an endorsement area or an approved subject matter concentration of at least 30 semester hours is required. Students interested in adding an additional endorsement area should consult with the coordinator or adviser of the additional area (see the following website for the contact information for the adviser or coordinator that works with students on teacher licensure: www.teacher.hs.iastate.edu. Persons interested in teaching in one of the following endorsement areas should also consult with the appropriate adviser or coordinator. Specific requirements for each teacher licensure area are described below (these requirements are in addition to the General Education Requirements and the Professional Teacher Education Requirements that were listed earlier).

Agricultural Education

The Department of Agricultural Education and Studies is responsible for preparing Agricultural Education teachers for grades 5-12.

For specific content area requirements see Curriculum in Agricultural Education and Studies (Teacher Certification Option).

Required professional courses are: AgEdS 110A, 211A, 310, 401, 402, 416, 417 (14 Cr.)

Required content courses are: AgEdS 488; Agron 114 and 154; An S 101 and 114; Hort 221; Econ 101, 331; NREM 120; 6 credits in agriculture and life sciences; 6 credits in courses 300-level or above to be chosen from technology systems management, animal science, agronomy, agricultural economics, forestry, or horticulture.

Biology

The Biology Program and the Department of Curriculum and Instruction share the responsibility of preparing Biology teachers for grades 5-12.

Required professional courses are: C I 280M,

C I 347, C I 418, C I 419, C I 468J, C I 468K and C I/LAS 417D

Required content courses are: Biol 211, 211L, 212, 212L, 312, 313, 313L, 314, 314L, 315. Biol 366 or 330, or 454. Biol 335 or BMS 329, Micro 302.

Additional courses to obtain a total of 17 credits at the 300 level or above in a basic biological science. Supporting coursework must include 13 credits in chemistry, 8 in physics, and 6 in mathematics.

Chemistry

The Department of Chemistry and the Department of Curriculum and Instruction share the responsibility of preparing Chemistry teachers for grades 5-12.

Required professional courses are C I 280M, C I 347, C I 418, C I 419, C I 468J, C I 468K, and C I 417B.

Required content courses are: Chem 177, 177L, 178, 178L, 211, 211L, 301, 316, 316L, 324, 325, 321L or 322L, 331, 331L, 332, 332L; Phys 221, 222 or Phys 111, 112; Math 165, 166; a minimum of one course in Biol is required; Biol 211 and 211L are recommended.

Students with an endorsement in a natural science who seek approval to teach chemistry as an additional subject area must earn credits in the following courses (15 minimum credits):

Chem 177, 177L, 178, 178L, 211, 211L, 331, 331L, 332, 332L or Chem 163, 163L, 164, 164L, 211, 211L, 231, 231L.

Students with no natural science endorsement who seek approval to teach chemistry as an additional subject area must complete one of the two sets of courses listed above plus sufficient additional courses to total 24 chemistry credits chosen from:

Chem 316, 316L, 324, 325, 322L or BBMB 301, 311, 451.

Early Childhood Education

The Department of Curriculum and Instruction and the Department of Human Development and Family Studies in the College of Human Sciences share the responsibility for preparing teachers to work with children from birth to age 8 (PK-3 including special education).

For specific course requirements, see College of Human Sciences, Curriculum in Early Childhood Education.

Earth Sciences

The Department of Geological and Atmospheric Sciences and the Department of Curriculum and Instruction share the responsibility of preparing Earth Science teachers for grades.5-12

Required professional courses are: C I 280M, 347, 418, 419, 468J, 468K, C I 417J.

Required content courses are: Geol 100, 100L, 102, 102L, 302, 311, 356, 365, 368 and a three credit geology elective; Mteor 206; Astro 120, 150; Chem 177, 177L, 178, 178L; Phys 111, 112; Math 151 or 160 or 165 or 181; Stat 101 or 104 or Com S 107; and one three credit biology course.

Students with an endorsement in a natural science who seek approval to teach earth sciences as an additional subject area must earn credits in the following courses: Geol 100, 100L, 102, 102L, Mteor 206, Astro 120, Astro 150, and at least 3 credits at the 300-level or higher.

Students with no other natural science endorsement, but who seek endorsement in this area, must take Geol 100, 100L, 102, 102L, Mteor 206, Astro 120, Astro 150, plus any additional credits to produce a total of 24, at least 3 credits at the 300-level or higher. See licensure area coordinator for approval prior to taking courses.

Elementary Education

The Department of Curriculum and Instruction in the College of Human Sciences is responsible for preparing elementary (K-6) teachers.

For specific course requirements, see College of Human Sciences, Curriculum in Curriculum and Instruction. Several endorsements may be added to a K-6 teaching license. See an adviser for the most current list and the necessary additional requirements.

English

The Department of English prepares English teachers for grades 5-12

Required professional courses are: C I 280A, 395; Engl 396, 397, 417, and 494.

Required content courses are: see Curriculum, English.

Students seeking to add English as an additional endorsement area must earn 46 credits in the following courses:

3 Advanced Writing: Engl 302, 303, 304, 305, 306, 309, 314, 315, 316

3 Rhetoric: Engl 310

3 Language: Engl 220

18 Literature: Engl 260; Engl 225; Engl 226; Engl 227; Engl 228; Engl 340's OR Engl 353 OR Engl 354

19 English Education: CI 395; Engl 396; Engl 397 and CI 280a; Engl 494 and CI 280a; SpEd 450

Students must earn grades of C or better in all of the above courses.

Family and Consumer Sciences

The Family and Consumer Sciences Program in the Department of Apparel, Educational Studies and Hospitality Management prepares Family and Consumer Sciences teachers for grades 5-12

For specific content area course requirements, see Curriculum, Family and Consumer Sciences Education and Studies.

Required professional courses are: FCEdS 206, 306, 318, 403, 413, 417A, and 417B.

Required content courses are: HD FS 102; 220 or 221 or 223 or 226; 276, 349, 283, 341 or 483 or 488; FS HN 111 and 167; T C 121 or 131 or 165 or 204; HD FS 239 or T C 342.

Health Education

The Department of Kinesiology prepares Health teachers for grades 5-12.

Required professional courses are: H S 375 and 417.

Required content courses are: Kin 258; H S 105, 110, 215, 305, 310, 350, 390; FS HN 167; HD FS 276, 373 or 377; Biol 255, 255L.

Students seeking approval for health education as an additional endorsement area must earn credits in the following courses: FS HN 167, HD FS 276, H S 110, 215, 305, 310, 350, 375, 390; Biol 255, 255L.

History-Social Sciences

The Curriculum and Instruction Department and the History Department share the responsibility for preparing History-Social Sciences teachers for grades 5-12.

Contact the History Department for specific information.

History-Social Sciences Education students must earn grades of C or better in all content and pedagogical coursework required for teacher licensure.

Mathematics

The Mathematics Department and the Curriculum and Instruction Department share responsibility for the preparation of Mathematics teachers for grades 5-12

For specific content area course requirements, contact Curriculum and Instruction Advising Office. Required professional courses are: CI 219, 280L, 280A, 480C, 497, 417C

Required content courses are: Math 165, 166, 201, 265, 266 or 267, 301, 317, 341, 397, 435, 436, Com S 107 or 207 or 227, and Stat 101.

Students wishing to add mathematics as an additional endorsement area or as a non-mathematics major with a major in one of the mathematical sciences, physical sciences, or engineering seeking a license to teach mathematics must take the following:

Math 165, 166, 201, 301, 317, 341, 397, 435, 436, Com S 107 or 207 or 227, Stat 101 and CI 480C, and 497.

Music

The Music Department prepares Music teachers for grades K-12.

For specific content area course requirements, see Curriculum, in Music.

Required professional courses are: Music 248, 266, 366, 367 or 368 or 490A, 464 or 465, 466, Music/C I 417K and 417L, Music/C I 480K.

Required content courses are: see Curriculum, in Music.

Physical Education

The Kinesiology Department prepares Physical Education teachers for grades K-12.

Kinesiology and Health (instead of Health and Human Performance)

Required professional courses are: KIN 280, 281, 312, 355, 358, 365 or 366, 372, 375, 395, 417, 418, 470, 475.

Required content courses are: see Curriculum, Kinesiology and Health

Physics

The Physics and Astronomy Department and the Curriculum and Instruction Department share the responsibility for preparing Physics teachers for grades 5-12

For specific content area course requirements, see Curriculum, Physics.

Required professional courses are: C I 280M, 347, 418, 419, 468J, 468K, 417B.

Required content courses are: Phys 221, 222, 311T, 399, 321. Select 12 credits from the following: Phys 302, 304, 306, 310, 321, 321L, 322, 322L, 361, 364, 365, 496; Astro 342, 344L, 346; Chem 324, 325, E E 201, 230; E M 274, 345, 378; M E 330, 231.

Students with an endorsement in a natural science who seek approval to teach physics as an additional endorsement area must complete one of the following sets of courses:

Phys 221, 222, 311T, 321, 321L, 399 (2 cr.),

OR Phys 111, 112, 302, 311T, 399 (2 cr.)

Students with no other natural science endorsement who seek approval to teach physics as an additional endorsement area must complete one of the two sets of courses listed above plus sufficient additional credits from the following list of courses to total 24 credits:

Phys 221, 222, 302, 304, 306, 310, 321, 321L, 322, 322L; Astro 342, 344L, 346; Chem 321, 324, 325; E E 441; E M 274, 345, 378; M E 330, 332.

Physical Science

The Department of Physics and Astronomy and the Department of Curriculum and Instruction share the responsibility for preparing Physical Science teachers for grades 5-12

Required professional courses are: C I 280M, 347, 418, 419, 468J, 468K, 417B.

Required content courses are: Phys 111, 112 or Phys 221, 222; Chem 163, 163L, 231, 231L; Astro 120, 150 or 342, 346; Geol 100, 100L; Mteor 206; Math 151 or 160 or 165 or 181; one course in biology; one additional course numbered 300 and above in astronomy and astrophysics, chemistry, meteorology, physics, or geology.

Students with an endorsement in a natural science who seek approval to teach physical science as an additional area must earn credits in the courses listed below. Students with no other science endorsement, but who seek an additional endorsement in this area, must take the listed courses plus additional credits in the area to total at least 24. See coordinator for approval prior to taking additional courses.

Astro 120 or 150 or 342 or 346
Chem 163, 163L
Geol 100, 100L
Mteor 206
Phys 111, 112; or 221, 222

World Languages and Cultures

The Department of World Languages and Cultures prepares World Language teachers for grades 5-12

World Language teachers can earn an endorsement in French, German, Latin, Russian or Spanish.

For specific content area course requirements, see Curriculum, World Languages and Cultures.

Required professional courses are: C I 280L, WLC/C I 480, WLC 417 and WLC 487.

Students seeking approval to teach a world language as their first endorsement must have a major in the target language. For an additional endorsement in a world language, students must earn 25 credits in that language. Nine (9) credits must be at the 300 level or above with six (6) of these credits in composition and conversation. Courses at the 100 level are not counted in the 25 required credits. For an endorsement in Latin, 10 of the 25 credits must be at the 300 or 400 level and must include Hist 430 (Cl St 403). All students seeking to teach a world language must demonstrate their proficiency in the language by taking the ACTFL OPI (Oral Proficiency Interview). Students are responsible for the cost of the administration of the OPI and must request that their scores from the OPI be added to their transcript.

Requirements for Additional Endorsements

Students may elect to add additional endorsements to their teaching license by completing the necessary requirements. All "Undergraduate Teacher Licensure Areas" listed above can be pursued as an additional endorsement. Below are the additional endorsements only options that require students to pursue one of the undergraduate, post-bachelor's or graduate teacher licensure areas listed above. Detailed requirements for any endorsement may be obtained from the University Teacher Education Office.

Art (grades K-8)

Students seeking an additional endorsement in Art (K-8) should see an adviser in the Department of Curriculum and Instruction.

Basic Science (grades K-8)

Students seeking an additional endorsement in Basic Science (K-8) should see an adviser in the Department of Curriculum and Instruction.

Coaching Interscholastic Athletics (grades K-12)

The Department Kinesiology offers courses that can lead to a K-12 athletic coach endorsement.

Students seeking approval for the Iowa State University endorsement to coach interscholastic athletics must satisfy the requirements of an endorsement area listed above and earn credits in the following:

Biol 155, Psych 230, KIN 220, and KIN 315

English and Language Arts (grades K-8)

Students seeking an additional endorsement in English and Language Arts (K-8) should see an adviser in the Department of Curriculum and Instruction.

English as a Second Language (grades K-12)

The Department of English offers courses that can lead to a K-12 ESL Teacher endorsement.

To add a K-12 teaching endorsement in English as a Second Language, students must fulfill the requirements of an endorsement area listed above and earn credits in the following courses. In some cases, relevant special topics courses or experimental courses may be substituted. Some courses have prerequisites.

Engl/Ling 219 or Engl/Ling 511
Engl/Ling 220
Engl/Ling 425 or Engl/Ling 517
Engl/Ling 514 or C I 420/520
Engl/Ling 518 or Engl/Ling 524 and Engl/Ling 525
Engl/Ling 588

General Science (grades 5-12)

General Science is an interdepartmental additional area of endorsement for grades 5-12

Students seeking approval to teach general science must earn credits in the following courses:

Biol 211, 211L, 212, 212L
Chem 177, 177L, 178, 178L, 231, 231L
Geol 100, 100L
Phys 111, 112; or 221, 222
Math 151 or 160 or 165 or 181

At least 6 credits from courses numbered 300 or above in astronomy and astrophysics, biochemistry and biophysics, biology, botany, chemistry, genetics, geology, meteorology, microbiology, or physics.

Health (grades K-8)

Students seeking an additional endorsement in Health (K-8) should see an adviser in the Department of Curriculum and Instruction.

History (grades K-8)

Students seeking an additional endorsement in History (K-8) should see an adviser in the Department of Curriculum and Instruction.

Mathematics (grades K-8)

Students seeking an additional endorsement in mathematics (K-8) should see an adviser in the Department of Curriculum and Instruction.

Middle School (grades 5-8)

Students seeking an additional endorsement in Middle School (5-8) should see an adviser in the Department of Curriculum and Instruction.

Reading (grades K-8, 5-12)

The Curriculum and Instruction Department offers courses that can lead to a reading endorsement for grades K-8. This department collaborates with the English Department to offer the necessary coursework for a 5-12 reading endorsement.

Students seeking an additional endorsement to teach elementary reading (K-8) should see a Department of Curriculum and Instruction.adviser.

Students seeking endorsement to teach reading (5-12) as an additional endorsement must earn credits in the following courses:

Foundations of Reading and Reading in the Content Area: C I 395/595 or CI 551 and C I/Engl 494.

Practicum: C I 488/588

Language Development: Engl 219 or 511

Reading Assessment and Oral Communication: C I 452/552

Written Communication: C I 395/595 and Engl 397

Adolescent Nonfiction and Fiction: Engl 396 or C I 554

Reading Instructional Strategies: C I 456/556 or 553

Social Sciences (grades K-8)

Students seeking an additional endorsement in Social Sciences (K-8) should see an adviser in the Department of Curriculum and Instruction

Special Education (grades K-8, 5-12, K-12)

The Department of Curriculum and Instruction offers courses that can lead to special education endorsements (Instructional Strategist I: Mild/Moderate Disabilities (grades K-8 and grades 5-12) and Instructional Strategist II: Behavior Disorders/Learning Disabilities (K-12)). Students seeking 5-12 special education endorsement must have a current teaching license.

Students seeking an additional K-8 endorsement to teach special education should see an adviser in the Department of Curriculum and Instruction.

Speech Communication (grades 5-12)

The Department of Speech Communication offers courses that can lead to 5-12 speech/theatre endorsement.

Students seeking endorsement to teach speech as an additional area must earn credits in the following courses:

Sp Cm 110 or ComSt 102, Sp Cm 212, 313, 322, 412, 495A, 495B;

Thtre 255 or 360 or 455; Thtre 358; JI MC 101.

World Languages and Cultures (French, German, Latin, Russian, and Spanish) (grades K-8)

Students seeking an additional endorsement World Languages and Cultures (K-8) should see an adviser in the Department of Curriculum and Instruction.

Master's Programs that Lead to Initial Teacher Licensure

Agricultural Education

The Agricultural Education and Studies Department offers a Master's of Science program that prepares Agricultural Education teachers for grades 5-12

See coordinator for program requirements.

Mathematics

The Curriculum and Instruction Department offers a Master's of Education program that prepares Mathematics teachers for grades 5-12

See coordinator for program requirements.

Physical Education

The Department of Kinesiology offers a Master's of Science program that prepares Physical Education teachers for grades K-12.

See coordinator for program requirements.

Secondary Sciences

The Department of Curriculum and Instruction offers a Master's of Arts in Teaching program that prepares Secondary Science teachers for grades 5-12

See coordinator for program requirements.

Technology and Social Change

Advisory Committee: Eric Abbott, coordinator; Robert Mazur, graduate coordinator.

Undergraduate Study

Technology and social change is a cross-disciplinary program examining the relationships between technologies and the social and cultural environments. The program has a national and international perspective, with courses addressing the interrelationships, policies, and impacts created by the international exchange of technologies. Through T SC, students will better understand the institutional and sociocultural consequences of technological change from differing perspectives and will become sensitive to the issues attending the use of technology to improve people's lives. Work in the program can also serve as preparation for advanced study in this field.

The program requirement for a minor in technology and social change is a minimum of 15 credits. One of the courses must be T SC 341. An additional 3 credits must be taken from T SC cross-listed courses. The remaining 9 may be selected from T SC cross-listed courses or from the list of T SC approved courses. At least 9 of the 15 credits must be in courses numbered 300 or above. Because technology and social change is an interdisciplinary study, minor programs must include coursework in at least two departments. Students seeking a minor should develop a specific program of courses either with the T SC faculty representative in their department or with the T SC coordinator. The student's minor program must be approved by the T SC program coordinator.

T SC courses are listed below. The list of T SC approved courses is available from the program coordinators. Through the program coordinator, students may petition for approval of courses not on the approved list that address matters relevant to technology and social change.

Graduate Study

The graduate minor in technology and social change is a cross-disciplinary program that enables students to study the interactions between technologies and their users, on both societal and individual levels. The minor strengthens the ability of students to apply differing perspectives in understanding the effects of the global exchange of technologies and to heighten their sensitivity to the institutional and sociocultural issues attending the use of technology to improve people's lives.

Students choosing to minor in technology and social change will pursue a degree program in the major department. In consultation with their major professor, students are to identify a T SC Faculty member to serve on the committee guiding their program of study. This T SC Faculty member must be on the Graduate faculty and must be from a discipline outside the major field of study. With the agreement of the POS committee, the student declaring a minor in T SC will select a group of courses from the list of T SC approved courses available through the program coordinators. For the master's degree, this group should be at least 9 credits; for a doctoral degree, the group should be at least 15 credits. In either case, T SC 543 is required. Students may not include in their minor any courses from their own major. All programs of study that include a T SC minor must be approved by the T SC Program coordinator.

Courses primarily for undergraduate students

T SC 341. Technology: International, Social, and Human Issues. (3-0) Cr. 3. F. *Prereq: Junior classification.* An interdisciplinary study of the international significance of technology and of the societal and human issues attending its development and adoption.

T SC 342. World Food Issues: Past and Present. (Cross-listed with Agron, Env S FS HN). (3-0) Cr. 3. F.S. *Prereq: Junior classification.* Zdorkowski, Ford. Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects. Nonmajor graduate credit.
H. Honors Section. (Honors Program students only.)

T SC 343. Philosophy of Technology. (Cross-listed with Phil). (3-0) Cr. 3. F.S. *Prereq: 6 credits of social science or T SC 341 and 3 credits of social science.* Moral and other philosophical problems related to developments in technology. Topics may include conditions under which technological innovations contribute to human emancipation, relationship of technology and democracy, utility and limits of technical rationality, and problems of ensuring that benefits of technological advance are communally shared. Topics discussed with reference to such issues as contemporary developments in microelectronics, technology transfer to the Third World, etc. Nonmajor graduate credit.

T SC 474. Communication Technology and Social Change. (Cross-listed with JI MC). (3-0) Cr. 3. *Prereq: Junior classification.* Examination of historical and current communication technologies, including how they shape and are shaped by the cultural and social practices into which they are introduced.

T SC 490. Independent Study. Cr. arr. Repeatable. *Prereq: 341, permission of instructor and of T SC coordinator.*

Courses primarily for graduate students, open to qualified undergraduate students

T SC 543. Technological Innovation, Social Change, and Development. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in social sciences.* Sources, theories and models of technological innovation; social and institutional contexts of technology transfer; appropriate/intermediate technology; issues and methods of impact assessment; planning technology related social change; democratic control of technological innovations and application; local and international case studies.

T SC 574. Communication Technologies and Social Change. (Cross-listed with JI MC). (3-0) Cr. 3. *Prereq: 6 credits in social science.* Personal, organizational, and social implications of the use of communication technologies. Includes theories and empirical research across the continuum of perspectives, from techno-utopianism through an anti-technology stance.

T SC 590. Special Topics: Technology and Social Change. Cr. arr. *Prereq: 541, permission of instructor and of T SC coordinator.* Individual study of topics concerning global and local implications of technological change.

Technology Systems Management

(Administered by the Department of Agricultural and Biosystems Engineering)

Rameshwar Kanwar, Chair of Department

Distinguished Professor: Brown

Distinguished Professor (Emeritus): H. Johnson

University Professor: Bern

University Professors (Emeritus): Baker

Professors: Chen, Downing, Glanville, Harmon, Hoff, Hurburgh, L. Johnson, Kanwar, Misra, Schwab, Van Leeuwen, Xin

Professors (Emeritus): Beer, Bekkum, Buchele, Bundy, Hazen, Hoerner, Keeney, Lovely, Maney, Mangold, Marley, Melvin, Miller, Pedersen, Riley, R. Smith

Professor (Collaborator): Laflen

Associate Professors: Anex, Bhandari, Birrell, Brumm, Burns, Freeman, Koziel, Mickelson, Raman, Steward, Tim

Associate Professors (Emeritus): Anderson, Greiner, Lorimor

Associate Professor (Collaborator): Han

Assistant Professors: , Grewell, Helmers, Kaleita-Forbes, Keren, Kim, Soupir, Tang, Yu

Assistant Professors (Emeritus): Boyd, Bradshaw

Assistant Professors (Adjunct): Inyang, Shahan, Tong

Assistant Professors (Collaborators): Dunn, Malone

Lecturer: Snell

Undergraduate Study

The Department of Agricultural and Biosystems Engineering offers work for the bachelor of science degree with majors in agricultural systems technology and industrial technology, (see *College of Agriculture, Curricula*).

Missions: The mission of the Agricultural Systems Technology program is to prepare women and men for careers that integrate and apply agricultural and biosystems engineering technology to manage human and natural resource systems for producing, processing, and marketing food and other biological products worldwide.

The mission of the Industrial Technology is to prepare women and men for careers that integrate and apply industrial technology to lead and manage human, manufacturing, and safety systems.

Objectives: At two to five years after undergraduate graduation, through the professional practice in technology, graduates should:
1. Have demonstrated competence in methods of analysis involving use of mathematics, fundamental physical and biological sciences, technology, and computation needed for the professional practice in the field of agricultural systems technology or industrial technology.

2. Have developed skills necessary to contribute to the design process; including the abilities to think creatively, to formulate problem statements, to communicate effectively, to synthesize information, and to evaluate and implement problem solutions.
3. Be capable of addressing issues of ethics, safety, professionalism, cultural diversity, globalization, environmental impact, and social and economic impact in professional practice.
4. Have demonstrated continuous professional and technical growth, with practical experience, so as to be licensed in their field or achieve that level of expertise, as applicable.
5. Have demonstrated the ability to:

a. be a successful leader of multi-disciplinary teams.
b. efficiently manage multiple simultaneous projects.
c. work collaboratively.
d. implement multi-disciplinary systems-based solutions.
e. to apply innovative solutions to problems through the use of new methods or technologies.
f. contribute to the business success of their employer, and
g. build community.

Outcomes: At the time of graduation, students of the Agricultural Systems Technology or Industrial Technology programs should have:

a) an ability to apply knowledge of mathematics, science, technology, and applied sciences;
b) an ability to design and conduct experiments, as well as to analyze and interpret data;
c) an ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
d) an ability to function on multi-disciplinary teams;
f) an understanding of professional and ethical responsibility;
g) an ability to communicate effectively;
h) the broad education necessary to understand the impact of solutions in a global, economic, environmental, and societal context;
i) a recognition of the need for, and an ability to engage in life-long learning;
j) a knowledge of contemporary issues; and
k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.

Graduates have developed and demonstrated workplace competencies, and have completed a professional internship. They are able to communicate effectively, have problem-solving skills and awareness of global, economic, environmental and societal issues.

Agricultural Systems Technology graduates have the ability to apply science and technology to problems related to agriculture; they manage complex agricultural systems for sustainability. They find careers within a variety of agriculturally-related industries, businesses, and organizations, including: agricultural machinery, environment, government, farm builders, grain, feed, seed, fertilizer, chemical, food, biorenewable resources, and production agriculture.

Industrial Technology graduates understand commonly-used manufacturing processes, lean manufacturing principles, continuous improvement, quality management, safety, regulatory issues affecting manufacturing, and the properties of manufacturing materials. They find careers within a variety of industries, businesses, and organizations focusing in manufacturing (e.g., quality control, production supervision, and process and facility planning) or occupational safety (e.g., development, management, and evaluation of safety programs and systems; and hazard identification and mitigation).

Certificate: The Department of Agricultural and Biosystems Engineering offers a undergraduate certificate in occupational safety which may be earned by completing a minimum of 20 credits of technology systems management courses, which includes TSM 27, 272,370, 372, 470, and 493D, plus an additional 6 credits from a departmentally approved list.

Minors: The Department of Agricultural and Biosystems Engineering offers a minor in agricultural systems technology which may be earned by completing a minimum of 15 credits of technology systems management courses, which includes TSM 115 and 210, plus an additional 9 credits from a departmentally approved list.

The Department of Agricultural and Biosystems Engineering also offers a minor in industrial technology which may be earned by completing a minimum of 18 credits of technology systems management courses, which includes TSM 115 and 210, plus an additional 12 credits from a departmentally approved list.

For the undergraduate curriculum in agricultural systems technology leading to the degree of bachelor of science or for the undergraduate curriculum in industrial technology leading to the degree of bachelor of science, see *College of Agriculture, Curricula*.

The department also offers an undergraduate curricula and courses in agricultural engineering, biological systems engineering, see *College of Engineering, Curricula*.

Graduate Study

The department offers work for the degrees master of science, and doctor of philosophy with a major in industrial and agricultural technology. It cooperates in the interdepartmental programs in professional agriculture, sustainable agriculture, environmental sciences, biorenewable resources and technology, and human computer interaction.

The master's program prepares advanced practicing professionals for industrial and/or agricultural technology positions in industry, business, and public service; it also provides a sound foundation for further graduate study. The doctoral program prepares exemplary industrial and/or agricultural technology professionals for learning, discovery, engagement, and leadership roles in education, industry, business, and public service organizations.

The department also offers work for the degrees master of science, master of engineering, and doctor of philosophy with a major in agricultural engineering. See *College of Engineering, Curricula*.

Visit our departmental website at www.abe.iastate.edu.

Courses primarily for undergraduate students.

TSM 110. Introduction to Technology. (1-0) Cr. 1. F. *Prereq: AST and I Tec majors only or permission of instructor.* Team-oriented introduction to agricultural systems technology and industrial technology. Report writing, internships, careers, competencies, academic success strategies, industry visits, transition to academic life.

TSM 111. Experiencing Technology. (0-2) Cr. 1. S. *Prereq: AST or I Tec majors only or permission of instructor.* Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of technology. Report writing, internships, competencies, portfolios, industry visits.

TSM 112. Orientation to Learning and Productive Team Membership. (Cross-listed with Aer E, FS HN, Hort, NREM). (2-0) Cr. 2. F. Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

TSM 114. Developing Responsible Learners and Effective Leaders. (Cross-listed with FS HN, Hort, NREM). (2-0) Cr. 2. S. Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

TSM 115. Solving Technology Problems. (2-2) Cr. 3. F.S. *Prereq: Math 140 or higher (can be taken concurrently).* Solving technology problems and presenting solutions through technical reports. Unit conversions, unit factor method, SI units, significant digits, graphing and curve fitting. Use of spreadsheet programs to solve and present technology problems. Solution of technology problems using computer programming languages.

TSM 116. Introduction to Design in Technology. (2-2) Cr. 3. F.S. 2D projections and 3D representations of objects, national and international standards for documentation, manufacturing processes, design projects, and teamwork. Free-hand sketching techniques and parametric solid modeling will be covered.

TSM 201. Entrepreneurship and Internship Seminar. (Cross-listed with A E, BSE). (1-0) Cr. 1. F.S. *Prereq: Sophomore classification in AE, AST, or I Tec.* 8 week course. Overview of the entrepreneurial process and its importance in the economy and the engineering/ technical workplace. Preparation for internship experiences. Relationship of workplace competencies to entrepreneurship, intrapreneurship, and internships; portfolios.

TSM 210. Fundamentals of Technology. (3-0) Cr. 3. F.S. *Prereq: 115 (may be taken concurrently) or equivalent, Math 140 or higher.* Introduction to problem solving related to fundamental agricultural and/or industrial technology systems. Basic laws of energy, force, and mass applied to technology systems such as: mechanical power transmission; equipment calibration; environmental and natural resources; heating, ventilation and air conditioning; electrical circuits. Using the time value of money to make economic decisions.

TSM 216. Advanced Technical Graphics, Interpretation, and CAD. (2-2) Cr. 3. F.S. *Prereq: 116.* Advanced design systems incorporating 2D and 3D design and productivity tools for use in manufacturing settings. Topics include: Geometric Dimensioning and Tolerancing, 3D models, welding symbols, advanced visualization, design modeling of parts and assemblies, feature based design. Use of AutoCAD and parametric modeling software.

TSM 240. Introduction to Manufacturing Processes. (1-4) Cr. 3. F. A study of selected materials and related processes used in manufacturing. Lecture and laboratory activities focus on materials, properties, and processes. This includes plastics and metals.

TSM 270. Principles of Injury Prevention. (3-0) Cr. 3. F. Basic foundations of injury causation and prevention in home, motor vehicle, public, and work environments.

TSM 272. Occupational Safety Management. (2-0) Cr. 2. F. Introduction to occupational safety and health administration and management. Focus on development and management of safety programs and obtaining employee involvement in occupational safety programs.

TSM 276. Fire Protection and Prevention. (3-0) Cr. 3. F. An overview of the current problems and technology in the fields of fire protection and fire prevention, with emphasis on industrial needs, focusing on the individual with industrial safety responsibilities.

TSM 301. Leadership and Ethics Seminar. (Cross-listed with A E, BSE). (1-0) Cr. 1. F.S. *Prereq: 201.* 8 week course. Leadership and ethics experiences through case studies and seminar presentations by practitioners. Relationship of workplace competencies to leadership and ethics; portfolios.

TSM 310. Total Quality Improvement. (3-0) Cr. 3. S. *Prereq: Stat 101 or 104, junior classification.* Introduction to the fundamental concepts of TQM - Deming style of management, statistical studies to understand the behavior of products, processes, or services, and how to define and document processes and customer focus. Introduction to continuous improvement tools and methods - DMAIC, SPC, and Design of experiments; emphasis on team work and problem solving skills.

TSM 322. Preservation of Grain Quality. (2-3) Cr. 3. S. *Prereq: Math 140 or higher.* Principles and management for grain quality preservation. Grain drying and storage. Fans and airflow through grain. Grain handling methods and system planning. Grain quality measurement and end-use value analysis.

TSM 324. Soil and Water Conservation Management. (2-3) Cr. 3. S. *Prereq: Math 140 or 160.* Introduction to engineering and conservation principles applied to the planning of erosion control systems, water control structures, water quality management, and drainage and irrigation systems.

TSM 325. Biorenewable Systems. (Cross-listed with A E, Agron, An S, BusAd, Econ). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing.

TSM 327. Animal Production Systems. (3-0) Cr. 3. F. *Prereq: 210.* Confined animal feeding operations. Environmental controls for animal production. Response of animals to the environment. Heat and moisture balance in animal housing. Ventilation, water, feed handling, air pollution, odor and waste management systems.

TSM 330. Agricultural Machinery and Power Management. (2-3) Cr. 3. F.S. *Prereq: 210, Math 142 or 160.* Selection, sizing, and operational principles of tractors and machinery systems. Cost analysis and computer techniques applied to planning and management of agricultural machine systems. Principles, operation, and application of agricultural machinery.

TSM 333. Precision Farming Systems. (2-2) Cr. 3. F. *Prereq: Math 140 or 160, junior or senior classification.* Geographic information systems and global positioning systems. Sampling strategies for precision farming. Building prescriptions and recommendations. Systems for precision farming, equipment, software uses, legal and social issues, and economics. Only one of TSM 333 and 433 may count toward graduation.

TSM 335. Tractor Power. (3-3) Cr. 4. F. *Prereq: 210, Math 142.* Theory and construction of tractor engines, mechanical power trains and hydraulic systems. Introduction to traction, chassis mechanics, and hydraulic power.

TSM 337. Fluid Power Systems Technology. (2-2) Cr. 3. S. *Prereq: 210.* Fundamental fluid power principles. Fluid properties. Function and performance of components such as pumps, valves, actuators, hydrostatic transmission and continuously variable transmissions. Basic analysis of fluid power systems. Introduction to electrohydraulics.

TSM 340. Advanced Automated Manufacturing Processes. (2-2) Cr. 3. F. *Prereq: 216, 240.* NC programming operations for CNC mills and lathes. Transfer of parts descriptions into detailed process plans, tool selection, and NC codes. Computer assisted CAD/CAM NC programming for 2D/3D machining.

TSM 363. Electric Power and Electronics for Agriculture and Industry. (3-3) Cr. 4. F. *Prereq: 210, Physics 112.* Basic electricity. Electrical safety, wiring, 3-phase service, controls, and motors for agricultural and industrial applications. Planning building electrical systems. Electronics to sense, monitor, and control mechanical processes: semiconductors, digital logic circuits; speed, pressure, position, temperature, and moisture sensors. Nonmajor graduate credit.

TSM 370. Occupational Safety. (3-0) Cr. 3. S. *Prereq: 270, junior standing.* Identifies safety and health risks in industrial work environments. Focus on how managers and supervisors meet their responsibilities for providing a safe workplace for their employees. Includes the identification and remediation of workplace hazards. Nonmajor graduate credit.

TSM 372. Legal Aspects of Occupational Safety and Health. (2-0) Cr. 2. F. *Prereq: 272.* Legal implications of legislation as it applies to health and safety in the workplace. Includes OSHA regulations, worker's compensation, and workplace liability.

TSM 397. Internship in Technology. Cr. R. F.S.SS. *Prereq: At least 45 credits of coursework, in AST or I Tec major, and approval of internship coordinator.* A supervised work experience in an approved learning setting with application to technology practices and principles. Reporting during work experience and self and employer evaluation required. Minimum GPA requirement.

TSM 399. Work Experience in Technology. Cr. 2. Repeatable. F.S.SS. *Prereq: 397 and approval of instructor.* Written reports and reflection on work experience. A maximum of 4 credits of TSM 399 maybe be used toward the total credits required for graduation.

TSM 401. Professionalism Seminar. (Cross-listed with A E, BSE). (1-0) Cr. 1. F.S. *Prereq: 301.* 8 week course. Examination of professionalism in the context of engineering and technology. Time, project and personnel management. Communications and professional portfolios. Professional licensure. Transition to professional careers.

TSM 408. Interdisciplinary Problem Solving. (Cross-listed with I E, E E). (3-0) Cr. 3. F.S. *Prereq: Junior or senior classification.* Use of the Theory of Constraints as a way of approaching problem solving, win-win negotiation, project planning and effective delegation in the context of engineering/business systems. Team projects aimed at improving design outcomes. Nonmajor graduate credit.

TSM 409. Interdisciplinary Systems Effectiveness. (Cross-listed with I E, E E). (3-0) Cr. 3. F.SS. *Prereq: Junior or senior classification.* Focus on functions that determine the effectiveness of an entire organization. Generic Theory of Constraints solutions to production, distribution, and project management are compared to traditional solutions. Strategy for improvements discovered using simulations. Nonmajor graduate credit.

TSM 415. Technology Capstone I. (1-2) Cr. 2. F.S. *Prereq: senior classification.* Team development, communications, and responsibilities. Identification of current technological problems in agricultural and industrial systems. Development of alternate solutions using creativity, critical analysis, and planning techniques.

TSM 416. Technology Capstone II. (1-2) Cr. 2. F.S. *Prereq: 415.* Selection of promising potential solutions to technology problems identified in 415 for development and analysis by student teams. Presentation of project through oral presentations, written reports, and working prototypes.

TSM 424. Impacts of Agriculture on Water Quality. (3-0) Cr. 3. F. *Prereq: Math 140 or 160, one of the following: 324, Agron 154.* Water use and water quality standards; characteristics of surface and groundwater resources; types of agricultural water pollutants and their impacts on water quality; how agricultural pollutants move and enter water resources; management practices to reduce ag pollutant movement and protect water resources. Nonmajor graduate credit.

TSM 433. Precision Farming Systems Advanced Concepts and Applications. (3-0) Cr. 3. F. *Prereq: Math 140 or equivalent, admission to Master of Agriculture program.* Technologies for precision resource management. Geospatial information technologies for precision agriculture (geographic information systems, global positioning systems, remote sensing systems). Sensing and sampling strategies in precision agriculture. Building input recommendations. Systems for precision agriculture, equipment, software uses, legal and social issues, and production economics. Advanced concepts and the future of precision agriculture. Only one of TSM 333 and 433 may count toward graduation. Nonmajor graduate credit.

TSM 440. Cellular Lean Manufacturing Systems. (2-2) Cr. 3. F.S. *Prereq: 310, 340.* Reviews principles and concepts required for cellular manufacturing system design to meet customer demand in production, quality, on-time delivery, and continuously reducing manufacturing cost. Emphasis on applying lean manufacturing principles, simulation techniques, and Kaizen methodologies with hands-on projects.

TSM 443. Statics and Strength of Materials for Technology. (2-2) Cr. 3. F. *Prereq: AE 271 or 272; Phys 111.* Application of standard analytic and computer based techniques of solving problems related to force and moments. The properties of materials and how to select appropriate materials for a particular design is reviewed.

TSM 444. Facility Planning. (3-0) Cr. 3. F. *Prereq: 216 and 240; Stat 101 or 104.* Principles and practices in designing, evaluating, and organizing existing facilities or creating new facilities. Emphasis on AutoCAD-based new facility design project - product design, production flow analysis, activity relationship analysis, layout deployment, materials handling, office and other service requirement design, and the necessary cost analysis for the new facility.

TSM 445. Polymer and Composite Processing. (2-2) Cr. 3. S. *Prereq: 240 or equivalent.* Design and production of plastic parts including thermoplastics and thermoset/composites. A study of plastic properties and their relationships to processing parameters and control techniques. Applying advanced CAE technology to check process feasibility, determine optimal process conditions, evaluate part and mold designs, and estimate the cost of plastic injection processes.

TSM 465. Automation Systems. (2-2) Cr. 3. S. *Prereq: 363.* Theory and applications of automation systems. Emphasizes features, capabilities, design and programming skills of Programmable Logic Controller (PLC) based industrial control systems. Introduction to industrial robots and sensors.

TSM 470. Industrial Hygiene: Physical, Chemical, and Biological Hazards. (3-0) Cr. 3. S. *Prereq: 272; Math 160 or higher.* A qualitative and quantitative introduction to health effects of chemical, biological, and physical hazards in a workplace. Nonmajor graduate credit.

TSM 471. Safety Laboratory. (0-2) Cr. 1. S. *Prereq: 470 (can be taken concurrently).* Introduction to equipment, methods, and strategies to measure, evaluate, control, and research hazards and risk in the workplaces.

TSM 477. System Safety Analysis. (Dual-listed with 577). (3-0) Cr. 3. F. *Prereq: Math 160, Stat 101 or 104.* System safety focuses on developing a safety oriented pattern of thinking that is appropriate for today's complex systems. The tools that will be gained in this course will be helpful in recognizing, understanding, and analyzing hazards and risks in modern complex systems.

TSM 481. Conversion of Lignocellulosic Materials. (Cross-listed with FOR). (2-3) Cr. 3. F. *Prereq: For 280 or TSM 210 or A E 215 or equivalent.* Conversion of Lignocellulosic Materials. (Cross-listed with TSM.) (2-3) Cr. 3. F. Prereq: 280 or TSM 210 or A E 216 or equivalent. Chemical properties of lignocellulosic materials. Wood chemistry. Various conversion processes. Pulp and paper technology. Biobased products. Other fiber products. Cellulose derivatives. Term paper and/or student project required for graduate level. Nonmajor graduate credit.

TSM 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department.* A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.
H. Honors
I. Manufacturing
J. Agriculture and Biosystems Management
M. Machine Systems
O. Occupational Safety

TSM 491. Seed Science Internship Experience. (Cross-listed with Agron, Hort). Cr. arr. Repeatable. F.S.SS. *Prereq: Agron 338, advanced approval and participation of employer and instructor.* A professional work experience and creative project for seed science secondary majors. The project requires prior approval and participation of the employer and instructor. The student must submit a written report.

TSM 493. Workshop in Technology. Cr. arr. Repeatable. Offered as demand warrants.
A. Agriculture and Biosystems Management
B. Machine Systems
C. Manufacturing
D. Occupational Safety

Courses primarily for graduate students, open to qualified undergraduate students

TSM 540. Advanced Design and Manufacturing. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Application of six sigma philosophy to advance product design and process control. Application of value steam mapping to the existing manufacturing system to develop future continuous improvement plans. Application of Taguchi Parameter design methodologies for optimizing the performance of manufacturing processes. Application of Taguchi Tolerance Design methodologies for product design.

TSM 541. Comprehensive Modern Manufacturing Systems. (3-0) Cr. 3. SS. *Prereq: Permission of instructor.* The study, design, and implementation of PULL manufacturing systems and their integration with functions of the production system for the manufacture of superior quality, low cost products. Topics include lean manufacturing system design, cost estimation/justification, JIT manufacturing, integrated quality and process control, automation, and CAD/CAM.

TSM 545. Manufacturability of Plastics. (2-2) Cr. 3. *Prereq: Permission of instructor.* Overview of current business environment and issues related to design for manufacturability of plastic products. Provide understanding of available materials and processes in manufacturing plastic parts. Utilize injection molding for an in-depth study of five elements for making successful plastic products; consumer input, part design, mold design, material selection, and manufacturing process. Computer-aided engineering exercises and laboratory practices included.

TSM 575. Safety and Public Health Issues in Modern Society. (2-0) Cr. 2. Exploration and analysis of current safety and public health issues impacting society. The focus will be on topics that impact individuals in work, public, and home environments.

TSM 577. System Safety Analysis. (Dual-listed with 477). (3-0) Cr. 3. F. *Prereq: Math 160, Stat 101 or 104.* System safety focuses on developing a safety oriented pattern of thinking that is appropriate for today's complex systems. The tools that will be gained in this course will be helpful in recognizing, understanding, and analyzing hazards and risks in modern complex systems.

TSM 590. Special Topics in Technology. Cr. arr. Repeatable. *Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor.*
A. Agriculture and Biosystems Management
B. Machine Systems

C. Manufacturing
D. Occupational Safety

TSM 593. Workshop in Technology. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

TSM 598. Technical Communications for a Master's Degree. (Cross-listed with A E). Cr. 1. F.S.SS. A technical paper draft based on the M.S. thesis or creative component is required of all master's students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on M.S. thesis or creative component is required of all master's students. This presentation must be in a form that satisfies the normal presentation requirements of a professional society. The presentation itself (oral or poster) may be made at a professional society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Satisfactory-fail only.

TSM 599. Creative Component. Cr. arr. Repeatable. A discipline-related problem to be identified and completed under the direction of the program adviser. Three credits required for all nonthesis master's degree students.

Courses for graduate students

TSM 601. Graduate Seminar. (Cross-listed with A E). (1-0) Cr. 1. F. Keys to writing a good MS thesis or PhD dissertation. How to begin formulating research problems. Discussion of research problems, review of literature, research hypothesis, objectives, methods, procedures, and reports. Research grant proposals, patents and intellectual property rights, and international research centers of excellence will be discussed.

TSM 652. Program and Learner Evaluation. (3-0) Cr. 3. *Prereq: Stat 401 or equivalent.* Techniques for evaluating learners, facilities, programs, and staff utilizing theories for developing measurement instruments. Outcomes assessment is emphasized.

TSM 655. Academic Leadership in Technology and Engineering. (3-0) Cr. 3. *Prereq: Permission of instructor.* A definition of the faculty role in technology and engineering disciplines, including strategies for dealing with programs, personnel, and constituencies are presented. Leadership skills involving team formation, team operation, and conflict resolution are addressed.

TSM 657. Curriculum Development in Technology and Engineering. (3-0) Cr. 3. *Prereq: Permission of instructor.* Basic concepts, trends, practices, and factors influencing curriculum development, techniques, organization and procedures. Emphasis will be given to program and course development.

TSM 694. Teaching Practicum. (Cross-listed with A E). Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification and permission of instructor.* Graduate student experience in the agricultural and biosystems engineering departmental teaching program.

TSM 697. Internship in Technology. Cr. R. *Prereq: permission of major professor and approval by department chair, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

TSM 698. Technical Communications for a Doctoral Degree. (Cross-listed with A E). Cr. 1. F.S.SS. A technical paper draft based on the dissertation is required of all Ph.D. students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on the dissertation is required of all Ph.D. students. This presentation must be in a form that satisfies the normal presentation requirements of a professional society. The presentation itself (oral or poster) may be made at a professional society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Satisfactory-fail only.

TSM 699. Research. Cr. arr.

TSM 698. Technical Paper for a Doctoral Degree. (Cross-listed with A E). Cr. 1. F.S.SS. A technical paper draft based on dissertation is required of all Ph.D. students. This paper must be in a form that satisfies the requirements of some specific journal. Satisfactory-fail only.

TSM 699. Research. Cr. arr.

Textiles and Clothing

(Administered by the Department of Apparel, Educational Studies, and Hospitality Management)

Robert Bosselman, Chair of Department

Distinguished Professors (Emeritus): Fanslow, Moyer, Winakor

University Professor (Emeritus): Farrell-Beck

Professors: Bosselman, Damhorst, Fiore, Kadolph

Professors (Emeritus): Anderson, Beavers, Brun, Burnet, Cowan, Crabtree, Gilmore, Smith, Stone, Williams

Associate Professors: Baltzer, Hausafus, Niehm, Parsons

Associate Professors (Emeritus): Amos, Brackelsberg, Brown, Ebert, Huss, Kundel, Kunz, Walsh

Associate Professor (Adjunct): Strohbehn

Assistant Professors: Barker, Hurst, Karpova, Keino, Y. Lee, Marcketti, Rajagopal, Wohlsdorf-Arendt, Zheng

Assistant Professor (Adjunct): Glock

Instructor (Adjunct): Fratzke

Lecturers: Ackerman, Burger, Christensen, Fiihr, Fitzpatrick, Kramer, M. Lee, Sanger, Trost, Wirth, Wise

Undergraduate Study

The program offers study for the degree of bachelor of science with a major in apparel merchandising, design, and production (AMDP). The program offers students a broad understanding of textile and apparel products, merchandising and marketing strategies, technical and creative design, product development, production processes, and business practices leading to a wide range of careers at state, national, and international levels in business and industry. Courses in the program provide scientific, technical, and humanistic knowledge about textiles, apparel, and related products basic to career preparation. Courses also provide knowledge applicable to the development and use of apparel and textile products by individuals, families, and institutions. The program provides a foundation for graduate study. Graduates understand the production, distribution, and use of textiles and apparel, aesthetic expression, and communication. They are prepared to plan, develop, and present textile and apparel products to meet the needs of consumers. They understand the issues involved in textile and apparel production and marketing, both nationally and internationally. Graduates appreciate the interdependence of nations and cultures as producers and consumers of textile products.

The AMDP major provides a broad-based program of study with flexibility in creating an individualized program. To complete the program, a student combines general education, AMDP core classes, and structured clusters of courses to form an option in merchandising, creative design, technical design, product development, or production and sourcing management.

An option in merchandising prepares students for the planning, development, and presentation of market-oriented product lines and events. Career opportunities are in product development, buying, promotion, and management in both manufacturing and retailing sectors with a focus on the textile and apparel industry. An option in creative design is appropriate for those interested in the aesthetic and creative aspects of design, product or line development, or promotion of textiles and apparel. The option in technical design prepares students for careers in technical design, product development, and quality assurance. An option in product development is appropriate for those interested in both designing and merchandising products or lines for consumer groups. Students in design have a review of their design skills after T C 225 and T C 278.

An option in production and sourcing management prepares students for positions related to apparel engineering, plant management, quality assurance, costing, product development, sourcing, and buying piece goods or trim for apparel manufacturing or retailing firms.

In addition, a student in merchandising or production and sourcing management selects a secondary option from business and entrepreneurship, consumer behavior/marketing, communications/publications, history/museum studies, human resource management, international trade, or public relations/event management. The combinations of primary and secondary options allow students to individualize their programs.

For additional courses of interest, see Apparel, Educational Studies, and Hospitality Management.

The program offers a minor in apparel merchandising, design, and production. The minor can be earned by taking T C 131 or 165; 204; 231, 245, or 275; 6 credits at the 300-400 level; for a total of 16 to 17 credits.

Grade point requirement: All students majoring in apparel merchandising, design, and production are required to earn a C– or better in all AESHM and T C courses applied toward the degree, including transfer credits.

Graduate Study

The program offers work for the master of science and doctor of philosophy with a major in textiles and clothing. The program also participates in the Master of Family and Consumer Sciences degree by offering a specialization within that program. For all programs the field of study is highly interdisciplinary; programs of study are tailored to students' background and interests.

Graduates understand how textiles and apparel are essential in meeting individual and societal needs and understand the interdependence of nations and cultures as producers and consumers. Graduates understand diverse philosophies of scholarship and apply multiple methods to creative activity, research, and teaching. Strong writing and oral communication skills help graduates disseminate scholarship and compete successfully for awards and grants.

Graduates accept positions relevant to their academic experience. All doctoral graduates have teaching experience. Masters and doctoral graduates have experience working in team-oriented and interactive environments. Graduates are prepared to adapt to future changes in their professions and to provide leadership in professional and public practice. They bring a strong sense of ethics to research, teaching, and business endeavors.

Program emphases for graduate study include consumer behavior; entrepreneurship; merchandising and marketing aspects of textiles and clothing; acquisition and use of textiles and apparel within cultures; U.S. dress and textiles from the 19th into the 21st centuries; textiles; social/psychological aspects of dress; aesthetics and design; product quality and development; textile conservation; and computer-aided design.

The program participates in the interdepartmental gerontology minor.

Courses primarily for undergraduate students.

T C 131. Overview of the Fashion Industry. (3-0) Cr. 3. F.S. Introduction to fashion industry, industry structure from concept to consumer. Focus on fashion-driven consumer goods.

T C 165. Dress and Diversity in Society. (3-0) Cr. 3. F.S.SS. Examination of diversity among consumers and forecasting future trends in consumer behavior. Social responsibility issues related to appearance.

T C 204. Textile Science I. (3-3) Cr. 4. F.S.SS. *Prereq: 131.* WWW lectures. Textile fibers, yarns, fabrication, coloration, and finishes. Quality and performance application to consumer soft goods and industrial textiles.

T C 210. Computer Applications in Textiles and Clothing. (0-2) Cr. 1. F.S.SS. *Prereq: 111, 131; 245 or concurrent.* Applications of basic skills in Photoshop, Illustrator, PDM, Excel, and databases.

T C 221. Apparel Assembly Processes. (1-4) Cr. 3. F.S.SS. *Prereq: 204 or concurrent.* Principles of garment assembly. Use of mass production equipment and methods to analyze, develop and assemble garments.

T C 225. Patternmaking I. (2-4) Cr. 4. F.S. *Prereq: 131, 204, 221. Permission of instructor.* Basic flat pattern and draping methods for women's, men's and children's wear. Patternmaking by computer.

T C 231. Product Development and Manufacturing. (3-2) Cr. 4. F.S. *Prereq: 204.* Analysis of apparel product development, sourcing, and manufacturing processes. Focus on materials and specifications relative to quality, performance, and cost.

T C 245. Aesthetics and Brand Image. (3-0) Cr. 3. F.S. *Prereq: 131, 165; 204 or concurrent.* Elements and principles of design. Analysis of fashion products and promotional settings affecting the consumer. Analysis of experiential aesthetic aspects of brand.

T C 257. Museum Studies. (3-0) Cr. 3. F. *Prereq: Sophomore standing.* Overview of museums in contemporary American society. Museum history, functions, philosophy. Collection and curatorial practices. Funding and governance issues. Object research and exhibit development.

T C 278. Fashion Illustration. (0-6) Cr. 3. F.S. *Prereq: 131, 245 or concurrent enrollment. Permission of instructor.* Development of drawing skills, including line, shape, perspective and value. Introduction to drawing the fashion figure and apparel using a variety of media. Fashion presentation and introduction to portfolio development.

T C 301. Basic Design Concepts Review. Cr. 1. Repeatable maximum of 2 credits. F.S. *Prereq: Completion or enrollment in 225, 278. Permission of instructor.* Project review and skill assessment related to 2-dimensional and 3-dimensional visualization, apparel assembly, basic product knowledge, design problem solving. Review of fashion illustration, textiles, flat pattern, basic apparel assembly, design problem solving. Satisfactory-fail only.

T C 305. Quality Assurance of Textiles and Apparel. (Dual-listed with 505). (2-2) Cr. 3. F.S. *Prereq: 231, one course in natural science; Stat 101, 226, or 401.* Principles of product and materials evaluation and quality assurance. Developing specifications and using standard practices for evaluating materials, product characteristics, performance, and quality.

T C 321. Computer Integrated Textile and Fashion Design. (0-6) Cr. 3. F.S. *Prereq: 278 or concurrent enrollment. Permission of instructor.* Analysis and advanced use of computer-aided design software for textile and fashion design for various markets. Digital presentation and portfolio development.

T C 325. Patternmaking II. (2-4) Cr. 3. F.S. *Prereq: 301. Permission of instructor.* Principles of advanced patternmaking by flat pattern and draping techniques. Interaction of fabric characteristics with style features. Analysis of fit and design; problem solving. Patternmaking by computer.

T C 326. Creative Design Processes. (Dual-listed with 526). (2-2) Cr. 3. F.S. *Prereq: 325 or concurrent enrollment. Permission of instructor.* Exploration of the creative process and sources of inspiration with emphasis on fashion presentation and design development for a variety of markets. Continued development of fashion illustration techniques. Use of traditional and non-traditional materials to create innovative garments.

T C 328. Design Seminar. (Dual-listed with 528). Cr. arr. Repeatable. F.S.SS. *Prereq: Vary with topic.* Focus on artisanal textile, apparel, or surface design techniques. Topics vary by term.

T C 354. History of European and North American Dress. (3-0) Cr. 3. F. *Prereq: 3 credits from Hist or Art H.* Survey of history of dress from ancient times through present; focus on European and North American dress. Emphasis on connection of dress to the social, cultural, environmental, and technological contexts of the Western world. Nonmajor graduate credit.

T C 356. History of Twentieth Century Fashion. (Dual-listed with 556). (3-0) Cr. 3. S. *Prereq: 3 credits Hist or Art H; T C 204 recommended.* Survey of major design and technological developments in 20th Century fashion. Emphasis on fashion as a system of design and production, culture of consumption, fashion change, and trends in art, society, and culture.

T C 362. Cultural Perspectives in Dress. (3-0) Cr. 3. S. *Prereq: 165 or 3 credits in anthropology, psychology, or sociology.* Analysis of multiple factors related to dress in selected societies, including technology, aesthetics, social organization, ritual, stability and change. Applications to apparel business.

T C 372. Sourcing and Global Issues. (3-0) Cr. 3. F.S. *Prereq: 231, AESHM 275; Econ 101 or 102 recommended.* Evaluation of key issues facing textile and apparel businesses in global markets considering ethical, economic, political, social, and professional implications. Sourcing strategies in a global environment. Corporate and consumer social responsibility.

T C 376. Merchandise Planning and Control. (2-2) Cr. 3. F.S. *Prereq: AESHM 275; Acct 284.* Assortment planning, model stocks, budget development, retail math, buying concepts and strategies.

T C 377. Brand Management and Promotions. (3-0) Cr. 3. F.S. *Prereq: 245; AESHM 340 or Mkt 340.* Principles of brand image development and management; focus on experiential marketing, promotions, store design/layout, visual merchandising components.

T C 380. Field Study. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits in T C, junior classification, minimum 2.0 GPA. Permission by application.* Study of and tours of textile and apparel manufacturers, forecasting firms, design studios, showrooms, markets, retailers, museums, testing laboratories, trade seminars and exhibitions, and other areas of interest within the textile and apparel industry.
A. Pre-trip Orientation. Cr.
R. Orientation to the field study location during semester preceding trip. B. Field trip. Cr. 1-2. Trip to location under supervision of faculty member. Reports required.

T C 381. International Field Study. Cr. arr. Repeatable. Alt. S., offered 2010. SS. *Prereq: 9 credits in T C, junior classification, minimum 2.0 GPA. Permission by application.* Study of and tours of textile and apparel manufacturers, forecasting firms, design studios, showrooms, markets, retailers, museums, testing laboratories, trade seminars and exhibitions, and other areas of interest within the textile and apparel industry. Countries vary.
A. Pre-trip Orientation. Cr.
R. Orientation to the international locations during semester preceding trip. B. Field trip. Cr. 1-3. Trip to international location under supervision of faculty member. Reports required.

T C 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

T C 404. Textile Science II. (Dual-listed with 504). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 204, 245; one natural science course.* Theories and principles of textile science; emphasis on fiber chemistry, performance and smart textiles, dyeing, and detergency.

T C 411. Seminar on Current Issues. Cr. arr. Repeatable. *Prereq: Senior classification, 12 credits in T C.* Trends, issues, and scholarship in textiles and apparel.

T C 415. Technical Design Processes. (2-2) Cr. 3. F. *Prereq: 231, 301. Permission of instructor.* Garment development and analysis of fit, performance, quality, cost. Exploration of alternative materials, construction methods, grading markers; develop specifications.

T C 431. Apparel Production Management. (2-3) Cr. 3. S. *Prereq: 231; T C 221 recommended.* Procedures and experiences related to application and use of process controls: method analysis, work measurement, costing, and production planning. Resource management, technology applications, and quality assurance.

T C 467. Consumer Behavior. (3-0) Cr. 3. F. *Prereq: Stat 101 or 104 or 226; T C 165.* Application of concepts and theories from the social sciences to the study of consumer behavior related to appearance. Experience in conducting market and consumer research.

T C 470. Supervised Experience. Cr. 3. Repeatable. F.S.SS. *Prereq: 311 and minimum 2.0 GPA; permission by application; junior or senior classification.* Supervised work experience with a cooperating firm or organization.
A. Textile Industry. Prereq: 305.
B. History of Dress and Textiles. Prereq: 6 credits from 257, 354, 356 or 362; 3 credits in anthropology or history recommended.
C. Textile and Apparel Design. Prereq: 210, 225, 231, 245; 278 recommended.
E. Entrepreneurship. Prereq: AESHM 275, 474.
I. Merchandising. Prereq: AESHM 275.
M. Museum. Prereq: 257.
N. Apparel Production Management. Prereq: 431
O. Technical Design. Prereq: 231, 225; 305, 415 and 431 recommended.
Q. Quality Assurance. Prereq: 305.
T. Public Relations and Publishing. Prereq: T C 275 and Advrt 230; JI MC 220 or JI MC 305.
U. Product Development. Prereq: 231, 245.
V. Sourcing and Global Issues. Prereq: TC 372

T C 475. Retail Information Analysis. (2-2) Cr. 3. F.S. *Prereq: 376.* Forecasting, customer demand, assortment planning, market research, analysis of customer databases, data mining, database interface, pattern recognition, retail technology applications and supply-chain/logistics management.

T C 490. Independent Study. Cr. arr. Repeatable. F.S. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair.*
A. Textile Science
B. History of Dress and Textiles
C. Textile and Apparel Design
D. Aesthetics
E. Entrepreneurship
F. Sociological and Psychological Aspects of Dress and Textiles
G. Consumer Behavior
H. Honors
I. Merchandising
K. Cultural Analysis of Dress and Textiles
M. Museums
N. Apparel Production Management
O. Technical Design
Q. Quality Assurance
T. Public Relations and Publishing
U. Product Development
V. Sourcing and Global Issues

T C 495. Senior Design Studio. (1-5) Cr. 3. F.S. *Prereq: 321, 325, 326. Permission of instructor.* Creation of a line of apparel from concept through completion. Development of portfolio using manual and computer-aided techniques. Line must be submitted to juried competition.

T C 496. Fashion Forecasting and Product Development. (3-0) Cr. 3. *Prereq: 231, 245, AESHM 275.* Applying consumer, aesthetic, and quantitative trend information to develop value-added apparel/textile products and product lines with merchandising/promotion campaigns for diverse target markets. Multi-function team projects. Presentation to industry representatives.

T C 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

T C 499. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Senior classification, 15 credits in T C. Permission of instructor, adviser, and department chair.* Research experience in textiles and clothing with application to a selected problem.

Courses primarily for graduate students, open to qualified undergraduate students

T C 504. Textile Science II. (Dual-listed with 404). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 204, 245; one natural science course.* Theories and principles of textile science; emphasis on fiber chemistry, performance and smart textiles, dyeing, and detergency.

T C 505. Quality Assurance of Textiles and Apparel. (Dual-listed with 305). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 231; Stat 226 or 401; one natural science course.* Principles of product and materials evaluation and quality assurance. Developing specifications and using standard practices for evaluating materials, product characteristics, performance, and quality. Proposal and research project.

T C 510. Foundation of Scholarship in Textiles and Clothing. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Overview of scholarship in textiles and clothing with emphasis on current and future directions. Fundamentals of writing literature reviews. Examination of ethical issues in scholarship and academic life. Introduction to creativity and an entrepreneurial perspective.

T C 521. Digital Textile and Apparel Design. (1-4) Cr. 3. Alt. SS., offered 2010. *Prereq: Experience with flat pattern or draping techniques and image manipulation software. Permission of instructor.* Design development, analysis and application of digital textile printing to textile products and garment forms.

T C 526. Creative Design Processes. (Dual-listed with 326). (2-2) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: Permission of instructor.* Exploration of the creative process and sources of inspiration with emphasis on fashion presentation and design development for a variety of markets. Continued development of fashion illustration techniques. Use of traditional and non-traditional materials to create innovative garments.

T C 528. Design Seminar. (Dual-listed with 328). Cr. arr. Repeatable. F.S.SS. *Prereq: Vary with topic.* Focus on artisanal textile, apparel, or surface design techniques. Topics vary by term.

T C 556. History of Twentieth Century Fashion. (Dual-listed with 356). (3-0) Cr. 3. S. *Prereq: Graduate standing.* Survey of major design and technological developments in 20th Century fashion. Emphasis on fashion as a system of design and production, culture of consumption, fashion change, and trends in art, society, and culture.

T C 557. Textile Conservation and Collection Management. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 204.* Condition assessment, repair, and stabilization of textiles and apparel in museum collections. Dry, aqueous, and solvent cleaning. Examination of storage and exhibition techniques, materials, and conditions. Experience with cataloging and management practices.

T C 562. Dress and Culture. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 362 or 6 credits in social science or cultural anthropology.* Analysis of dress as artifact, behavior, and symbol from cultural perspectives. Focus on construction of cultural identity. Examination of ethnographic approaches and field research methods to the study of dress as material culture.

T C 567. Consumer Behavior and Apparel. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 467 or Mkt 447; Stat 401.* Application of concepts and theories from the social sciences to the study of consumer behavior. Experience in conducting research; manuscript writing.

T C 570. Practicum in Textiles and Clothing. Cr. arr. Repeatable. F.S.SS. *Prereq: 510, 6 graduate credits in textiles and clothing. Permission of instructor.* Supervised experience related to career objective. Proposal must be approved semester before placement.
A. Teaching practicum
B. Internship

T C 572. Sourcing and Global Issues. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: a course in merchandising, Econ 101.* Evaluation of key issues facing textile and apparel businesses in global markets considering ethical, economic, political, social, and professional implications. Experience in conducting research using secondary data.

T C 581. International Study. Cr. arr. Repeatable. S.SS. *Prereq: 9 credits in T C. Permission by application.* Study abroad of apparel and textile design, merchandising, forecasting firms, production, distribution, consumption, history, and museums. Countries vary.
A. Pre-trip Orientation. Cr.
R. Orientation to the international locations during semester preceding trip B. Field trip. Cr. 1-3. Trip to international location under supervision of faculty member. Report required.

T C 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s).* Individually designed textile and clothing-related projects that reflect the special interests of the student.
A. Textile Science
B. History of Dress and Textiles
C. Textile and Apparel Design
D. Aesthetics
E. Entrepreneurship
F. Sociological and Psychological Aspects
G. Consumer Behavior
I. Merchandising
K. Cultural Analysis of Dress and Textiles
L. Conservation
M. Museums
N. Apparel Production Management
O. Technical Design
P. Interdisciplinary
Q. Quality Assurance
T. Public Relations and Publishing
U. Product Development
V. Sourcing and Global Issues

Courses for graduate students

T C 610. Philosophical Issues of Textiles and Clothing Scholarship. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 2 courses in research methods, 6 graduate credits in textiles and clothing.* Models, theory, alternative philosophies, and ethics of science as applied in textiles and clothing scholarship. Grant writing and research program development.

T C 611. Seminar. Cr. arr. Repeatable. *Prereq: 6 graduate credits in textiles and clothing. Permission of instructor.* Discussion of scholarship and current issues. Topics vary.

T C 625. Design Theory and Process. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Permission of instructor.* Analysis of design theory and creative processes, including strategies for solving aesthetic, functional, and technology-focused design problems. Design criticism and frameworks for practice-based design research.

T C 650. Historic Research Methods in Dress and Textiles. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Permission of instructor.* Current methods, interpretive strategies, and diverse academic approaches to research in history of dress and textiles, including material culture approach. Emphasis on historical research, writing, and evaluation of sources.

T C 665. Social Science Theories of Appearance. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits in sociology or psychology.* Analysis of social science theories and concepts applicable to clothing and appearance research. Emphasis on qualitative research and philosophy of knowledge, including postmodern, symbolic interaction, semiotic, and feminist theories.

T C 675. Research in Merchandising. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: AESHM 275 or equivalent.* Merchandising and related marketing theory, research processes, and methods. Experience in conducting research; prepare manuscripts for academic, industry and lay audiences.

T C 690. Advanced Topics. Cr. arr. Repeatable. *Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E.*

T C 699. Research. Cr. arr. Repeatable.

Theatre and Performing Arts

www.theatre.iastate.edu

(Administered by the Department of Music)

Performing Arts graduates will understand and demonstrate: 1) Knowledge of the cultural heritage and history of the Performing Arts 2) A theoretical and experiential background in the areas of performance, theatrical design, music, and dance 3) Knowledge of creative problem solving and artistic collaboration 4) Skills necessary to perform in or design for a variety of periods, styles, and genres in theatre and dance 5) Awareness of the diversity of expression in the Performing Arts throughout the world's cultures 6) A practical understanding of the rigors of the field.

Assessment measures include the semester exhibit of design work or audition pieces, graduating senior seminar and exit interviews, public performances or designs, course grades, exhibited convention work, and internship evaluations.

Undergraduate Study

Students interested in theatre as a major area of concentration declare a major in Performing Arts and select an emphasis in Theatrical Design or Acting/Directing. Students implement the theories and principles explored in the classroom by participating in production work. During the academic year, Iowa State University Theatre presents up to ten mainstage and second stage productions in Fisher Theater, and works in close collaboration with ISU Music and Dance.

The major in Performing Arts offers the undergraduate student a cross-disciplinary concentration in Music, Dance and Theatre. The core curriculum consists of 24 credits in the three areas. Students elect a 24-credit emphasis in either Dance, Theatrical Design or Acting/Directing. In addition to coursework, Performing Arts majors and minors participate in concert (Orchesis, Footfalls), workshop (Opera Studio, Minority Theatre Workshop) and production (Barchje, Stars Over Veishea, ISU Theatre/Music Theatre/Second Stage and Studio) experiences.

Performing Arts graduates, in addition to a solid theoretical and experiential background in the areas of performance, theatrical design, dance and music, are prepared to meet the challenges of the work force or graduate school with their strengths in collaboration, creative problem solving, meeting deadlines and processing diverse input to yield cohesive output. Two required professional internships prior to graduation are vital to the student's appreciation and practical understanding of the rigors of the field.

The theatre area offers a wide variety of courses. Students may select from courses in acting, design (costume, scenic, lighting/sound), make-up, stage direction, playwriting, stage management, and theatre history. Independent study and special topics courses supplement formal course offerings to provide opportunities to intensify study in a particular aspect of theatre.

Auditions for ISU Theatre productions are open to all students irrespective of academic major. Similarly, participation in areas of production other than acting is open to both majors and nonmajors. Qualified students also present experimental, laboratory, and Minority Theatre Workshop productions. Student actors, directors, designers, and technical crew heads are required to maintain a grade point average of at least 2.0 to participate in productions.

Theatre scholarships are awarded on a yearly basis to students who make significant contributions to Iowa State University Theatre.

Bachelor of Arts - Performing Arts Major (Perf)

The Core for the Performing Arts Major (24 cr)

(For individual Dance and Music course descriptions, see *Index* for individual department listing.)

Music 101, 102

Dance 120-Modern Dance, 130–Ballet I, 220–Modern Dance Composition

Dance 270–Dance Appreciation

Thtre 255, 263, 365

Perf 105–(six semesters), Perf 310 (2), Perf 401

Emphasis in Theatrical Design (24 cr)

Thtre 250 (2 cr), 360, 366, 455, 461, 465, 466, Music 133

Emphasis in Dance (24 cr)

Art 292, Music 133, Ex Sp 355

Dance 222, 224 (2 cr), 232, 360, 370

Select 2 credits from: Dance 140, 150, 160, 170, 211 (instead of 160, 170)

Select 2 credits from: Dance 223, 233, 242, 243, 262

Select 3 credits from: Dance 320, 384, 385, 386

All students enrolled in the Dance Emphasis must register for one dance technique course every semester of residence up to a total of 8 credits and must complete one computer course (Com S 103, 107, 207, C I 201).

Emphasis in Acting/Directing (24 cr)

Thtre 151, 250 (2 cr), 251, 351, 451, 455, 465, 466

Music 133

Minor in Performing Arts (21 cr)

Perf 105 (three semesters)

Music 101, 102

Dance 120 or 130, 270

Thtre 255, 263 or 251

plus six credits 300+ in Dance, Thtre or Perf

Communication Proficiency requirement: Select one course from Engl 302, 303, 304, 305, 306, 307, 309, 314, 315, 316, 366, 370.

Graduate Study

The department offers graduate courses as supporting work in other fields.

Performing Arts

Courses primarily for undergraduate students.

Perf 105. Issues in the Performing Arts. (1-0) Cr. R. F.S. Cross-disciplinary analysis and discussion of topics in the performing arts. Six semesters required of performing arts majors.

Perf 310. Performing Arts Internship. Cr. R. F.S.SS. Required of performing arts majors. A job or internship with a professional or semi-professional performing arts organization. Satisfactory-fail only.

Perf 401. Performing Arts Seminar. (2-0) Cr. 2. S. Intensive collaborative study and practice of topics in music, dance and theatre. Required of performing arts majors. Nonmajor graduate credit.

Theatre

Courses primarily for undergraduate students.

Thtre 106. Introduction to the Performing Arts. (3-0) Cr. 3. F.S.SS. An audience oriented, broad-based, team-taught survey of the performing arts which emphasizes theatre and includes segments on television, radio, film, dance, and music.

Thtre 110. Theatre and Society. (3-0) Cr. 3. F.S. An introduction to Theatre focusing on its relationship with society throughout history.

Thtre 151. The Actor's Voice. (3-0) Cr. 3. S. Study and practice of fundamentals of vocal production: breathing, quality, articulation, projection, and expressiveness for the performing artist.

Thtre 224. Concert and Theatre Dance. (Cross-listed with DANCE). (0-3) Cr. arr. Repeatable. F.S. *Prereq: By audition only.* Choreography, rehearsal, and performance in campus dance concerts and/or musical theatre productions. Satisfactory-fail only.

Thtre 250. Theatre Practicum. Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Practice in various aspects of technical theatre production. Satisfactory-fail only.

Thtre 251. Acting I. (3-0) Cr. 3. F.S. Theory and practice in fundamentals of acting.

Thtre 255. Introduction to Theatrical Production. (3-3) Cr. 4. F.S. Standard structure and procedures, historical overview of performing arts production including the design and creation of scenery, costumes and lighting.

Thtre 263. Script Analysis. (3-0) Cr. 3. F.S. Theory, analysis, and interpretation of play scripts for production.

Thtre 290. Special Projects. Cr. arr. Repeatable. F.S.SS. *Prereq: 3 credits in theatre; permission of instructor; approval of written proposal.*

Thtre 316. Creative Writing -- Playwriting. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Engl 250, not open to freshmen.* Progresses from production of scenes to fully developed one-act plays. Emphasis on action, staging, writing, analytical reading, workshop criticism, and individual conferences. Nonmajor graduate credit.

Thtre 351. Acting II. (3-0) Cr. 3. S. *Prereq: 251, Dance 120 recommended.* Theory and practice of techniques of acting with emphasis on character and scene analysis.

Thtre 352. Stage Combat. (1-2) Cr. 2. Alt. S., offered 2010. *Prereq: 351.* Theory, history, and practice of theatrical combat. Includes tumbling, hand-to-hand, quarterstaff, broadsword, rapier, and dagger.

Thtre 354. Musical Theatre I. (2-2) Cr. 3. *Prereq: 251 or Music 232 or 3 credits in Dance.* Theory, history and practice of musical theatre techniques. Designed to develop the musical theatre performance skills of singers, dancers, and actors.

Thtre 355. Musical Theatre II. (2-2) Cr. 3. *Prereq: 354.* Theory, history and practice of musical theatre techniques. Designed to develop the musical theatre performance skills of singers, dancers, and actors.

Thtre 357. Stage Make-up. (1-2) Cr. 2. F. Theory and practice of make-up and hair-styling techniques for the performing arts: Theatre, Opera, Dance, Television and Film. Lab required.

Thtre 358. Oral Interpretation. (3-0) Cr. 3. F. Principles of oral interpretation: practice in analysis, in reading aloud of literary selections, and in reader's theatre.

Thtre 359. Theatre for Children and Youth. (3-0) Cr. 3. Study and practice of directing, acting, and the production of theatre for children and youth.

Thtre 360. Stagecraft. (3-2) Cr. 4. S. *Prereq: 255.* Tools, materials, and techniques of planning, constructing and painting of performing arts scenography. Basic principles of lighting technology. Technical drawing for performing arts production.

Thtre 365. Theatrical Design I. (2-2) Cr. 3. F. *Prereq: 255.* An exploration of the elements, principles and art of theatrical design.

Thtre 366. Theatrical Design II. (2-2) Cr. 3. S. *Prereq: 365.* Intensive application of the principles introduced in 365. In-depth study and practice of the graphic skills of rendering and drafting.

Thtre 367. Stage Management. (3-0) Cr. 3. F. *Prereq: 255.* The responsibilities and techniques of stage management for the performing arts.

Thtre 393. Workshop. Cr. 3. Repeatable. F.S.SS. *Prereq: 3 credits in theatre.* Offered to explore special topics.
A. Minority Theatre
B. Repertory
C. Children's Theatre
D. Musical Theatre
E. Creative Dramatics
F. International Storytelling

Thtre 451. Acting III. (3-0) Cr. 3. F. *Prereq: 351 and permission of instructor.* Analysis and practice of period scenes.

Thtre 455. Directing I. (3-0) Cr. 3. F. *Prereq: 255; 263; 251 recommended.* Theory, techniques, and practice of directing.

Thtre 456. Directing II. (2-2) Cr. 3. S. *Prereq: 455.* Practical and theoretical experience in directing the stage play.

Thtre 461. Theatrical Design Studio. (3-2) Cr. 4. Repeatable. F.S. *Prereq: Permission of instructor.* Focuses on the art and craft of specific areas of theatrical design. Each semester the student will focus on one or two of the following: scenic, costume, or lighting design.

Thtre 465. History of Theatre I. (3-0) Cr. 3. F. *Prereq: Hist 201 or equivalent.* Theatre history from ancient times to 1800. Nonmajor graduate credit.

Thtre 466. History of Theatre II. (3-0) Cr. 3. S. *Prereq: 465.* Theatre history from 1800 to present. Nonmajor graduate credit.

Thtre 469. Advanced Theatre Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits in theatre courses; junior classification.* Practicum in production with ISU Theatre, with opportunities for specialization within various areas. Required: Approval of written proposal.

Thtre 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits in theatre, approved written proposal, junior classification.* Only one independent study enrollment within the department is permitted per semester. No more than 9 credits in Thtre 490 may be counted toward graduation.

Thtre 497. Senior Seminar. (3-0) Cr. 3. S. *Prereq: 15 credits in theatre courses; senior classification.* Directed study of a theatre issue or problem identified by each student. Students synthesize relevant theory and research culminating in senior project or paper.

Thtre 499. Theatre Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: 18 credits in theatre, other courses deemed appropriate by faculty adviser; 2nd semester junior or senior standing; cumulative GPA of at least 2.5 overall and 3.0 in theatre courses.* Supervised application of theatre in professional settings.

Courses primarily for graduate students, open to qualified undergraduate students

Thtre 504. Seminar. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits in theatre.* Topics may include the following:
A. Musical Theatre
B. Acting Techniques
C. Acting Styles
D. Design and Technical Theatre
E. Arts Management

Thtre 590. Special Topics. Cr. arr. Repeatable. *Prereq: Approved written proposal.*

Toxicology

www.toxicology. iastate.edu

toxmajor@iastate.edu

(Interdepartmental Graduate Major)

Supervisory Committee: A. Kanthasamy, Chair; J. Coats, A. Kanthasamy, R. Martin, P. Murphy, G. Osweiler

Toxicology is the science of studying the adverse effects of substances on living organisms. Students observe, gather data and predict risks and outcomes in populations. Whole organism research and cellular and molecular approaches are used to determine toxicant exposure and mechanisms. Work is offered for the degrees doctor of philosophy and master of science. Students majoring in toxicology will be affiliated with one of the following cooperating departments: Agricultural and Biosystems Engineering; Animal Science; Biochemistry, Biophysics and Molecular Biology; Biomedical Sciences; Chemistry; Entomology; Food Science and Human Nutrition; Genetics, Development and Cell Biology; Geological and Atmospheric Sciences; Natural Resource Ecology and Management; Physics; Plant Pathology; Veterinary Diagnostic and Production Animal Medicine; Veterinary Microbiology and Preventive Medicine; and Veterinary Pathology.

The prerequisites for entrance into the graduate toxicology major include an undergraduate degree in a relevant area of study; for example, chemical engineering, biology, biochemistry, chemistry, ecology, entomology, food science and technology, microbiology, nutritional science, zoology, or veterinary medicine. Minimum undergraduate coursework should include the following or their equivalent: 1 year of college mathematics, including calculus; 1 year of inorganic chemistry with quantitative analysis; 1 course in physics; 1 year of organic chemistry; 2 years of biological sciences including 1 course in physiology.

Other courses that are considered desirable in undergraduate preparation include: biochemistry, physical chemistry, qualitative analysis, and some specialized courses such as histology or advanced physiology.

Facilities and faculty are available for fundamental research in such areas as environmental fate and effects of chemicals, insect toxicology, aquatic toxicology, food safety, nutritional toxicology, mycotoxins, neurotoxicology, cellular and molecular toxicology and veterinary toxicology.

Students majoring in toxicology will be affiliated with a cooperating department. All Ph.D. students take a core curriculum consisting of Tox 501 and 502, Tox 504 (Toxicology Seminar, taken twice); 7 additional credits in toxicology; 8 credits in biochemistry from BBMB 404, 405, 420, 451, 542; 3 graduate credits in physiology, histology, pathology, neuroscience, immunobiology or cellular and molecular biology; and Stat 401 and 402. M.S. students take a core of Tox 501, 502, 504; 3 additional credits in toxicology; BBMB 404, 405; and Stat 401. Additional coursework is selected to meet departmental requirements and to satisfy individual student research interests.

A graduate minor in toxicology is available for students enrolled in other majors. A minor for an M.S. degree includes Tox 504 and 501 and 3 credits in other toxicology courses. A minor at the Ph.D. level includes Tox 504, 501, and 6 credits in other toxicology course work. One member of the student's program of study committee will be a member of the toxicology faculty.

Most students awarded doctoral degrees continue their training as postdoctoral associates at major research institutions in the U.S. or abroad in preparation for research and/or teaching positions in academia, industry, the military, veterinary research, or government environmental and public health institutions. A few go directly to permanent research positions in industry. Many students awarded master's degrees continue their training as doctoral students; however, some choose research support positions (i.e., technician, chemist, research associate) in academia, industry, or government. A more thorough list of outcomes is available at our Web site.

Graduates of the Toxicology major will be able to carefully design, execute and analyze experiments that extend the knowledge of toxicology and closely related sciences. They will be able to clearly communicate research findings, and thoroughly evaluate the literature of toxicology, contributing significantly to the advancement of the field.

Courses primarily for undergraduate students.

Tox 419. Foodborne Hazards. (Cross-listed with FS HN, Micro). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Micro 201 or 302, a course in biochemistry.* Pathogenesis of human microbiological foodborne infections and intoxications, principles of toxicology, major classes of toxicants in the food supply, governmental regulation of foodborne hazards. Only one of Tox 419 and 519 may count towards graduation. Nonmajor graduate credit.

Tox 420. Food Microbiology. (Cross-listed with FS HN, Micro). (3-0) Cr. 3. F. *Prereq: Micro 201 or 302.* Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Tox 501. Principles of Toxicology. (3-0) Cr. 3. F. *Prereq: BBMB 404 or equivalent.* Principles of toxicology governing entry, fate, and effects of toxicants on living systems. Includes toxicokinetics and foreign compound metabolism relative to toxification or detoxification. Fundamentals of foreign compound effects on metabolism, physiology, and morphology of different cell types, tissues, and organ systems.

Tox 502. Toxicology Methods. (0-6) Cr. 3. Alt. S., offered 2010. *Prereq: Tox 501.* Provides demonstrations or laboratory experience in the application of methods used in toxicology, including safety procedures, calculation and data analysis, teratologic and morphologic evaluation, electrophysiologic measures, in vitro enzyme induction/biotransformation, neural and behavioral toxicology testing.

Tox 504. Toxicology Seminar. (1-0) Cr. 1. Repeatable. F.S.SS. *Prereq: Permission of instructor required.* Presentation of a seminar about a current topic in toxicology as part of a weekly series of seminars by graduate students, faculty, and guest lecturers from off campus.

Tox 515. Regulatory Toxicology. (Cross-listed with FS HN). (1-0) Cr. 1. Alt. F., offered 2010. *Prereq: BBMB 404 or FSHN 403.* Regulatory toxicology in the real world. Approaches used by toxicologists in regulatory agencies for generating, enforcing and complying with laws and regulations in an unambiguous, defensible manner. Different obligations of scientists in research and regulatory settings. Perform simple risk assessments and suggest ways of dealing with data gaps. Examine strengths and weaknesses of common approaches used by regulatory agencies.

Tox 519. Food Toxicology. (Cross-listed with FS HN, NutrS). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: A course in biochemistry.* Basic principles of toxicology. Toxicants in the food supply: modes of action, toxicant defense systems, toxicant and nutrient interactions, risk assessment. Only one of Tox 419 and 519 may count toward graduation.

Tox 526. Veterinary Toxicology. (Cross-listed with VDPAM). (3-0) Cr. 3. S. *Prereq: Permission of instructor.* A study of disease processes in animals caused by toxicants and the use of differential diagnostic and therapeutic procedures. Emphasis is on use of clinical cases to define mechanism of poisoning, diagnostic and management procedures and public health and food safety issues.

Tox 546. Clinical and Diagnostic Toxicology. (Cross-listed with VDPAM). (0-3) Cr. arr. Repeatable. F.S.SS. *Prereq: D.V.M. degree or 526.* Advanced study of current problems and issues in toxicology. Emphasis on problem solving utilizing clinical, epidemiological, and laboratory resources.

Tox 550. Pesticides in the Environment. (Cross-listed with Ent). (2-0) Cr. 2. S. *Prereq: 9 credits of biological sciences.* Coats. Fate and significance of pesticides in soil, water, plants, animals, and the atmosphere.

Tox 554. General Pharmacology. (Cross-listed with B M S). (3-0) Cr. 3. S. *Prereq: BMS 549 and 552; BBMB 404, 405.* General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems.

Tox 565. Methods of Biostatistics. (Cross-listed with STAT). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 500 or 401; Stat 543 or 447.* Statistical methods useful for biostatistical problems. Topics include analysis of cohort studies, case-control studies and randomized clinical trials, techniques in the analysis of survival data and longitudinal studies, approaches to handling missing data, and meta-analysis. Examples will come from recent studies in cancer, AIDS, heart disease, psychiatry and other human and animal health studies. Use of statistical software: SAS, S-Plus or R.

Tox 570. Risk Assessment for Food, Agriculture and Veterinary Medicine. (Cross-listed with Agron, VDPAM). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 104 or consent of instructor: Wolt, Hurd.* Risk assessment principles as applied to biological systems. Exposure and effects characterization in human and animal health and ecological risk assessment. Risk analysis frameworks and regulatory decision-making. Introduction to quantitative methods for risk assessment using epidemiological and distributional analyses. Uncertainty analysis.

Tox 575. Cell Biology. (Cross-listed with B M S). (3-0) Cr. 3. F. *Prereq: 10 credits in biological science and permission of instructor.* A multi-instructor course covering major topics in cell structure and function, including: universal features of prokaryotic and eukaryotic cells, types of utilization and conversion of energy, genetic control of cell shape and functionality, internal organization of cells, communication between cells and their environment, development of multicellular systems. Students have to write a term paper.

Tox 590. Special Topics. Cr. arr. Repeatable. Contact individual faculty for special projects or topics. Graded.

Courses for graduate students

Tox 626. Advanced Food Microbiology. (Cross-listed with FS HN, Micro). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: FS HN 420 or 421 or 504.* Topics of current interest in food microbiology, including new foodborne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials.

Tox 627. Rapid Methods in Food Microbiology. (Cross-listed with FS HN, Micro). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: FS HN 420 or 421 or 504.* Provides an overview of rapid microbial detection methods for use in foods. Topics include historical aspects of rapid microbial detection, basic categories of rapid tests (phenotypic, genotypic, whole cell, etc.), existing commercial test formats and kits, automation in testing, sample preparation and "next generation" testing formats now in development.

Tox 656. Cellular and Molecular Pathology II. (Cross-listed with V PTH). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate course in biochemistry, genetics, or cell biology.* Cellular and molecular mechanisms of carcinogenesis.

Tox 675. Insecticide Toxicology. (Cross-listed with ENT). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 501 or Ent 555.* Coats. Principles of insecticide toxicology; classification, mode of action, metabolism, and environmental effects of insecticides.

Tox 697. Graduate Research Rotation. (0-12) Cr. arr. Repeatable. F.S.SS. *Prereq: Admission to Toxicology graduate program.* Graduate research projects performed under the supervision of selected faculty members in the graduate Toxicology major.

Tox 699. Research. Cr. arr. Repeatable.

Transportation

www.ctre.iastate.edu/mstrans/

(Interdepartmental Graduate Major)

Supervisory Committee: K. Gkritza, Chair; D. Johnston, M. Crum

Work is offered for the degree master of science with a major in transportation under a cooperative arrangement with various departments including Civil, Construction and Environmental Engineering (CCEE), Community and Regional Planning (CRP), and Logistics, Operations and Management Information Systems (LOMIS). Opportunities are afforded for research in such areas as modeling and performance of transportation systems, highway safety and information systems, remote sensing, environmental analysis, techniques for urban and regional transportation system planning, environmental and social policy analysis of transportation systems, transportation policy analysis, analysis of transportation technologies, commodity distribution, public administration of the transportation planning process, regional development and transportation system interrelationships, transportation economics and finance, and planning for logistics management.

Students majoring in transportation will develop a program of study under the guidance of a program of study committee selected by the student in consultation with and approved by the chair of the faculty supervisory committee. For administrative purposes, the student's home department will be the department originally admitting the student. A major professor may be selected from any of the three participating departments. A student must designate at least one member of the POS committee from his or her home department, and at least one member from outside the home department.

A student must complete at least 36 credits of acceptable work including preparation of a 6 credit thesis or a 2-3 credit creative component. A structured minor requires 12 credits of approved transportation courses and a thesis or creative component on a transportation related topic.

A required core includes C E 551, Trans 691, Stat 401 and at least one course from all three cooperating departments (CRP, CCEE and LOMIS). Detailed requirements are available from the chair of the supervisory committee.

Graduate students pursuing a major in any of the cooperating departments who have an interest in transportation are encouraged to consider a formal declared minor in transportation. Students considering a declared minor should consult with the chair of the supervisory committee about the requirements for it.

Students typically focus their program of study to support a career in one of five areas: transportation consulting, regional and statewide transportation planning, transportation service operations and management, transportation policy and economic analysis, and transportation planning and operation for local and state governments. Graduates will have specific knowledge in one or more of these focus areas and the skills to conduct research and analysis of transportation issues. These skills allow graduates to be productive immediately in positions related to a focus area or to continue in more advanced transportation graduate work.

Courses primarily for graduate students

Trans 555. Economic Analysis of Transportation Investments. (3-0) Cr. 3. F. *Prereq: C E 350 or 355.* Application of economic analysis methodologies to evaluate transportation projects. Multi-modal approaches to evaluate impacts of transportation investments and maximize economic efficiency while considering equity and other social issues related to investment options.

Trans 599. Creative Component. Cr. arr. *Prereq: Pre-enrollment contract required.* Advanced topic for creative component report in lieu of thesis.

Trans 691. Seminar in Transportation Planning. Cr. arr. Repeatable. S. Provides an overview of current transportation issues; lecturers provide seminars on a variety of timely transportation topics.

Trans 699. Research. Cr. arr. Repeatable.

University Studies

Associate Provost for Academic Programs

Certain interdisciplinary courses are offered through university studies, at the discretion of the associate provost for academic programs and upon the advice of the Faculty Senate Curriculum Committee. No major is available in university studies, but credit obtained through university studies offerings may be applied toward a degree in any of the colleges, consistent with the stipulations of the student's curriculum.

Requests to make use of U St 290, 490, 590 should be directed to the associate provost for academic programs and should be accompanied by a positive recommendation from the department heads and deans of the instructors making the request. The associate provost for academic programs will refer requests to the Faculty Senate Curriculum Committee which will make recommendations to the associate provost for academic programs regarding their disposition after consultation with appropriate college and university committees.

Courses primarily for undergraduate students.

U St 105. Carver Academy Seminar: Freshmen. (1-0) Cr. 1. F. *Prereq: Acceptance in Carver Academy Program, George Washington Carver scholarship recipient.* Orientation to the university for Carver Academy students focusing primarily on transition and acclimation to the university environment. Individual and group identity development. Life and legacy of George Washington Carver. Satisfactory-fail only.

U St 106. Carver Academy Seminar: Freshmen. (1-0) Cr. 1. S. *Prereq: Acceptance in Carver Academy Program, George Washington Carver scholarship recipient.* Introduction for Carver Academy students to resources at ISU to supplement classroom learning. Exploration of multicultural communities and leadership opportunities at ISU. Satisfactory-fail only.

U St 111. Hixson Scholars Seminar. (1-0) Cr. 1. F. *Prereq: Recipient of the Hixson Opportunity Award.* Orientation to Iowa State University and the Hixson Opportunity Awards Program. Satisfactory-fail only.

U St 115. MVP Seminar. (1-0) Cr. 1. F. *Prereq: Recipient of the MVP Award.* Orientation to Iowa State University and the MVP Program. Satisfactory-fail only.

U St 116. MVP Seminar. (1-0) Cr. 1. S. *Prereq: Recipient of the MVP Award, 115 or consent of instructor.*. A continuation of the introduction to life and resources at Iowa State University and to the functions of the Multicultural Vision Program focusing individually in areas of personal development, ethnic and racial identity, and leadership. Satisfactory-fail only.

U St 120. Student Support Services Program Seminar. (1-0) Cr. 1. S. *Prereq: Acceptance in Student Support Services Learning Community.* Designed to assist students in developing successful academic strategies to meet demands of college and achieve desired goals. Satisfactory-fail only.

U St 160. Gender Justice. (2-0) Cr. 1. F.S. Half semester course. Examines the socialization process in the United States and how our perspectives are formed. An introduction to patriarchy, sexism, and ally development are explored. Skills to enhance communication and understanding among women and men will be developed. Satisfactory-fail only.

U St 170. Leadership ISU. (0-2) Cr. 1. F. *Prereq: Freshman or sophomore classification.* An introductory leadership course for first-year and second-year students. Students will gain a basic understanding of leadership skill development and resources available to student leaders at Iowa State University. Course content will be delivered through a variety of methods such as guest speakers, team building exercises, and small group discussions. Students will be expected to

complete several out of class assignments to apply the leadership skills they have learned. Satisfactory-fail only.

U St 205. Carver Academy Seminar: Peer Mentors. (1-0) Cr. 1. F. *Prereq: 106, intended primarily for sophomores.* Leadership and peer mentor training for Carver Academy students who will be serving as peer mentors in Carver Academy. Definitions and analysis of diversity in academia. Academic portfolio preparation and career exploration. Satisfactory-fail only.

U St 206. Carver Academy Seminar: Peer Mentors. (1-0) Cr. 1. S. *Prereq: 106, Intended primarily for sophomores.* Development of leadership and mentoring skills. Survey of leadership in diverse communities in the U.S. Satisfactory-fail only.

U St 290. Independent Study. Cr. arr. *Prereq: Permission of the associate provost for academic programs.* Independent study on topics of an interdisciplinary nature. Intended primarily for freshmen and sophomores.

N. Ncore. The Ncore Course: Forum on Race and Ethnicity in the United States. Cr. 3. Prereq: Selection as an Ncore student scholar. Attendance at Ncore. Exploration of issues of race and ethnicity in the United States.

U St 301. McNair Scholars Seminar: Orientation to the McNair Program and to Academic Research. (0-2) Cr. 1. F. *Prereq: New fall admit to the Ronald E. McNair Postbaccalaureate Achievement Program.* Covers program guidelines and requirements, the basics of preparing for the graduate admissions process, and the formulation of a research topic to begin the required research project. Satisfactory-fail only.

U St 302. McNairs Scholars Seminar: The Review of Literature and the Methodology. (0-2) Cr. 1. S. *Prereq: 301.* Covers the review of literature and the methodology components of the required research project. Satisfactory-fail only.

U St 305. Carver Academy Seminar: Community Leaders. (1-0) Cr. 1. F. *Prereq: Intended primarily for juniors.* Leadership development for Carver Academy students; frameworks for multicultural leadership. Students will research and assess needs for community enhancement projects under faculty supervision. Satisfactory-fail only.

U St 306. Carver Academy Seminar: Community Leaders. (1-0) Cr. 1. S. *Prereq: Intended primarily for juniors.* Leadership development for Carver Academy students; self-directed development of leadership abilities. Implement student-directed community enhancement projects under faculty supervision. Begin preparation for graduate and professional schools and career placement. Satisfactory-fail only.

U St 311. Leadership Seminar I. (1-0) Cr. 1. Repeatable. *Prereq: 111, 115.* For students serving as peer mentor first-year seminar leaders under faculty supervision. Development of course facilitation and peer leadership skills. Satisfactory-fail only.
A. Leaders in Hixson Seminar
B. Leaders in MVP Seminar

U St 312. Leadership Seminar II. (1-0) Cr. 1. Repeatable. *Prereq: 311.* For students serving as leaders in Hixson Seminar or MVP Seminar under faculty supervision. Development of course facilitation and peer leadership skills. Satisfactory-fail only.
A. Leaders in Hixson Seminar
B. Leaders in MVP Seminar

U St 336. International Perspectives in Career Development. (3-0) Cr. 3. Students will examine the career development process in the context of pursuing an international career. Topics will include career exploration, the job search, and cultural differences from international points of view. Faculty members will guest lecture on culture, history, economics, environment, and art of the selected country. Following the spring seminar students will participate in a study tour of the selected country where they will visit international employers and historical and cultural sites. Satisfactory-fail only.

U St 401. McNair Scholars Seminar: Data Collection and Data Analysis. (0-2) Cr. 1. F. *Prereq: 302.* Covers the data collection and data analysis sections of the required research project. Satisfactory-fail only.

U St 402. McNair Scholars Seminar: Findings, Conclusions, and the Writing of the Final Report. (0-2) Cr. 1. S. *Prereq: 401.* Final course for second year scholars. Covers data analysis, data clean up, and the writing of the final project. Satisfactory-fail only.

U St 405. Carver Academy Seminar: Fellows. (1-0) Cr. 1. F. *Prereq: Intended primarily for seniors.* Continued preparation for graduate school, professional school and/or chosen profession. Research project experience with faculty mentor is required. Satisfactory-fail only.

U St 406. Carver Academy Seminar: Fellows. (1-0) Cr. 1. S. *Prereq: Intended primarily for seniors.* Oral and written presentation of research under faculty supervision. Satisfactory-fail only.

U St 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of the associate provost for academic programs.* Independent study on topics of an interdisciplinary nature. Intended primarily for juniors and seniors.

Courses primarily for graduate students, open to qualified undergraduate students

U St 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of graduate college.* Independent study on topics of an interdisciplinary nature. Intended primarily for graduate students.

Veterinary Clinical Sciences

Claire Andreasen, Interim Chair of Department

Professors: Andreasen, Betts, Evans, Hoefle, Hopkins, Jergens, Kraus, Merkley, Noxon, D. Riedesel, Toombs, Ware, Whitley

Professors (Emeritus): Carithers, Clark, Eness, Grier, Jackson, McGee

Professor (Collaborator): Carpenter

Associate Professors: Baldwin, Booth, Fox, McClure, Miles, O'Brien, Reinertson, E. Riedesel, Wagner

Assistant Professors: Christensen, Deitz, Ellinwood, Grozdanic, Kersh, May, Brett Sponseller, Wong

Instructors (Adjunct): Alcott, Claude, Clemans, Dujowich, Gerber, Ginman, Gross, Koshino, Krebs, L'Heureux, Madron, E. Miller, Morgan, Olsen, Parker, Sakai, Schoeffler, Schutte, Severin, Waller, Willmore, Wynne

Senior Clinician: King

Lecturer: Howard-Martin

Clinicians: Berryessa, Buttrick, Caston, Cerfogli, Galow-Kersh, Howard, Kauffman, Kraus, D. Miller, Morrison, Prickett, Beatrice Sponseller, Thompson, Zacharias

Professional Program of Study

For the professional curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see *Veterinary Medicine, Curriculum.*

The curriculum of veterinary clinical sciences explores the preventive health care, and diagnosis and treatment of diseases of companion and competitive athletic animals. Veterinary specialists lead didactic and laboratory based learning in the clinical sciences. Experiential based courses conducted through the Veterinary Medical Center during the fourth year provide the student an opportunity to participate in the application of clinical skills and knowledge.

Graduate Study

The department offers work for the degree master of science with major in veterinary clinical science, and minor work for students majoring in other departments. Within the veterinary clinical sciences major, the student may specialize in veterinary medicine, surgery, or theriogenology. The D.V.M. degree or equivalent is prerequisite to a major graduate work.

Both thesis and nonthesis options are available and require the completion of a minimum of 30 graduate credits and a final examination.

World languages and cultures requirements may be established by the student's program of study committee.

Courses primarily for professional curriculum students

V C S 305. Shelter Medicine. Cr. 1. S. *Prereq: First year classification in Veterinary Medicine or with permission of instructor.* An elective course designed to educate the veterinary student about issues of relevance to companion animal population and shelter medicine and welfare. Students may concurrently be enrolled in VCS 306X.

V C S 311. Veterinarian in Society I. Cr. R. F. *Prereq: First-year classification in veterinary medicine.* Introduction to the veterinary profession and the various career opportunities available.

V C S 312. Veterinarian in Society II. (Cross-listed with VDPAM). (1-0) Cr. 1. S. *Prereq: First-year classification in veterinary medicine.* A continuation of the Veterinarian in Society series. This course is designed to provide an introduction to the topics of animal behavior, animal welfare, and the human animal bond.

V C S 313. Veterinarian in Society III. (1-1) Cr. 1. F. *Prereq: Second-year classification in veterinary medicine.* A continuation of the Veterinarian in Society series. The course covers selected topics on moral and ethical issues affecting the practice of veterinary medicine.

V C S 314. Veterinarian in Society IV. (1-0) Cr. 1. F. *Prereq: Third-year classification in veterinary medicine.* A continuation of the Veterinarian in Society series. This course will focus on helping students develop their communication, leadership, team building and conflict resolution skills.

V C S 315. Veterinarian in Society V. (1-0) Cr. 1. S. *Prereq: Third-year classification in veterinary medicine.* A continuation of the Veterinarian in Society series. This course will emphasize veterinary law.

V C S 339. Clinical Foundations I. (Cross-listed with B M S). (0-2) Cr. 1. F. *Prereq: First-year classification in veterinary medicine.* Canine physical examination; basic behavior, animal handling and restraint; medical record keeping.

V C S 385. Seminar. Cr. R. Repeatable. F.S. *Prereq: Classification in veterinary medicine.* Seminars and case discussions on selected clinical subjects by staff and fourth-year students of the College of Veterinary Medicine. Attendance is required for a passing grade Satisfactory-fail only.

V C S 391. Clinical Imaging. (1-0) Cr. 1. F. *Prereq: First-year classification in veterinary medicine.* Evaluation of morphologic anatomy of the dog and cat utilizing clinical imaging methods - radiography, ultrasonography, computed tomography, magnetic resonance imaging and nuclear imaging. Emphasis will be placed on normal radiographic anatomy.

V C S 393. Principles of Surgery. (3-0) Cr. 3. F. *Prereq: Second year classification in veterinary medicine.* General principles of surgery of companion animals

V C S 394. Principles of Surgery Laboratory. (0-3) Cr. 1. S. *Prereq: Second year classification in veterinary medicine.* General principles of surgery of companion animals.

V C S 395. Small Animal Surgery. (2-0) Cr. 2. S. *Prereq: V C S 394.* Small animal surgery.

V C S 396. Equine Surgery. (2-0) Cr. 2. S. *Prereq: 394.* Elective course in equine surgery.

V C S 398. Anesthesiology. (1-0) Cr. 1. S. *Prereq: Second-year classification in veterinary medicine.* Anesthetic equipment, agents, and procedures for domestic animals.

V C S 399. Ophthalmology. (1-0) Cr. 1. S. *Prereq: Third year classification in veterinary medicine.* Principles and techniques of medical and surgical ophthalmology.

V C S 401. Advanced Small Animal Orthopedics. (1-0) Cr. 1. S. *Prereq: Third or Fourth-year classification in veterinary medicine.* Lecture course covering advanced diagnosis and treatment of small animal orthopedic conditions. Medical and surgical options are covered.

V C S 402. Clinical Cardiology. (1-0) Cr. 1. F. *Prereq: Third or fourth-year classification in veterinary medicine; 444 or concurrent enrollment in 444.* Elective course in diagnosis and management of cardiac diseases. Emphasis on interpretation of electrocardiography.

V C S 405. Pet Bird and Exotic Species Medicine. (1-3) Cr. 2. Alt. S., offered 2010. *Prereq: Second-, third- or fourth-year classification in veterinary medicine.* Elective course in management and diseases of pet birds and exotic species.

V C S 407. Feline Internal Medicine. (1-0) Cr. 1. F. *Prereq: Third-year classification in veterinary medicine.* Elective course in feline internal medicine.

V C S 414. Companion Animal Nutrition. (1-0) Cr. 1. S. *Prereq: Third or fourth -year classification in veterinary medicine.* Elective course in small animal and equine nutrition.

V C S 415. Advanced Small Animal Dermatology. (1-2) Cr. 2. F. *Prereq: Third or Fourth-year classification in veterinary medicine.* Elective course in dermatology.

V C S 419. Preceptorship in Companion Animal/ Equine Veterinary Medical Practice. (0-40) Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine, permission of department chair.* Elective course in veterinary practice under the guidance of veterinarians in approved practice settings.

V C S 421. Husbandry and Diseases of Non-traditional Species. (2-0) Cr. 1. Alt. F., offered 2010. *Prereq: Second-, third-, or fourth-year classification in veterinary medicine.* Husbandry, management, and common diseases of rabbits, guinea pigs, hamsters, gerbils, rats, and mice.

V C S 436. Small Animal Internal Medicine. (3-0) Cr. 3. F. *Prereq: Third year classification in veterinary medicine.* Clinical diagnosis and treatment of diseases of small animals.

V C S 440. Introduction to Clinics. (Cross-listed with VDPAM). Cr. R. F. *Prereq: Third-year classification in veterinary medicine.* Rotating assignments through multiple sections within the Veterinary Teaching Hospital.

V C S 443. Equine Lameness. (1-2) Cr. 2. S. *Prereq: Second or third-year classification in veterinary medicine.* Orthopedic diseases of the equine.

V C S 444. Small Animal Medicine. (4-0) Cr. 4. F.S. *Prereq: Third-year classification in veterinary medicine.* Clinical diagnosis and treatment of diseases of small animals.

V C S 445. Equine Medicine. (2-0) Cr. 2. F. *Prereq: Third-year classification in veterinary medicine.* Clinical diagnosis and treatment of diseases of equine.

V C S 446. Clinical Neurology. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical rotation in neurology with an emphasis on neurolocalization, disease processes, use of diagnostics in medical and surgical neurology and treatment options. Exposure to neurosurgical techniques.

V C S 448. Diagnostic Imaging and Radiobiology. (2-2) Cr. 3. F.S. *Prereq: Third-year classification in veterinary medicine.* Essentials of diagnostic image interpretation. Essentials of radiobiology, radiation therapy and protection from radiation.

V C S 449. Junior Surgery Laboratory. (1-6) Cr. 3. F. *Prereq: Third-year classification in veterinary medicine.* Pre-laboratory presentations and laboratories introduce the student to surgical technique principles that can be applied to all animal species.
A. Alternative Curriculum - consists of only neutering humane society animals throughout the laboratory experience.
B. Traditional Curriculum - provides a broader range of surgical experiences throughout the laboratory experience, including humane society neutering.

V C S 450. Disturbances of Reproduction. (Cross-listed with VDPAM). (4-0) Cr. 4. F. *Prereq: Third-year classification in veterinary medicine.* General principles of diseases causing disturbances in reproduction.

V C S 451. Advanced Junior Surgery Laboratory. (1-6) Cr. 2. S. *Prereq: 449. 8 weeks.* Continuation of surgical laboratory experience. Techniques and advanced principles learned are applicable to all animal species.
A. Alternative Curriculum - consists of only neutering humane society animals throughout the laboratory experience.
B. Traditional Curriculum - exposure to more advanced surgical techniques with most surgical principles useful in all animal species. Also includes some humane society neutering.
C. Traditional Curriculum - a second repeat for students with a special interest in small animal surgery. Limited space is available.

V C S 452. Clinical Dermatology. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine, small animal option.* Study of clinical dermatological problems via computer-aided instruction, case simulations, and/or lectures. Clinical management of cases presented to Veterinary Teaching Hospital.

V C S 453. Small Animal Medicine I. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in small animal medicine.

V C S 454. Small Animal Medicine II. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in small animal medicine.

V C S 455. Small Animal Soft Tissue Surgery. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in soft tissue surgery.

V C S 456. Small Animal Orthopedic Surgery. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in orthopedic surgery.

V C S 457. Equine Medicine. Cr. 4. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in equine medicine.

V C S 458. Equine Surgery. Cr. 4. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in equine surgery.

V C S 459. Small Animal Overpopulation Medicine and Surgery. Cr. 2. *Prereq: Fourth year classification in Veterinary Medicine.* A 2-week surgical emphasis, elective rotation at a humane society that addresses the issues facing veterinarians and non-veterinary humane society personnel who deal with small animal overpopulation issues. Each section can be taken for credit once.
A. Nebraska Humane Society, Omaha NE
B. Animal Rescue League of Iowa, Des Moines IA.
C. WaySide Waifs, Kansas City MO

V C S 460. Radiology. Cr. 3. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in veterinary radiology.

V C S 463. Community Practice. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical experience in hospital based general practice.

V C S 464. Equine Field Services. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in equine ambulatory practice.

V C S 465. Farrier. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine; 457 and 458.* Elective clinical assignment on the principles and practices of normal and therapeutic horseshoeing and equine foot care.

V C S 466. Anesthesiology. Cr. 3. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in small animal and large animal anesthesiology.

V C S 468. Intensive Care. Cr. 4. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment to provide supervision of hospital cases requiring intensive care and including emergency cases.

V C S 469. Ophthalmology. Cr. 2. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in ophthalmology.

V C S 470. Radiology. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine. Completion of VCS 460 recommended.* Elective clinical assignment in veterinary radiology.

V C S 471. Animal Reproduction. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in animal reproduction. Equine and small animal reproduction only.
E. Equine Reproduction
S. Small Animal Reproduction

V C S 472. Small Animal Medicine. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in small animal medicine.

V C S 473. Small Animal Surgery. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in small animal surgery split between soft tissue surgery (one week) and orthopedic surgery (one week).

V C S 474. Equine Medicine and Surgery. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in equine medicine or surgery.
M. Medicine
S. Surgery

V C S 476. Anesthesiology. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in small animal and large animal anesthesiology.

V C S 478. Intensive Care. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in intensive care.

V C S 479. Ophthalmology. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine and V C S 469.* Elective clinical assignment in ophthalmology.

V C S 480. Veterinary Dentistry. Cr. 1. F. *Prereq: Third or Fourth-year classification in veterinary medicine.* All aspects of veterinary dentistry, prophylaxis, endodontics, and orthodontics.

V C S 483. Advanced Small Animal Surgery. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine and V C S 473.* Elective clinical assignment in small animal surgery. One or both sections offered can be taken more than once.
O. Orthopedic surgery
S. Soft tissue surgery

V C S 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

V C S 492. Orientation for International Experience. (2-0) Cr. 1. Repeatable. S. *Prereq: Classification in veterinary medicine.* 8 weeks. Predeparture orientation for group study abroad. Cultural considerations for the study abroad experience and a conversational language introduction. Out of class work may be assigned.

V C S 495. Seminar. Cr. R. S. *Prereq: Fourth-year classification in veterinary medicine.* Seminars and case discussions on selected subjects by staff of the College of Veterinary Medicine and others, including student presentations. Completion of the seminar is required for graduation. Satisfactory-fail only.

V C S 496. International Preceptorship. (0-40) Cr. arr. Repeatable. *Prereq: Second-year classification in veterinary medicine.* International Preceptorships and Study Abroad Group programs. Provides opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduate students

V C S 590. Special Topics. Cr. arr. Repeatable.
A. Medicine
B. Surgery
C. Theriogenology
D. Radiology
E. Anesthesiology

V C S 596. International Preceptorship. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: Admission to graduate college.* International Preceptorships and Study Abroad Group programs. Provides opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

V C S 599. Creative Component. Cr. arr. *Prereq: Enrollment in nonthesis master's degree program.*

Courses for graduate students

V C S 604. Seminar. Cr. 1. Repeatable. F.S.

V C S 640. Advanced Radiology. (2-0) Cr. 2. *Prereq: 448.* Detailed principles of clinical radiology with particular reference to radiographic interpretation.

V C S 671. Advanced General Surgery. (1-3) Cr. 2. *Prereq: Permission of instructor.* Course designed to discuss and perform advanced surgical procedures in soft tissue, orthopedic and neurological surgery. Minimally invasive surgical procedures and organ transplantation will be included.

V C S 672. Advanced Special Surgery. (1-3) Cr. 2. *Prereq: Permission of instructor.* Innovative techniques in microvascular, thoracic, gastrointestinal, neurological and reconstructive surgery will be investigated.

V C S 676. Advanced Medicine. (2-0) Cr. 2. *Prereq: 445.* Principles of general medicine. A study in depth of factors that contribute to the development of clinical signs as related to the pathogenesis of disease.

V C S 677. Advanced Medicine. (2-0) Cr. 2. *Prereq: 445.* An advanced study of metabolic diseases.

V C S 699. Research. Cr. arr. Repeatable.
A. Medicine
B. Surgery
C. Theriogenology
E. Anesthesiology

Veterinary Diagnostic and Production Animal Medicine

Patrick Halbur, Chair of Department

University Professor: McKean

Professors: Evans, Halbur, Harris, Hoffman, Hopkins, Hyde, Janke, Osweiler, Shearer, Thomson, Trampel, Uhlenhopp, Yoon, Zimmerman

Professors (Emeritus): Carson, Hartwig, Hopper, Kunesh, Wass

Professor (Collaborator): Thacker

Associate Professors: Engelken, Frana, Hurd, Kersting, Main, Millman, O'Connor, Thompson, Timms, Youngs

Associate Professors (Collaborators): Apley, Polson

Assistant Professors: G. Dewell, Holtkamp, Karriker, Opriessnig, Ramirez, Wang

Assistant Professors (Adjunct): Harmon, Imerman, Kinyon

Assistant Professors (Collaborators): Erdman

Instructors (Adjunct): Clothier, Irwin, Madson, Patterson, Vander Ley

Senior Clinicians: Baker, Cooper, Gorden

Lecturers: Bickett-Weddle, C. Plummer, Sweiger

Clinicians: R. Dewell, Ensley, Gauger, Johnson, Kim, Leuschen, P. Plummer, Ramamoorthy, Rathje, Schwartz, Strait, West

Professional Program of Study

For the professional curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see V*eterinary Medicine, Curriculum.*

Courses in veterinary diagnostic and production animal medicine provide students with basic and advanced skills in diagnostics, reproduction, medicine, surgery, production, and health management of the major livestock species. Students in the fourth year of the curriculum in veterinary medicine may elect to take advanced courses in beef, dairy, swine, poultry or sheep production medicine. Elective courses may include preceptorships in private practices, at other veterinary schools, in research and disease control laboratories, or in related agribusinesses.

Production animal medicine emphasizes the integration of veterinary medicine with nutrition, genetics, economics, food safety, and other disciplines, enabling graduates to acquire and use a broad knowledge base to support the health and improve the production and efficiency of the food supply chain.

Graduate Study in Veterinary Preventive Medicine

Veterinary Preventive Medicine is a multidisciplinary program focused on the study of health and disease in populations. The various disciplines represented in the program are unified by a common approach based on the application of statistical methods to problem solving in populations. Through their research and course work, students will learn to understand and apply a variety of disciplines, principles, and techniques to population health issues involving environmental, ecological, nutritional, genetic, infectious, or non-infectious diseases.

Graduate study in Veterinary Preventive Medicine will provide valuable skills and experience to persons interested in public health, food safety, emerging infectious diseases, zoo or wildlife health management, and livestock health. A degree in Veterinary Preventive Medicine may be valuable for individuals considering a future in the biological or pharmaceutical industries, government regulatory agencies, public veterinary practice, or international service agencies responsible for population health.

Veterinary Preventive Medicine is an interdepartmental major administered by the Department of Veterinary Diagnostic and Production Animal Medicine (VDPAM) with participating faculty from colleges and departments across the University and collaborators from the National Animal Disease Center (USDA:ARS) and the National Veterinary Services Laboratories (USDA:APHIS) located in Ames, Iowa.

Both thesis and nonthesis options are available and require the completion of a minimum of 30 graduate credits for thesis and 36 graduate credits for nonthesis and a final examination.

Graduate Study in Veterinary Diagnostic and Production Animal Medicine

Veterinary Diagnostic and Production Animal Medicine masters degree is a program focused on the assessment of health and disease in populations of animals and the development of methods to study populations of animals. The various disciplines represented in the program are unified by a common approach based on the application of epidemiological and statistical methods to enable quantitative evaluation and critical appraisal of clinical and research data to continuously establish best production practices for health assurance; further to provide the principles and tools for design and execution of hypothesis-based research in production animal units or in research trials supporting animal health issues. Through their research and course work, students will learn to understand and apply a variety of disciplines, principles, and techniques to population health issues involving environmental, ecological, nutritional, genetic, infectious, or non-infectious diseases. This includes gaining knowledge of current principles of diagnostic evaluation and critical to best support decisions about animal health programs and practices.

Graduate students will be provided experiences in production animal medicine by involvement in the animal health and food supply decision making processes of modern production systems.

Graduate study in Veterinary Diagnostic and Production Animal Medicine will provide valuable skills and experience to persons interested in public health, food safety, food policy, emerging infectious diseases, wildlife health management, and livestock health assurance. A degree in Veterinary Diagnostic and Production Animal Medicine may be valuable for individuals considering leadership positions in food supply veterinary medicine.

Veterinary Diagnostic and Production Animal Medicine is administered by the Department of Veterinary Diagnostic and Production Animal Medicine (VDPAM) with participating faculty from colleges and departments across the University and collaborators from the National Animal Disease Center (USDA:ARS) and the National Veterinary Services Laboratories (USDA:APHIS) located in Ames, Iowa.

Both thesis and nonthesis options are available and require the completion of a minimum of 30 graduate credits for thesis and 36 graduate credits for nonthesis and a final examination.

Courses primarily for professional curriculum students

VDPAM 309. Intro to Production Animal Informatics. (1-0) Cr. 1. S. The fundamentals of how clinical, diagnostic, production and financial information is obtained and used by production animal operations. Students will acquire skills to create and use spreadsheets for manipulating and summarizing data. They will also acquire knowledge of where to find inexpensive and readily available resources with information on how to use spreadsheets and other software. Students will also have the opportunity to work with different record keeping programs used by swine, beef and dairy operations.

VDPAM 310. Intro to Production Medicine. Cr. 2. S. *Prereq: Currently enrolled in Vet Med III.* The role of the veterinarian in the management of animal health and production in dairy and beef cattle herds, beef feedlots and swine herds. Provides veterinary students with a starting point to understand the principles and techniques that are the basis of food-animal health management programs.

VDPAM 311. Introduction to Food Animal Clinics. (1-1) Cr. 1. Repeatable. S. *Prereq: Vaccinated for rabies, enrollment in Veterinary Medicine.* A one hour per week discussion of current cases in the food animal hospital and topics of interest. Student will learn physical examination of the food animal as well as animal handling techniques and record keeping procedures. Students will be able to participate in activities related to cases in the food animal hospital and the VDPAM Department. Satisfactory-fail only.

VDPAM 312. Veterinarian in Society II. (Cross-listed with V C S). (1-0) Cr. 1. S. *Prereq: First-year classification in veterinary medicine.* A continuation of the Veterinarian in Society series. An introduction to the topics of animal behavior, animal welfare, and the human animal bond.

VDPAM 340. Clinical Foundations I. (0-40) Cr. 1. F.S.SS. *Prereq: Classification in veterinary medicine.* One week course at Great Plains Veterinary Educational Center in Clay Center, Nebraska. An introduction to Food Supply Veterinary Medicine covering industry (beef, dairy, pork, sheep) overviews, production systems, behavior, welfare, handling and restraint and examination techniques, biosecurity, epidemiology and food safety.

VDPAM 350. Basic Livestock Nutrition and Feeding. (1-0) Cr. 1. S. *Prereq: Classification in Veterinary Medicine.* Introductory course on livestock (beef, dairy, swine, sheep, and equine) nutrition and feeding principles. Students will apply scientific facts and principles to problem-solving procedures in determining nutritious and economical livestock feeding programs.

VDPAM 402. Advanced Dairy Production Informatics. (1-1) Cr. 2. Repeatable. S. *Prereq: 309 or permission of instructor.* Advanced coverage of concepts related to collection, manipulation, analysis and reporting of information used by dairy farms and their consultants. Hands on experience with Dairy Comp 305 and PCDart as well as other dairy management and information software. Integrates this data with dairy operations' financial situations.

VDPAM 402L. Advanced Dairy Production Informatics Lab. Cr. arr. Repeatable. S. *Prereq: Permission of instructor.* Continued practice in computer dairy records. Experience in tracking sample herd performance and providing written report with graphs/tables as the final assignment

VDPAM 407. Evidence Based Clinical Decision Making. (Dual-listed with 507). (1-0) Cr. 1. S. *Prereq: Permission of instructor.* Discussion, lectures and laboratories to assess the quality and significance of medical evidence in making informed decisions about the treatment of individual animals and animal populations.

VDPAM 408. Poultry Diseases. (Dual-listed with 508). Cr. 2. Alt. S., offered 2010. *Prereq: Enrollment in College of Veterinary Medicine.* Bacterial, viral, parasitic, and nutritional diseases of domestic poultry and gamebirds; biosecurity, immunization, and management procedures to prevent poultry diseases.

VDPAM 414. Veterinary Practice Entrepreneurship. (Dual-listed with 514). Cr. 2. S. *Prereq: Graduate Veterinarian.* To provide a formal exposure to the entrepreneurial and business skills necessary to own and operate a successful veterinary practice.

VDPAM 416. Bovine Reproduction Evaluation Laboratory. (0-4) Cr. 1. F.S. *Prereq: Third year classification in veterinary medicine. 10 students per section.* Bovine rectal palpation techniques will be repetitively taught in 7 four-hour sessions. Students will also learn techniques of epidural anesthesia, artificial insemination, and ultrasonic imaging. University-owned cattle will be used.

VDPAM 419. Advanced Swine Production Informatics. (1-0) Cr. 1. F. *Prereq: 309.* Advanced coverage of concepts related to collection, manipulation, analysis and reporting of information used by swine production companies. Production, financial, diagnostic and clinical data will be covered in the course. Hands-on experience with computer software and information systems used in swine production will be provided. Students will learn to objectively evaluate the validity of information that is presented to them and also be able to make practical and useful recommendations regarding the types of information tools that can/should be used. The students will learn what software and information systems are available and be able to critically evaluate them.

VDPAM 420. Preceptorship in Veterinary Medical Practice. Cr. arr. Repeatable. F.S.SS. *Prereq: Fourth-year classification in veterinary medicine.*. Elective course in veterinary practice under the guidance of veterinarians in approved practice settings.

VDPAM 426. Veterinary Toxicology. (Dual-listed with 526). (3-0) Cr. 3. S. *Prereq: Third-year classification in veterinary medicine.* Study of toxicological diseases of domestic animals emphasizing clinical recognition, circumstances of poisoning, differential diagnosis with clinical and laboratory data, therapeutic procedures, preventive management and public health implications. Supplemented with case-based materials.

VDPAM 436. Beef Records Analysis. (0-30) Cr. arr. F.S. *Prereq: Classification in Veterinary Medicine, VM1-VM3 or special permission of instructor.* The class will have both a lecture and lab component and students can enroll in one or both. Lectures will emphasize current production and evaluation techniques for beef cow/calf operations and students will learn to conduct and critically assess production and financial data using a standardized approach. Lab activities will allow students an opportunity to work with individual beef cattle producers to identify areas for improving profitability, health, and sustainability. Enrolling in the class for multiple semesters will be encouraged.

VDPAM 437. Basic Clinical Skills for Production Medicine (MS 623-701): Dairy Herd Problem Identification. (7-33) Cr. 2. F.S.SS. *Prereq: Fourth-year classification in veterinary medicine.* Seven hours recitation/discussion and 33 hours clinical experience per week. Course taken for two weeks at University of Wisconsin, Madison, on a space-available basis. Learn to interpret DHI records and use them to identify and monitor herd problems of production, mastitis, reproduction, and replacement heifer management. Evaluate rates and treatment protocols of common dairy herd diseases. Assess dairy housing including ventilation and freestalls. Estimate costs of herd problems and develop partial-budgets.

VDPAM 438. Mastitis Problem Investigations (MS 623-703): Mastitis/Milk Quality. (9-31) Cr. 2. F.S.SS. *Prereq: Fourth-year classification in veterinary medicine.* Nine hours recitation/discussion and 31 hours clinical experience per week. Course taken for two weeks at University of Wisconsin, Madison, on a space-available basis. Learn to evaluate rates of clinical mastitis using manual and computerized (DC305) record systems. Interpret somatic cell count records to target mastitis problems. Collect samples and interpret milk microbiology reports. Evaluate mastitis risks in housing systems (stalls, bedded packs, etc). Analyze milking systems and milker practices. Develop mastitis treatment protocols.

VDPAM 439. Clinical Investigations of Fresh Cow and Calf Problems (MS 623-705): Applied Dairy Nutrition. (3-37) Cr. 2. F.S.SS. *Prereq: Fourth-year classification in veterinary medicine.* Three hours lecture, 37 hours clinical experience per week. Course taken for two weeks at University of Wisconsin, Madison, on a space-available basis. Learn to evaluate calf and peri-parturient cow management practices. Develop an investigation stragegy for ambiguous herd problems. Collect samples and interpret herd-based diagnostic tests for infectious and metabolic diseases. Assess environmental risk factors for metabolic and infectious disease including hygiene and housing. Assess nutritional status of herds via nutritional management, actual feed intake, particle length determination, etc.

VDPAM 440. Introduction to Clinics. (Cross-listed with V C S). Cr. R. F. *Prereq: Third-year classification in veterinary medicine.* Rotating assignments through multiple sections within the Veterinary Teaching Hospital.

VDPAM 445. Clinical Medicine. (3-0) Cr. 3. S. *Prereq: Third year classification in veterinary medicine.* Clinical diagnosis and treatment of diseases of swine, beef, dairy, and sheep.

VDPAM 450. Disturbances of Reproduction. (Cross-listed with V C S). (4-0) Cr. 4. F. *Prereq: Third-year classification in veterinary medicine.* General principles of diseases causing disturbances in reproduction.

VDPAM 451. Clinical Embryo Transfer. (0-40) Cr. 2. F.S.SS. *Prereq: Fourth year classification in veterinary medicine.* Elective clinical assignment in techniques of embryo transfer. Primary species studied will be bovine but equine and small ruminant embryo transfer will be covered during appropriate seasons. Enrollment is limited to four students per two week session.

VDPAM 455. Diagnostic Laboratory Practicum. Cr. 2. Repeatable. F.S. *Prereq: Fourth-year classification in veterinary medicine.* Practical experience in diagnosis of infectious and toxic diseases of livestock through exposure to cases in the ISU Veterinary Diagnostic Laboratory.

VDPAM 456. Veterinary Diagnostic Lab Methods & Applications. (16-0) Cr. 1. F. *Prereq: VM 2, VM 3 or VM 4.* Cases materials are used to develop diagnostic questions and to better understand the value of diagnostic tests. Testing methods and interpretation of diagnostic tests are coupled with sampling strategy and objective assessment of available evidence to provide accurate diagnosis.

VDPAM 476. Food Animal Field Service. (40-0) Cr. 2. F.S. *Prereq: Fourth year classification in Veterinary Medicine or Permission of Instructor.* Elective course in food animal field services. Students will assist the University veterinarian in delivering health care production management services to the ISU livestock farms and other selected farms in the region. Focus will be on delivery of individual animal care and establishment of best practices for herd management of dairy production systems at the university and in the region.

VDPAM 477. Food Animal Medicine and Surgery. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment focused on the management of food animal medicine and surgery cases. Specific instruction in clinical evaluation of cases coupled with appropriate diagnostic testing and therapeutic intervention will be emphasized. Additional instruction will be provided in disease prevention, intensive care and management of food animal species. Particular emphasis will be placed on appropriate on-label and extra-label drug usage in food animal species.

VDPAM 479. Applied Swine Production Medicine. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: 310.* Advanced course in swine production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week. Assignments will include preceptorships with a practicing veterinarian and/or a production unit.

VDPAM 480. Swine Production Medicine. (15-25) Cr. 2. Repeatable. F.S.SS. *Prereq: 310 or permission of instructor.* Two week clinical rotation in swine production medicine. Students will be assigned to take the lead in investigating field based client cases with supervision of the instructors. Develop critical thinking skills that will allow students to apply concepts of herd management, production analysis, economic analysis, and disease prevention in addressing client cases. Variable amounts of travel to farm sites will be required with the potential for rare overnight stays.

VDPAM 482. Applied Beef Production Medicine. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: 310.* Advanced course in beef production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week.
A. Assignment with practicing veterinarian and/or production unit
B. Bull Breeding Soundness at Great Plains Veterinary Educational Center (GPVEC)
C. Calving at GPVEC
D. Feedlot Management at GPVEC
E. Weaning Management at GPVEC
F. Pregnancy Examination at GPVEC
G. Bovine Reproduction at GPVEC
I. Stocker/Feedlot Management

VDPAM 483. Beef Production Medicine. (15-20) Cr. 2. F.S. *Prereq: 310.* Two week advanced clinical rotation in beef production medicine. Fifteen hours recitation/discussion and 20 hours clinical experience per week. This course is designed to expose students to cow-calf and feedlot production concepts. The activities scheduled for the rotation depend greatly on the time of year. When ever possible, the class incorporates field trips. Students should anticipate that travel is required and overnight stays may be required. These field trips can vary in length from several hours to several days and may include weekends. As of 2006, one week of the rotation is spent at the Great Plains Veterinary Education Center, Clay Center, NE. Students should, therefore, plan accordingly and contact the instructor, immediately, if they anticipate a conflict. Students should not schedule Grand Rounds during this rotation.

VDPAM 484. Dairy Production Medicine. (15-20) Cr. 2. F.SS. *Prereq: Fourth-year classification in veterinary medicine; 310.* Two week course in dairy production medicine combining class time with multiple on-farm visits to learn various management aspects (DHIA, DC305 & PC Dart record analysis, calf rearing through lactating cows, reproduction programs, udder health and milk quality, biosecurity, welfare, nutrition and cow comfort) for a wide variety of dairy operations. Students will learn the latest in dairy management by reviewing current topic articles and gain experience in farm evaluation through a group project. Fifteen hours recitation/discussion and 20 hours clinical experience per week.

VDPAM 485. Applied Dairy Production Medicine. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: VDPAM 484.* Advanced course in dairy production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week. Assignments will include preceptorships with a practicing veterinarian and/or a production unit.

VDPAM 486. Introduction to Small Ruminant Production Medicine. (13-6) Cr. 1. S. *Prereq: Classification in Veterinary Medicine.* Herd health, disease monitoring and prevention, and typical management systems will be emphasized in lecture. Students will be required to learn and demonstrate proficiency at typical veterinary procedures such as blood collection, breeding soundness exams and parasite evaluations. Students will also be expected to develop herd health programs for individual producers. Field trip required.

VDPAM 487. Livestock Disease Prevention. (3-0) Cr. 3. F. A survey of diseases of large domestic animals, including discussion of causes, transmission, and control. Designed for students majoring in agricultural sciences.

VDPAM 488. Laboratory in Clinical Microbiology. Cr. 1. Repeatable. F.S.SS. *Prereq: Fourth-year classification in veterinary medicine.* Application of microbiological procedures to the diagnosis of infectious diseases.

VDPAM 489. Issues in Food Safety. (Cross-listed with An S, FS HN, HRI). (1-0) Cr. 1. S. *Prereq: Credit or enrollment in FS HN 101 or 272 or HRI 233; FS HN 419 or 420; FS HN 403.* Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

VDPAM 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of department chair.*

VDPAM 491. Advanced Ruminant Nutrition. (30-10) Cr. 3. F. *Prereq: 350 recommended.* Beef and dairy nutrition from the calf to the adult, lactating cow. Balanced rations for beef cow-calf, feedlot & dairy operations. Introduces different feedstuffs and forage varieties to determine those that are best suited for bovine diets.

VDPAM 492. Orientation for International Experience. (2-0) Cr. 1. S. *Prereq: Classification in veterinary medicine.* Predeparture orientation for group study abroad. Cultural considerations for the study abroad experience and a conversational language introduction. Out of class work will be assigned.

VDPAM 494. Advanced Dairy Production Medicine II. (20-20) Cr. 2. S. *Prereq: 484 or permission of instructor.* Advanced coverage in investigating dairy herd problems relating to milk quality or nutrition. Milk quality and nutrition troubleshooting will be taught through the combination of lecture and on-farm investigations. Students will combine lecture knowledge, data acquired from on-farm investigations and record analysis to generate management plans.

VDPAM 496. International Preceptorship. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: Second-year classification in veterinary medicine.* International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduate students

VDPAM 507. Evidence Based Clinical Decision Making. (Dual-listed with 407). (1-0) Cr. 1. S. *Prereq: Permission of instructor.* Discussion, lectures and laboratories to assess the quality and significance of medical evidence in making informed decisions about the treatment of individual animals and animal populations.

VDPAM 508. Poultry Diseases. (Dual-listed with 408). Cr. 2. Alt. S., offered 2010. *Prereq: Permission of instructor.* Bacterial, viral, parasitic, and nutritional diseases of domestic poultry and gamebirds; biosecurity, immunization, and management procedures to prevent poultry diseases.

VDPAM 514. Veterinary Practice Entrepreneurship. (Dual-listed with 414). Cr. 2. S. To provide a formal exposure to the entrepreneurial and business skills necessary to own and operate a successful veterinary practice.

VDPAM 522. Principles of Epidemiology and Population Health. (Cross-listed with V MPM). (3-0) Cr. 3. S. *Prereq: Micro 310 or equivalent.* Epidemiology and ecology of disease in populations. Disease causality and epidemiologic investigations. Issues in disease prevention, control, and eradication.

VDPAM 526. Veterinary Toxicology. (Dual-listed with 426). (Cross-listed with Tox). (3-0) Cr. 3. S. *Prereq: Permission of instructor.* A study of the disease processes in animals caused by toxicants and the use of differential diagnostic and therapeutic procedures. Emphasis is on use of clinical cases to define mechanism of poisoning, diagnostic and management procedures and public health and food safety issues.

VDPAM 527. Applied Statistical Methods in Population Studies. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 401.* Measures of agreement, assessment of diagnostic tests, correlated data analysis, bioinformatics, linear models, comparison of multiple groups.

VDPAM 529. Epidemiological Methods in Population Research. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Stat 401.* Designing, conducting, and analyzing data from field-based studies, including cross-sectional, case-control, cohort, and ecological studies. Clinical trials. Modeling disease in populations.

VDPAM 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, B BMB, BCB, B M S, FS HN, Hort, NutrS, EEOB, NREM,V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

VDPAM 546. Clinical and Diagnostic Toxicology. (Cross-listed with Tox). (0-3) Cr. arr. Repeatable. F.S.SS. *Prereq: D.V.M. degree or 526.* Advanced study of current problems and issues in toxicology. Emphasis on problem solving utilizing clinical, epidemiological, and laboratory resources.

VDPAM 551. Advanced Veterinary Diagnostic Medicine. (0-3) Cr. arr. Repeatable. F.S.SS. *Prereq: 455.* Necropsy techniques of animals with emphasis on gross and microscopic lesion description and microbiological diagnosis of disease in food animals.

VDPAM 570. Risk Assessment for Food, Agriculture and Veterinary Medicine. (Cross-listed with Agron, Tox). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 104 or consent of instructor: Wolt, Hurd.* Risk assessment principles as applied to biological systems. Exposure and effects characterization in human and animal health and ecological risk assessment. Risk analysis frameworks and regulatory decision-making. Introduction to quantitative methods for risk assessment using epidemiological and distributional analyses. Uncertainty analysis.

VDPAM 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics in medicine, surgery, theriogenology; beef, swine, dairy, or sheep production medicine.

VDPAM 596. International Preceptorship. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: Admission to graduate college.* International Preceptorships and Study Abroad Group programs. Provides opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

VDPAM 599. Creative Component. Cr. arr. Repeatable. *Prereq: Enrollment in nonthesis master's degree program.*

Courses for graduate students

VDPAM 650. Swine Diagnostic Medicine. Cr. arr. SS. *Prereq: Permission of instructor.* A detailed study of swine diseases emphasizing the pathogenesis and diagnosis of swine respiratory, enteric, reproduction, metabolic, and septicemic diseases.

VDPAM 655. Advanced Swine Production Medicine. Cr. arr. S. *Prereq: Permission of instructor.* Detailed overview of applied techniques used in swine production medicine; production modeling and record analysis, production economics and financial analysis, therapeutic and vaccination strategies, quality control procedures and food safety.

VDPAM 699. Research. Cr. arr. Repeatable.

Veterinary Microbiology and Preventive Medicine

Michael Wannemuehler, Interim Chair of Department

Distinguished Professors: Roth

Distinguished Professors (Emeritus): Beran, Cheville, Kaeberle, Ross, Switzer

Professors: Minion, Nolan, Phillips, Platt, Reynolds, Rosenbusch, Thoen, Uhlenhopp, Wannemuehler, Yoon, Zhang, Zimmerman

Professors (Emeritus): Hogle, Kramer, Moon

Professors (Collaborators): Carpenter, Kehrli, Nystrom-Dean, Schultz, Tabatabai, Thacker

Associate Professors: Cornick, Davis, Griffith

Associate Professors (Collaborators): Frey, Harp, Panigrahy, Richt, Sacco, Sharma, Zuerner

Assistant Professors: Bellaire, Blitvich, Miller, Sponseller

Assistant Professors (Collaborators): Anderson, Bannantine, Brockmeier, Faaberg, Halling, Lager, Register, Roof, Scupham, Stabel, Stanton, Vaughn, Vincent, Waters, Wesley

Instructor (Collaborator): Schlater

Lecturer: Brown

Clinician: Plummer

The Department of Veterinary Microbiology and Preventive Medicine offers instruction in the areas of bacteriology, mycology, virology, immunology, epidemiology and public health at the graduate level.

Microbiologic, immunologic, regulatory, and preventive medical aspects of infectious diseases of animals are emphasized in courses for students in the veterinary curriculum.

Professional Program of Study

For the professional curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see *Veterinary Medicine, Curriculum*.

The Department of Veterinary Microbiology and Preventive Medicine provides instruction on pathogenic bacteria, fungi, and viruses and their interaction with host animal species. Principles and applications of infectious diseases, immunity to disease, diagnostic methods for infectious diseases, and vaccinology are covered. Principles and applications of epidemiology, public health, preventive veterinary medicine, regulatory veterinary medicine and food safety are also emphasized.

Graduate Study

The department offers opportunities for the degree doctor of philosophy with a major in veterinary microbiology. A specialization in preventive medicine is an option for this degree. Graduates in the Veterinary Microbiology and Preventive Medicine programs have a broad understanding of the fundamental processes involved in infectious diseases, pathogenesis and immunology. They are able to effectively establish research programs, which involve complex biological systems and disease syndromes. They are also prepared to address microbial-based social, ethical and environmental problems. Graduates acquire effective written and oral communication skills which lead to successful research and teaching careers in the medical and veterinary sciences. The department also offers work towards the master of science with majors in veterinary microbiology or veterinary preventive medicine. A non-thesis master's option is available for majors in preventive medicine. Courses are open for students majoring in other graduate programs.

Prerequisite to graduate study is completion of coursework in general microbiology, biology, biochemistry, mathematical sciences, and physics. Candidates for the majors in veterinary microbiology should possess an undergraduate degree in biomedical science with emphasis in medical microbiology or the D.V.M. degree. Candidates for the major in preventive medicine should possess the D.V.M. degree.

The department also participates in the interdepartmental majors and programs in genetics, immunobiology, and MCDB (molecular, cellular, and developmental biology; see Index).

Each graduate student must demonstrate proficiency in English composition within two semesters in residence.

Courses primarily for professional curriculum students

V MPM 378. Case Study IV. (2-0) Cr. 2. S. *Prereq: Second-year classification in veterinary medicine.* Case-based applied learning that relates to the basic science courses. Emphasis on early integration of basic and clinical science concepts.

V MPM 380. Veterinary Immunology. (2-0) Cr. 2. S. *Prereq: First-year classification in veterinary medicine.* Structure and function of the immune system in animals.

V MPM 386. Veterinary Microbiology. (3-5) Cr. 5. F. *Prereq: Second-year classification in veterinary medicine.* Bacteria and fungi of veterinary importance with emphasis on mechanisms of disease production and laboratory diagnostic procedures.

V MPM 387. Veterinary Virology. (3-0) Cr. 3. S. *Prereq: Second-year classification in veterinary medicine.* Basic principles of animal virology. Pathogenesis of viral infections. The nature and ecology of viruses of veterinary and zoonotic importance.

V MPM 388. Public Health and the Role of the Veterinary Profession. (3-0) Cr. 3. S. *Prereq: Second-year classification in veterinary medicine.* Fundamental epidemiology, zoonotic diseases, occupational health, food safety, other public health topics.

V MPM 390. Topics in Veterinary History. (2-0) Cr. 1. S. 8 weeks. Significant persons, noteworthy events, and pivotal scientific discoveries in the course of the development and advancement of veterinary medicine from ancient times to the present.

V MPM 409. Infectious Diseases of Captive Wild Animals. (1-0) Cr. 1. F. *Prereq: Second year classification in veterinary medicine.* Infectious diseases (bacterial, viral, and mycotic) of non-human primates, birds, ruminants, cold-blooded animals, marine mammals, and carnivores.

V MPM 437. Infectious Diseases and Preventive Medicine. (3-0) Cr. 3. S. *Prereq: Third-year classification in veterinary medicine.* Etiology, epidemiology, laboratory diagnosis, regulatory control and preventive medicine aspects of the infectious diseases of swine, sheep, goats, cattle and horses.

V MPM 486. Laboratory in Public Health. Cr. 1. Repeatable. F.S. *Prereq: Fourth-year classification in veterinary medicine.* Discussions, lectures, exercises and field trips related to veterinary public health.

V MPM 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor and department chair.*

V MPM 491. CDC Epidemiology Elective Preceptorship. Cr. 6. F.S.SS. Introduction to preventive medicine, public health and the principles of applied epidemiology within the working atmosphere of the Centers for Disease Control.

V MPM 494. Zoo Preceptorship. Cr. arr. Repeatable. F.S.SS. *Prereq: Fourth year classification in veterinary medicine.* Elective course in zoo veterinary practice under guidance of approved veterinarians.

V MPM 496. International Preceptorship. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: Second-year classification in veterinary medicine.* International Preceptorships and Study Abroad group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduate students

V MPM 520. Medical Immunology I. (4-0) Cr. 4. F. *Prereq: Micro 310 or V MPM 386, 3 credits in biochemistry.* Nature of the immune system and its role in health and disease. Credit for either V MPM 520 or 575, but not both may be applied toward graduation.

V MPM 522. Principles of Epidemiology and Population Health. (Cross-listed with VDPAM). (3-0) Cr. 3. S. *Prereq: Micro 310 or equivalent.* Epidemiology and ecology of disease in populations. Disease causality and epidemiologic investigations. Issues in disease prevention, control, and eradication.

V MPM 536. Zoonoses and Environmental Health. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 386, 387 and 388 or equivalent or permission of instructor.* Pathogensis and control of zoonotic diseases. Factors influencing transmission and survival of pathogenic microorganisms in the environment.

V MPM 540. Livestock Immunogenetics. (Cross-listed with An S, Micro). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: An S 561 or Micro 575 or V MPM 520.* Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

V MPM 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BBMB, BCB, B M S, EEOB, FS HN, Hort, NREM, NutrS, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.

A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

V MPM 565. Professional Practice in the Life Sciences. (Cross-listed with Pl P, Agron, An S, BCB, Hort, Micro). Cr. arr. Repeatable. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.
A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

V MPM 575. Immunology. (Cross-listed with MICRO). (3-0) Cr. 3. S. *Prereq: 310.* Humoral and cellular immune functions. Interactions between cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either V MPM 575 or V MPM 520, but not both, may be applied toward graduation.

V MPM 586. Medical Bacteriology. (Cross-listed with MICRO). (4-0) Cr. 4. F. *Prereq: Permission of instructor.* Bacteria associated with diseases of vertebrates, including virulence factors and interaction of host responses.

V MPM 586L. Medical Bacteriology Laboratory. (0-6) Cr. 2. F. *Prereq: credit or enrollment in 586 or 625.* Procedures used in isolation and identification of pathogenic bacteria, including molecular and genetic techniques used in research.

V MPM 587. Animal Virology. (4-0) Cr. 4. *Prereq: Permission of instructor.* The biology of animal viruses and pathgenic mechanisms in viral diseases.

V MPM 587L. Laboratory in Animal Virology. (0-3) Cr. 1. *Prereq: Permission of the instructor.* Basic laboratory techniques in virology.

V MPM 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*

V MPM 596. International Preceptorship. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: Admission to graduate college.* International Preceptorships and Study Abroad Group programs. This course will provide opportunties for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunties.

V MPM 599. Creative Component. Cr. arr. *Prereq: Nonthesis M.S. Option only.* A written report based on laboratory research, library reading, or topics related to the student's area of specialization and approved by the student's advisory committee.

Courses for graduate students

V MPM 604. Seminar. (1-0) Cr. 1. Repeatable. F. Satisfactory-fail only.

V MPM 608. Molecular Virology. (Cross-listed with Micro, Pl P). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: BBMB 405 or GDCB 511.* C. Miller, B. Blitvich, A. Miller. Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

V MPM 615. Molecular Immunology. (Cross-listed with BBMB, Micro). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: BBMB 405 or 502.* Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signalling pathways leading to expression of genes that control and activate immune function.

V MPM 625. Mechanisms of Bacterial Pathogenesis. (Cross-listed with Micro). (4-0) Cr. 4. Alt. S., offered 2011. *Prereq: Credit in Biochemistry and Microbiology.* Review of current concepts in specific areas of microbial pathogenesis including the genetic basis for bacterial disease, genetic regulation and control of virulence factors and their mechanisms of action, and host-pathogen interactions at the cellular and molecular levels. The application of microbial genetics to understanding pathogenesis will be included.

V MPM 629. Advanced Topics in Cellular Immunology. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 520 or 575.* Current topics and literature in cellular immunology. Topics include thymocyte development and selection, T cell interactions with antigen presenting cells, and lymphocyte effector functions.

V MPM 660. Pathogenesis of Persistent Infections. (Cross-listed with V Pth). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Permission of instructor.* Study of current knowledge related to host pathogen interactions during persistent and chronic infections by bacteria, viruses and parasites.

V MPM 690. Current Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Colloquia or advanced study of specific topics in a specialized field.
A. Immunology
B. Infectious Diseases

V MPM 698. Seminar in Molecular, Cellular, and Developmental Biology. (Cross-listed with MCDB, BBMB, GDCB, MIcro). (2-0) Cr. arr. Repeatable. F.S. Student and faculty presentations.

V MPM 699. Research. Cr. arr. Repeatable.

Veterinary Pathology

www.vetmed.iastate.edu/departments/vetpath/

Claire Andreasen, Chair of Department

Distinguished Professor (Emeritus): Cheville

University Professor (Emeritus): Kluge

Professors: Ackermann, Andreasen, Bender, Halbur, Haynes, Hyde, Janke, Myers, Osweiler

Professors (Emeritus): Carson, Greve, Hagemoser, Holter, Hopper, Jeska, Ledet, Miller, Moon, Niyo, Seaton, Stahr

Professors (Collaborators): Arp, Brogden, Meador, Sasseville

Associate Professors: Beetham, Jarvinen, Jones, Yaeger

Associate Professors (Collaborators): Olsen, Perry

Assistant Professors: Danielson, Fales, Garcia-Tapia, Hostetter, Petersen

Assistant Professors (Adjunct): van Geelen

Assistant Professors (Collaborators): Greenlee, Harris, Meyerholz, Palmer, Thacker, Thomsen

Instructors (Adjunct): Burrough, Johnson, Olivier, Ostojic, Pillatzki, Plattner

Lecturer: Flaherty

Professional Program of Study

For the professional curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see *Veterinary Medicine, Curriculum*.

The Department of Veterinary Pathology offers a systematic study of basic disease mechanisms with emphasis on the changes in gene expression, cells, tissues, organs, and body fluids associated with disease. The theory and practice of veterinary pathology, veterinary clinical pathology, veterinary parasitology, veterinary toxicology, and related disciplines provide the basis for accurate diagnosis and a rational approach to the treatment and prevention of animal diseases.

Graduate Study

The department offers work for the degree master of science and doctor of philosophy with a major in veterinary pathology. As an option, students may choose an area of specialization in pathology, veterinary anatomic pathology, veterinary clinical pathology, veterinary toxicology, or veterinary parasitology (www.vetmed.iastate.edu/departments/vetpath/default.aspx?id=2562&ekmensel=c57dfa7b_166_170_2562_1). The master of science degree is available on a thesis or nonthesis basis in the veterinary pathology major with or without an area of specialization.

For the ACVP training track (residency) of the anatomic or clinical pathology graduate program designed to train veterinary pathologists, the student must have a funded position within the Department of Veterinary Pathology. If the student does not have a funded position or is not enrolled in the departmental degree program, enrollment in courses pertaining to the residency program and activities that support the residency program must have the approval of the Department Chair of Veterinary Pathology and the head of the departmental residency training program.

Graduates have a broad understanding of the mechanistic basis of disease pathogenesis. They are able to communicate with clinicians, other scientists, and other colleagues on scientific matters, and with the general public on related science policy matters. Graduates are able to address complex problems facing the agricultural and biomedical sciences, and comparative medicine, and are able to make appropriate diagnoses and investigations of animal diseases. They consider ethical, social, legal and environmental issues, and are skilled at carrying out research, communicating research results, and writing concise and competitive grant proposals.

Collaborative work is recommended in other departments in the College of Veterinary Medicine or departments or programs in other colleges. The department participates in the interdepartmental program in immunobiology (www.immunobiology.iastate.edu/) and the interdepartmental major in toxicology (www.toxicology.iastate.edu). (See Index.)

A veterinary degree (doctor of veterinary medicine or equivalent) is required for training in Veterinary Anatomic Pathology and Veterinary Clinical Pathology. Other specializations do not require the veterinary degree. A minimum score of 550 paper-based (213 computer-based; 79 internet based) is required on the TOEFL examination for students whose native language is not English. Scores on the standardized Graduate Record Examination (GRE) General Test are required of students not having a veterinary degree from the United States or Canada. The GRE General Test is strongly recommended for all other applicants. A foreign language requirement will be determined by the

student's program of study committee with the approval of the departmental chair. The Graduate English Examination is a graduate college requirement for native English speakers.

The M.S. thesis degree in veterinary pathology, with or without an area of specialization, requires a minimum of 30 graduate credits. Following completion of all other requirements, a comprehensive final examination is administered covering all graduate work including the thesis. The examination is typically oral, but a written component may be specified by the program of study committee. The degree candidate must submit a thesis, including at least one manuscript suitable for publication, to the committee members and departmental chair at least two weeks prior to the final examination. The departmental requirement for graduate courses includes 3 credits of basic biological sciences (biochemistry, genetics, cell biology), 4 credits of statistics (Stat 401), 4 credits of systemic pathology (from V Pth 570 or 571), 1 credit of postmortem pathology (V Pth 551), 1 credit of seminar (V Pth 605), and a significant number of research credits (V Pth 699).

The M.S. nonthesis degree in veterinary pathology, with or without an area of specialization, requires a minimum of 40 graduate credits including at least 10 graduate credits earned outside the department. Every nonthesis master's degree program requires evidence of individual accomplishment demonstrated by completion of a creative component, special report, or scientific study. A minimum of 3 credits of such independent work (V Pth 599) and a practical diagnostic examination (V Pth 606) corresponding to the area of specialization are required on every program of study. The final examination is comprehensive and consists of written and oral questions. The departmental requirement for graduate courses includes those for the M.S. thesis degree plus additional courses corresponding to the area of degree emphasis of specialization. Contact the department for a more complete list of requirements and information on areas of specialization.

The Ph.D. degree in veterinary pathology, with or without an area of specialization, requires a minimum of 72 graduate credits including at least 12 graduate credits earned outside the department. The preliminary examination, consisting of written and oral components, is comprehensive and not restricted to the content of graduate courses. The degree candidate must submit a dissertation, including at least two manuscripts suitable for publication, to the committee members and departmental chair at least two weeks prior to the final examination. The final examination is primarily a defense of the dissertation, but it may include questions on other areas of specialized knowledge. The department also offers a combined DVM/Ph.D. program designed for completion of courses for the Ph.D. degree in Veterinary Pathology simultaneously with study in the professional curriculum in the College of Veterinary Medicine. Contact the department for a more complete list of requirements for the Ph.D. degree and information on areas of specialization.

Courses primarily for professional curriculum students

V Pth 342. Anatomic Pathology I. (Dual-listed with 542). (2-2) Cr. 3. S. *Prereq: First-year classification in veterinary medicine.* Basic pathology with emphasis on disease in animals and introduction to diseases by system.

V Pth 372. Anatomic Pathology II. (3-3) Cr. 4. F. *Prereq: 342.* Response to injury by each body system.

V Pth 376. Veterinary Parasitology. (Dual-listed with 576). (3-3) Cr. 4. F. *Prereq: Second-year classification in veterinary medicine.* Parasitic diseases of domestic animals and their control.

V Pth 377. Case Study III. (0-4) Cr. 2. F. *Prereq: Second-year classification in veterinary medicine.* Clinical applications of the basic sciences taught concurrently in the fall semester of the second year curriculum in veterinary medicine.

V Pth 401. Basics of Medical Terminology. (1-0) Cr. 1. F. 8 weeks, offered first half semester only. Discussion of prefixes, suffixes, and roots (mostly from Latin and Greek) that comprise medical terms.

V Pth 409. Introduction to Veterinary Cytology and Laboratory Techniques. (0-2) Cr. 1. S. *Prereq: Third-year classification in veterinary medicine.* Description, interpretation, and techniques for cellular preparations from tissues and body fluids.

V Pth 410. Llama Medicine. (1-0) Cr. 1. S. *Prereq: Second or third year classification in veterinary medicine.* Offered first half semester only. Introduction to basic camelid medicine, including anatomy, behavior, restraint, handling, husbandry, herd health, common diseases, surgical conditions, and anesthesia protocols.

V Pth 425. Clinical Pathology. (2-4) Cr. 4. S. *Prereq: 372.* Principles of clinical hematology, clinical chemistry, and urinalysis in domestic animals.

V Pth 456. Necropsy Laboratory Practicum. Cr. 1. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Practicum in postmortem examination and diagnosis.

V Pth 457. Clinical Pathology Laboratory Practicum. Cr. 1. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Methodology in clinical chemistry, hematology and cytology; practice in interpretation of laboratory data.

V Pth 478. Global Protozoology - Molecular Biology of Protozoa. (Dual-listed with 578). (Cross-listed with Ent). (2-1) Cr. 3. F. *Prereq: Permission of instructor.* Analysis of cellular systems, molecules, and organelles of pathogenic protozoan parasites. Emphasis is placed on processes and systems that are unique to protozoa, are important to understanding vector-parasite-host biology/ecology, or are targets of disease prevention/treatment programs for international disease control. Nonmajor graduate credit.

V Pth 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor and department chair.*

V Pth 492. Orientation for International Experience. (2-0) Cr. 1. Repeatable. S. *Prereq: Classification in veterinary medicine.* 8 weeks. Predeparture orientation for group study abroad. Cultural considerations for the study abroad experience and a conversational language introduction. Out of class work will be assigned.

V Pth 496. International Preceptorship. (0-40) Cr. 1-12. Repeatable. F.S.SS. *Prereq: Second-year classification in veterinary medicine.* International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experience in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduate students

V Pth 530. Teaching and Learning in Veterinary Medical Education. (3-0) Cr. 3. F. Study of principles of teaching and learning as they relate to veterinary medical education. These include: theories of learning, analyzing content/learners/context, identifying goals, identifying appropriate instructional strategies (specific to medical education), matching assessment processes to goals and strategies, common curricular approaches and decision-making processes in medical education, and the scholarship of teaching and learning for veterinary medical educators.

V Pth 542. Anatomic Pathology I. (Dual-listed with 342). (2-2) Cr. 3. S. *Prereq: Graduate classification and Biol 352 or equivalent for graduate credit, permission of instructor.* Basic pathology with emphasis on disease in animals and introduction to diseases by system.

V Pth 548. Diagnostic Parasitology Laboratory. Cr. 1-3. F.S.SS. *Prereq: 376 or 576.* Contact hours are (0-3 to 0-9). A laboratory experience in the technical and applied aspects of veterinary parasitology.

V Pth 549. Clinical Pathology Laboratory. (0-3) Cr. 1. Repeatable. F.S.SS. *Prereq: 457; permission of instructor.* Laboratory procedures and clinical interpretations with emphasis on hematology, cytology, and clinical chemistry. Satisfactory-fail only.

V Pth 550. Surgical Pathology Laboratory. Cr. 1-3. Repeatable. F.S.SS. *Prereq: 570 or 571; permission of instructor.* Contact hours are (0-3 to 0-9). Diagnosis of lesions in biopsy specimens; classification of neoplasms. Course includes rotation through departmental biopsy service and review of selected cases from departmental archives. Satisfactory-fail only.

V Pth 551. Postmortem Pathology Laboratory. Cr. 1-3. Repeatable. F.S.SS. *Prereq: 542; permission of instructor.* Contact hours are (0-3 to 0-9). Necropsy techniques of animals with emphasis on gross and microscopic lesions and diagnosis. Satisfactory-fail only.

V Pth 554. Ethics in Scientific Research and Writing. (1-0) Cr. 1. Alt. SS., offered 2010. *Prereq: Graduate classification.* Ethical conduct in biomedical research, criticism, writing, and adherence to regulations. Satisfactory-fail only.

V Pth 570. Systemic Pathology I. (2-4) Cr. 4. Alt. F., offered 2010. *Prereq: 342 or 542; permission of instructor.* Pathology of the respiratory, reproductive, endocrine, musculoskeletal, and cardiovascular systems. Emphasis on pathogenesis and anatomic pathology correlated with interpretive clinical pathology where appropriate.

V Pth 571. Systemic Pathology II. (2-4) Cr. 4. Alt. F., offered 2009. *Prereq: 342 or 542; permission of instructor.* Pathology of the integumentary, urinary, digestive, lymphoid, and nervous systems and special senses. Emphasis on pathogenesis and anatomic pathology correlated with interpretive clinical pathology where appropriate.

V Pth 576. Veterinary Parasitology. (Dual-listed with 376). (3-3) Cr. 4. F. *Prereq: Graduate classification and 542.* Parasitic diseases of domestic animals and their control.

V Pth 578. Global Protozoology - Molecular Biology of Protozoa. (Dual-listed with 478). (Cross-listed with Ent). (2-1) Cr. 3. F. *Prereq: Permission of instructor.* Analysis of cellular systems, molecules, and organelles of pathogenic protozoan parasites. Emphasis is placed on processes and systems that are unique to protozoa, are important to understanding vector-parasite-host biology/ecology, or are targets of disease prevention/treatment programs for international disease control.

V Pth 590. Special Topics. Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor.*
A. Veterinary Pathology
B. Veterinary Parasitology
C. Veterinary Toxicology

D. Veterinary Clinical Pathology
E. Other

V Pth 596. International Preceptorship. (0-40) Cr. 1-12. Repeatable. F.S.SS. *Prereq: Admission to graduate college.* International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

V Pth 599. Creative Component Research. Cr. arr. Repeatable. Course for departmental graduate research.
A. Veterinary Pathology
B. Veterinary Parasitology
C. Veterinary Toxicology
D. Veterinary Clinical Pathology

Courses for graduate students

V Pth 604. Pathology Case Seminar. Cr. 1-2. Repeatable. F.S. *Prereq: permission of instructor.* Description and interpretation of microscopic lesions and clinical pathology data collected from cases of natural and experimental disease. Satisfactory-fail only.

V Pth 605. Current Topics Seminar. Cr. 1. Repeatable. F.S.SS. A seminar of graduate research at the time of thesis or dissertation defense.

V Pth 606. Diagnostic Interpretation. Cr. R. F.S.SS. *Prereq: permission of instructor.* A comprehensive examination in the diagnostic description and interpretation of case materials relevant to veterinary pathology and areas of specialization for the graduate degree preliminary examination.
A. Veterinary Pathology
B. Veterinary Parasitology
C. Veterinary Toxicology
D. Veterinary Clinical Pathology

V Pth 652. Pathologic Hematology. (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 425; permission of instructor.* Pathologic changes in blood constituents of domestic animals.

V Pth 655. Cellular and Molecular Pathology I. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate course in biochemistry, genetics, or cell biology.* Cellular and molecular mechanisms of cell injury, cellular responses to injury, and inflammation.

V Pth 656. Cellular and Molecular Pathology II. (Cross-listed with Tox). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate course in biochemistry, genetics, or cell biology.* Cellular and molecular mechanisms of carcinogenesis.

V Pth 660. Pathogenesis of Persistent Infections. (Cross-listed with V MPM). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Permission of instructor.* Study of current knowledge related to host pathogen interactions during persistent and chronic infections by bacteria, viruses and parasites.

V Pth 663. Clinical Chemistry. (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 425; permission of instructor.* The pathophysiology, methodology, and clinical application of laboratory medicine.

V Pth 679. Histopathology of Laboratory Animals. (0-4) Cr. 2. Alt. SS., offered 2010. *Prereq: 570 or 571; permission of instructor.* Study of microscopic lesions in laboratory animals with emphasis on description, etiology, pathogenesis, and diagnosis.

V Pth 699. Research. Cr. arr. Repeatable. Course restricted to graduate program within the department.
A. Veterinary Pathology
B. Veterinary Parasitology
C. Veterinary Toxicology
D. Veterinary Clinical Pathology

Women's Studies

www.public.iastate.edu/~wsprogram/homepage.html

(Interdepartmental Program)

Diane Price Herndl, Program Director
Julie Snyder-Yuly, Assistant Director

Core Faculty: Leslie Bloom (Curriculum & Instruction), Chrisy Moutsatsos (Anthropology), Anastasia Prokos (Sociology).

Undergraduate Study

Women's Studies in the College of Liberal Arts and Sciences is a cross-disciplinary program in which students may elect a minor or a major. Women's Studies provides an opportunity for students to examine women's roles, contributions, and status in social and cultural context and to investigate a variety of disciplines from feminist perspectives. Women's Studies creates an understanding that interrelated factors —e.g., race, ethnicity, class, age, disability, religion, national origin, and sexual orientation — inform knowledge of women's history, culture, and social roles. Women's Studies seeks to improve critical thinking and to provide students with the intellectual means to question prevailing assumptions. It encourages students to explore the contexts and ideological origins of knowledge and to examine the relationship between knowledge and power in society. It promotes social responsibility by examining the connections between personal experience and political activity, and validates student contributions and voices. Women's Studies graduates are skilled in critical thinking, research methods, and effective communication. Because they have developed a thorough understanding of gender, race, and class, they can understand and work effectively with employers, colleagues, and clients to analyze and address complex social problems. Women's Studies graduates acquire strong backgrounds for careers in such areas as counseling, education, human resources, public policy, politics, business, or law. The program includes core courses in Women's Studies and cross-listed courses in anthropology, art history, classical studies, economics, English, history, health and human performance, political science, psychology, religion, sociology, speech communication, and world languages and cultures. An undergraduate major requires 33 credits of core, cross-listed, and independent study courses. Women's Studies majors must satisfy the following requirements:

1. 21 credits selected from women's studies core courses (W S).
   A. Required core courses: W S 201, 301, 401 and 402. Students must also choose between a thesis, W S 499 (3 cr.) or an internship, W S 491 (3 cr.)
   B. The remaining 6 credits should be chosen from the Women's Studies core courses: W S 203, 205, 302, 320, 350, 425, 435, 450 (may be taken more than once), and 490.
   C. No more than 6 credits of W S 490 may be counted toward the W S major.
2. 12 credits selected from W S cross-listed courses or W S core courses.

Women's Studies majors must also declare either a minor or a second major in a different program or department. Communication Proficiency requirement: The Women's Studies major requires an average grade of C- or better in English 150 and 250 (or 250H) and W S 301.

Undergraduate students may minor in Women's Studies by taking 15 semester hours of Women's Studies classes, including W S 201, 301 and one 400 level core Women's Studies course, plus 6 additional credits of core or cross-listed courses.

Any student interested in a minor or major in Women's Studies should contact the Assistant Director of the program.

Graduate Study

The graduate minor in Women's Studies is designed to provide students with knowledge of theories and methods within a variety of approaches in feminist scholarship. The program seeks to integrate and synthesize knowledge from many disciplines and to offer students opportunties for systematic study of gender and women's experiences and perspectives in all knowledge fields. Students will be prepared to take leadership roles in supporting gender equity and diversity in their careers in education, social service work, business, law, public policy, governmental and non-governmental organizations, and research.

The graduate minor requires 12 credits for students enrolled in a master's or a doctoral degree program. Students are required to take either W S 510 or W S 620; taking both is strongly recommended. Students will also take two or three electives selected from the list of core and cross-listed Women's Studies courses approved for graduate study. At least one member of the Women's Studies faculty will serve on the program of study for doctoral students. A list of eligible faculty members may be obtained from the Director of the Women's Studies program. Women's Studies has 70 affiliated faculty members from departments and programs throughout the University.

Courses primarily for undergraduate students

W S 201. Introduction to Women's Studies. (3-0) Cr. 3. Introduction to the interdisciplinary field of Women's Studies. Contemporary status of women in the U.S. and worldwide from social, economic, historical, political, philosophical and literary perspectives. Analysis of intersection of gender, race, class, and sexuality. Subject matter includes work, health, sexuality, and violence. Foundation for the other courses in the program.

W S 203. Introduction to Lesbian Studies. (3-0) Cr. 3. S. Study of contemporary and historic lesbian cultures and communities from a US and international perspective. Addresses issues of race, class, gender and sexuality as they intersect with the formation of lesbian identities. Explores who identifies as lesbian and how that dis/enables political resistance and formation of community.

W S 205. Introduction to Queer Studies. (3-0) Cr. 3. F. *Prereq: Engl 150.* Interdisciplinary study of issues relating to lesbian, gay, bisexual, transgender, and queer identities in the U.S. Attention will be given to race and socioeconomic class.

W S 222. Leadership Styles and Strategies in a Diverse Society. (Cross-listed with LAS). (3-0) Cr. 3. *Prereq: Sophomore classification.* Develop and practice leadership skills through understanding personal leadership styles, leadership theory and communication theory, including how they relate to gender issues and cultural diversity; exploring personality types, communication styles, and leadership styles, networking and developing mentoring relationships; setting goals and participating in leadership opportunities and service.

W S 258. Human Reproduction. (Cross-listed with Biol). (3-0) Cr. 3. F. *Prereq: Biol 101, or 155, or 211.* Anatomy and physiology of human reproductive systems, including fertility, pregnancy, and delivery.

W S 301. International Perspectives on Women and Gender. (3-0) Cr. 3. Repeatable. F. *Prereq: 201 or 3 credits in Women's Studies at the 300 level or above.* Study of women in a range of cultures, depending on faculty specialization. Special emphasis on women in development seen in postcolonial context. Nonmajor graduate credit.

W S 302. Issues in Women's Health and Reproduction. (3-0) Cr. 3. *Prereq: Women's Studies 201 or 3 credits in Women's Studies at 300 level or above.* Current feminist scholarship in the social sciences and humanities on women's health, health care, and reproduction. Intersections among race, gender, class, ability, and sexuality are emphasized. Nonmajor graduate credit.

W S 304. Creative Writing - Fiction. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Engl 250, not open to freshmen.* Progresses from practice in basic techniques of fiction writing to fully developed short stories. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

W S 307. Women in Science and Engineering. (Cross-listed with Biol). (3-0) Cr. 3. F. *Prereq: A 200 level course in science, engineering or women's studies; Engl 250.* The interrelationships of women and science and engineering examined from historical, sociological, philosophical, and biological perspectives. Factors contributing to underrepresentation; feminist critiques of science; examination of successful strategies.

W S 320. Ecofeminism. (Cross-listed with Env S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: W S 201 or 3 credits in Women's Studies at the 300 level or above.* Women's relationships with the earth, non-human nature, and other humans. The course explores the connections between the mastery of women and the mastery of nature; origins of ecofeminism and its relation to the science of ecology and to other branches of feminist philosophies. Critique of modern science, technology, political systems as well as solutions will be included.

W S 321. Economics of Discrimination. (Cross-listed with Econ). (3-0) Cr. 3. F. *Prereq: Econ 101.* Economic theories of discrimination. Analysis of the economic problems of women and minorities in such areas as earnings, occupations, and unemployment. Public policy concerning discrimination. Poverty measurement and antipoverty programs in the U.S. Nonmajor graduate credit.

W S 323. Gender and Communication. (Cross-listed with Sp Cm, ComSt). (3-0) Cr. 3. *Prereq: Sp Cm 212.* The rhetorical strategies women and men use to succeed in oral communication; the theory, principles, and practice of effective gender communication in a variety of settings. Nonmajor graduate credit.

W S 327. Sex and Gender in Society. (Cross-listed with Soc). (3-0) Cr. 3. F.S.SS. *Prereq: Soc 130 or 134.* How the biological fact of sex is transformed into a system of gender stratification. The demographics and social positions of women and men in the family, education, media, politics, and the economy. Theories of the social-psychological and sociological bases for behavior and attitudes of women and men. The relationship between gender, class, and race.

W S 328. Sociology of Masculinities and Manhood. (Cross-listed with Soc). (3-0) Cr. 3. S. *Prereq: Soc 130, 134, or W S 201.* Examination of socially constructed and idealized images of manhood, the nature of social hierarchies and relations constructed on the basis of imagery, ideologies, and norms of masculinity. Theories on gender (sociological, psychological, and biological). Particular attention given to theory and research on gender variations among men by race, class, ethnicity, sexual orientation, physical ability and age.

W S 333. Women and Leadership. (Cross-listed with LAS). (3-0) Cr. 3. *Prereq: Sophomore classification.* This course will examine historical and contemporary barriers to and opportunities for women's leadership in a variety of contexts, including professions and public service. It will examine theories of women's leadership, gender differences in leadership styles, and the perceptions and expectations about women's leadership. Multiple perspectives of women's leadership will be highlighted through lectures, readings, videos, guest speakers and group work.

W S 336. Women and Religion. (Cross-listed with Relig). (3-0) Cr. 3. F. *Prereq: Relig 105, 210 or W S 201 recommended.* Examines the status of women in various religions, feminist critiques of religious structures and belief systems, and contemporary women's spirituality movements. Nonmajor graduate credit.

W S 338. Feminist Philosophy. (Cross-listed with Phil). (3-0) Cr. 3. F. *Prereq: 3 credits in philosophy or women's studies recommended.* A critical, theoretical examination of the oppression of women, especially as it relates to issues of race, class, and sexual orientation. How concepts such as sex and gender, self and other, nature and nurture, complicate our understanding of what it means to be a woman. Historical and contemporary feminist philosophers addressing topics such as violence, sexuality, pornography, political power, family structure and women's paid and unpaid labor. Nonmajor graduate credit.

W S 339. Goddess Religions. (Cross-listed with Relig). (3-0) Cr. 3. *Prereq: Relig 205 recommended.* Exploration of the foundational myths of Goddess spirituality, including historical and cross-cultural female images of the divine and their modern usage by American women. Nonmajor graduate credit.

W S 340. Women's Literature. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: Engl 250.* Historical and thematic survey of literature by and about women. May include autobiographies, journals, letters, poetry, fiction, and drama. Nonmajor graduate credit.

W S 342. American Indian Women Writers. (Cross-listed with Am In). (3-0) Cr. 3. *Prereq: Engl 250.* Literature of American Indian women writers which examines their social, political, and cultural roles in the United States. Exploration of American Indian women's literary, philosophical, and artistic works aimed at recovering elements of identity, redescribing stereotypes, resisting colonization, and constructing femininity. Nonmajor graduate credit.

W S 345. Women and Literature: Selected Topics. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Engl 250.* Literature by women and/or dealing with the images of women, e.g., study of individual authors or related schools of authors; exploration of specific themes or genres in women's literature; analysis of recurrent images of women in literature. Nonmajor graduate credit.

W S 346. Psychology of Women. (Cross-listed with PSYCH). (3-0) Cr. 3. S. *Prereq: 2 courses in psychology including 101.* Survey of psychological literature relating to biological, developmental, interpersonal, and societal determinants of the behavior of women.

W S 350. African American Women. (Cross-listed with Af Am). (3-0) Cr. 3. S. *Prereq: 3 credits in Women's Studies or African American Studies.* Economic, social, political and cultural roles of African American women in the U.S. Includes literary, philosophical, and artistic expressions. Myths and realities explored. Nonmajor graduate credit.

W S 352. Gay and Lesbian Literature. (Cross-listed with Engl). (3-0) Cr. 3. *Prereq: Engl 250.* Literary portrayals of gay and lesbian lives and relationships from many different genres. Attention to changing definitions and representations of sexual orientation and gender identity over time.

W S 370. Studies in English Translation. (3-0) Cr. 3. Readings, discussions, and papers in English.
F. French topics on women or feminism (cross listed to Frnch 370F)
G. German topics on women or feminism (cross listed to Ger 370G)
R. Russian topics on women or feminism (cross listed to Rus 370R)
S. Hispanic topics on women or feminism (cross listed to Span 370S)

W S 374. Women in the Ancient Mediterranean World. (Cross-listed with Cl St, Hist). (3-0) Cr. 3. Repeatable. S. *Prereq: Any one course in Cl St, W S, Latin, or Greek.* Chronological and topical survey of the status of women in the Ancient Mediterranean world; study of constructs of the female and the feminine. Readings from ancient and modern sources. Emphasis on either the Greek world and Hellenistic Egypt, or Hellenistic Egypt and Rome.
A. Hellenic World and Hellenistic Egypt
B. Roman World including Roman Egypt

W S 380. History of Women in Science, Technology, and Medicine. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of women's relationship to the fields of science, technology, and medicine, as students and professionals, consumers, subjects and patients, family members, workers and citizens. Concentrates especially on 19th and 20th century United States, concluding with an examination of current issues of special interest to women in science, technology, and medicine.

W S 385. Women in Politics. (Cross-listed with Pol S). (3-0) Cr. 3. S. Examination of the entry and participation of women in politics in the United States and other countries including a focus on contemporary issues and strategies for change through the political process.

W S 386. History of Women in America. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* A survey of social, economic, and political aspects of women's role from colonial era to present; emphasis on employment, education, concepts of sexuality, and changing nature of the home.

W S 401. Feminist Theories. (3-0) Cr. 3. *Prereq: 201 or 3 credits in Women's Studies at the 300 level or above.* Current theories of feminism, the feminine and sexual difference. Topics in race, class, sexuality, and ethnicity as they are addressed in diverse feminisms. May include readings in lesbian, Black, postcolonial, psychoanalytic and postmodern thought. Nonmajor graduate credit.

W S 402. Feminist Research in Action. (3-0) Cr. 3. S. *Prereq: 201 and 301.* Feminist research methods and scholarship. Class collaborates on a community research and action project to improve women's lives. Nonmajor graduate credit.

W S 422. Women, Men, and the English Language. (Cross-listed with Engl, Ling). (3-0) Cr. 3. S. *Prereq: Engl 219.* The ways men and women differ in using language in varied settings and the ways in which language both creates and reflects gender divisions. Nonmajor graduate credit.

W S 425. Intersections of Race, Class and Gender. (Dual-listed with 525). (3-0) Cr. 3. *Prereq: W S 201 and one additional W S course.* Race, ethnicity, class and gender distinctions and intersections lead to inequitable distributions of power, social well-being, and resources. Explores how inequities are institutionalized and how multiple identities are experienced by women in daily life.

W S 435. Women and Development. (Dual-listed with 535). (3-0) Cr. 3. *Prereq: 201 or 3 credits in Women's Studies at the 300 level or above.* Cross-cultural study of development utilizing both case studies and theoretical works. Explores the nature of women's roles in developing countries and the ways women and their needs have been excluded/included in development approaches, policies, and projects. Includes discussion of actual development projects as well as women's organizing.

W S 444. Sex and Gender in Cross-cultural Perspective. (Dual-listed with 544). (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 201; Anthr 306*

recommended. Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

W S 450. Topics in Women's Studies. (Dual-listed with 550). (3-0) Cr. 3. Repeatable. S. *Prereq: 201 or 3 credits in Women's Studies at the 300 level or above.* Special and/or experimental topics in a specific discipline, e.g., women and education, women and religion, women and the law, women and science.

W S 460. Seminar in Gender and Ethnicity. (Cross-listed with Engl). (3-0) Cr. 3. Repeatable. F. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected readings of various authors, movements, eras, or genres. Readings in criticism; required research paper. Nonmajor graduate credit.

W S 486. History of Medicine, Gender, and the Body. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of medicine, history of science, and women's history combine for an intensive examination of topics related to health, the body, and medical care over the centuries. Topics include gender and sexuality, reproduction, historical interpretations of gender differences, and the politics of women's health. Nonmajor graduate credit.

W S 488. Interdisciplinary Research on Women and Leadership. (Cross-listed with LAS). (3-0) Cr. 3. Research on women and leadership in selected content areas (e.g., Athletics, Business, Education, Politics and Public Service, and Science and Engineering). Following overview of quantitative and qualitative methods and critical analyses of journal articles on women and leadership. Students will work with a faculty mentor in selected content areas to research, write and present paper.

W S 490. Independent Study. Cr. arr. Repeatable. *Prereq: Any two courses in Women's Studies, permission of instructor, consultation with the Women's Studies Program Director.* Independent study on a topic in Women's Studies.

W S 491. Senior Internship. (3-0) Cr. 3. Repeatable. F.S.SS. *Prereq: Senior classification. Permission of department.* Internship designed to provide an application of Women's Studies principles and methods in a workplace. To be arranged with an internal or external employer and conducted under the supervision of a member of the Women's Studies faculty.

W S 499. Senior Thesis. (3-0) Cr. 3. F.S.SS. *Prereq: Senior classification.* Senior thesis to be independently researched and written under the supervision of a member of the Women's Studies faculty.

Courses primarily for graduate students, open to qualified undergraduate students

W S 510. Contemporary Feminist Theories. (3-0) Cr. 3. F. Advanced study of current theoretical developments in Women's Studies in the U.S. and around the world. Examination of the epistemological bases of feminist scholarship.

W S 525. Intersections of Race, Class and Gender. (Dual-listed with 425). (3-0) Cr. 3. *Prereq: W S 201 and one additional W S course.* Race, ethnicity, class and gender distinctions and intersections lead to inequitable distributions of power, social well-being, and resources. Explores how inequities are institutionalized and how multiple identities are experienced by women in daily life.

W S 535. Women and Development. (Dual-listed with 435). (3-0) Cr. 3. Cross-cultural study of development utilizing both case studies and theoretical works. Explores the nature of women's roles in developing countries and the ways women and their needs have been excluded/included in development approaches, policies, and projects. Includes discussion of actual development projects as well as women's organizing.

W S 544. Sex and Gender in Cross-cultural Perspective. (Dual-listed with 444). (Cross-listed with Anthr). (3-0) Cr. 3. *Prereq: Anthr 201; Anthr 306 recommended.* Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

W S 545. Women's Literature. (Cross-listed with Engl). (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 6 credits in literature.* Primary texts by women writers; historical, thematic, formal, or theoretical approaches; secondary readings; e.g., Nineteenth-Century Women Writers; American Women's Personal Narratives; Southern Women Writers of the U.S.

W S 550. Topics in Women's Studies. (Dual-listed with 450). (3-0) Cr. 3. Repeatable. *Prereq: 201 or 3 credits in Women's Studies at the 300 level or above.* Special and/or experimental topics in a specific discipline, e.g., women and education, women and religion, women and the law, women and science.

W S 586. Proseminar in Women's History and Feminist Theory. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Permission of instructor.* Feminist theory from the 1960s to the present as it relates to the writing of women's history. Analysis of interpretations of U.S. women's history from patriarchal to postmodernist perspectives.

W S 587. Diversity Issues in Marriage and Family Therapy. (Cross-listed with HD FS). (3-0) Cr. 3. Alt. F., offered 2009. Review treatment implications associated with topics such as gender and power, race/ethnicity, family structure, and socioeconomic status. Discuss treatment implications of social oppression and discrimination on families.

W S 590. Special Topics. Cr. arr. *Prereq: Permission of Women's Studies Program Director.* Independent study on a topic in Women's Studies.

W S 594. Women/Gender in Art. (Dual-listed with 394). (Cross-listed with ART H, Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture.

Courses for graduate students

W S 620. Advanced Seminar in Feminist Research Methods. (3-0) Cr. 3. S. Focus on feminist interdisciplinary research methods. Analysis of contemporary issues facing feminist scholars. Students conduct original research in their disciplinary areas.

World Languages and Cultures

Mark Rectanus, Chair of Department

University Professor (Emeritus): Joanna Courteau

Professors: Bratsch-Prince, Henry, Leonard, Matibag, M. Rectanus

Professors (Emeritus): Bernard, Dow, Frink, J. N. Lacasa

Associate Professors: Allen, Amidon, Gasta, Mariner, Mook, Mu

Associate Professors (Emeritus): Dial, Nabrotzky, Thogmartin

Associate Professor (Adjunct): Rosenbusch

Assistant Professors: Dominguez-Castellano, Haywood-Ferreira, L'Hote, Mesropova, Pardo-Ballester, Rizo-Arbuckle, Vander Lugt, Weber-Feve

Assistant Professors (Emeritus): Chatfield, Johnson

Assistant Professor (Adjunct): Rodriguez

Instructor (Adjunct): Kottman

Senior Lecturers: Martin, Taoutel, Waldemer

Lecturers: Amling, Baszczynski, Cai, Galarraga-Oropeza, Goodman, Guthrie, Looney, Meyers, E. Rectanus, Rosenstock, Shi, Wilhelm, Zwanziger

Undergraduate Study

Curriculum: World language study should be an integral part of an academic program for most students. The theoretical understanding of and practical experience in language underlie many intellectual disciplines that try to meet the complex problems of contemporary society. Courses offered by the Department of World Languages and Cultures are designed to develop students' understanding of a second culture through the language spoken by that culture.

Upon the completion of their program of studies in the Department of World Languages and Cultures, majors with a concentration in French, German, Russian Studies, or Spanish will demonstrate proficiency in five goal areas: Communication, Cultures, Connections, Comparisons, and Communities. Students will be able to: (a) use their concentration language to present and interpret information and to communicate both orally and in writing; (b) demonstrate an understanding of the relationships among the products, practices, and perspectives of the culture(s) in which their concentration language is spoken; (c) demonstrate their ability to acquire information and further their knowledge through their concentration language; (d) demonstrate an understanding of the nature of language and the concept of culture by making comparisons with their own language and culture(s); and (e) demonstrate a desire to become a life-long learner of their concentration language.

Graduates will achieve both linguistic proficiency and cultural literacy through the study of the language and culture of their program. Linguistic proficiency entails the ability to function effectively in the target language and the ability to communicate competently with native speakers of the target language. Students of Latin and Ancient Greek demonstrate proficiency by becoming able to read the languages and to translate from these languages into clear and idiomatic English. Cultural literacy includes a general knowledge of the culture's history, familiarity with its literature, and basic knowledge of its social and political institutions.

The Department offers a major in World Languages and Cultures with two options, leading to the Bachelor of Arts degree: 1) Languages and Cultures with a Concentration in French, German, Russian Studies, or Spanish; 2) Languages and Cultures for Professions (as a second major only) with a Concentration in French, German, Russian Studies, or Spanish. The Department offers minors in Chinese Studies, French, German, Latin, Russian Studies, and Spanish; and instruction in Arabic, Classical Greek, and Portuguese. The Department also houses the College of Liberal Arts and Sciences' Program in Classical Studies.

A full statement of requirements for majors and minors may be obtained from the Department. For a complete statement of all the college degree requirements, *see Liberal Arts and Sciences, Curriculum.* Current and detailed information about the Department, including placement information, is available on-line at www.language.iastate.edu.

Policies

Students who have had formal training in world languages offered at Iowa State may obtain credit by passing appropriate examinations. Students with native fluency in languages taught at Iowa State may not enroll in or take the Exam for Credit

in elementary or intermediate courses (100 and 200 level) in their native language. Students are considered to have native fluency if their ethnic first language as indicated on the matriculation form is the language in which they wish to enroll. Students are also considered to have native fluency if they have had substantial attendance at a secondary school or university where the language of instruction is the language in which they wish to enroll at ISU. Students with native fluency may be eligible to enroll in literature and civilization courses in their native language at the 300 level or above; such students must also consult the department office to determine eligibility for advanced composition and conversation courses (300 level and above). Students who have completed *three or more years* of high-school world language study may not enroll in or receive credit for 101-102 in those languages; credit may be obtained by passing the appropriate Exam for Credit or by completing an advanced sequence (200-level or higher) in that language. 101-102 may not be taken on a remedial basis.

Students who have completed two years but less than three years of a single high-school world language may not enroll in a 101 course in that language. These students may enroll in either a 102 course in that language, or in the case of Spanish, Span 97. Before enrolling in either Span 97 or a 102 language course, students are recommended to take the on-line placement test available at www.language.iastate.edu. Span 97 is designed for students who need additional remedial work in the language at the first-year level (101-102) and are not planning to continue their language study at the second-year 201-202 level. Students who complete Span 97 with a passing grade will have fulfilled the LAS world language requirement. Students who have completed Span 97 and wish to pursue further study in Spanish at the 201-202 level may enroll in 102.

Students with disabilities who need to satisfy the world language requirement may direct questions to their academic adviser and the Disability Resource Office.

Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is not normally available.

The Department of World Languages and Cultures participates in the Iowa Regents' world language summer study abroad programs in France, Peru and Spain. The Department also offers summer programs in Greece, Russia, Spain and Mexico; and semester study abroad programs in Mexico and Spain. Information concerning these programs can be obtained directly from the Department.

Language and literature courses numbered 300 and above are principally taught in the target language; courses numbered in the 270s, 370s, and 470s are taught in English. For courses taught in English about Ancient Greek and Rome, see *Classical Studies*. Students may not take intermediate (200 level) courses for credit after successfully completing any advanced (300/400 level) course, except those in the 370 series or courses taught in English translation. Students who have successfully completed any course in the intermediate (200 level) sequence may not take a lower-numbered course in that sequence for a grade.

Students at all levels of foreign language study will have access to the Language Studies Resource Center, located in 3142 Pearson. The Resource Center contains an extensive collection of world language materials, including audio-visual materials, electronic resources, music, books, language specific software and hardware, and other course-related materials.

Materials fees: Each student enrolled in a 100- through 400- level world language course is assessed a materials and professional support fee of $25.00 per course. No student will be charged more than $50.00 per semester, regardless of the number of world language courses in which she or he is enrolled for the semester. If a student drops a course subject to the fee by the 15th day of the semester the fee for that course will not be assessed.

Communication Proficiency requirement: The Department requires a grade of C- or better in each of Engl 150 and 250 (250H), and a grade of C or better in any course numbered between 370 and 379 (with the exception of Rus 375) taught by the Department of World Languages and Cultures or the interdepartmental program in Classical Studies.

Languages and Cultures for Professions (LCP)

Students with primary majors in the College of Business or the College of Engineering are encouraged to complete an LCP second major option in World Languages and Cultures with a concentration in French, German, Russian Studies, Spanish, or Chinese Studies (minor only). The primary objective of the LCP option is to provide learning environments within which students can achieve global literacy, linguistic proficiency, and inter-cultural competence. In the LCP curriculum, students will learn how professions are shaped by social and cultural forces and, alternatively, how professions shape society. In courses on contemporary culture and society, students will identify and analyze issues dealing with the complex interrelationships of languages and cultures and consider how they may affect their chosen profession. Students will experience living and working in diverse cultural settings through study abroad and internship opportunities offered through the LCP program and/or in collaboration with the Colleges of Business and Engineering. Students enrolled in the LCP second major option may receive non-graded academic credit for the successful completion of internships (WLC courses numbered 499 in each language area).

For the LCP second major option, students will complete 30 credits within their language concentration beyond the fourth-semester level, selected from the list of approved LCP core courses and electives designated for their respective college curricula in either Business or Engineering. Students may only enroll in the LCP option as a second major and may not graduate with the LCP option in the WLC major alone.

Students in the College of Business may combine course work in the International Business (IB) Secondary Major with course work in LCP by selecting from a list of approved options. Students should consult their academic adviser in the College of Business and the WLC advisor for coursework and international experience that fulfill requirements in both the IB and LCP major options. (IB) Major

Graduate Study

The Department of World Languages and Cultures offers course work leading to a graduate minor in French, German, Latin, Russian Studies or Spanish. The graduate minor in each of these languages is designed to provide an opportunity for graduate students to further their knowledge of that language to complement work in their major disciplines. The graduate minor provides formal recognition of student achievement and expertise in one of the languages above. Graduate minor credits are also offered in Greek.

Graduate Minor

Program Requirements:

a. Prerequisites: Graduate students who wish to minor in one of the languages above must have 400-level proficiency in that language. When this is not the case, the student may be required to take a language course below the 400-level, which would not count towards the graduate minor requirements.

b. Course Requirements: For the M.A. or M.S.: Three courses in the language of the minor. No more than three credits may be in courses numbered 401, 402, and 403. For the Ph.D.: Four courses in the language of the minor which must include at least one three credit course at the 500 level. No more than three credits may be in courses numbered 401, 402, or 403. At least two courses for the M.A. and the Ph.D. minors must be taken in residence at Iowa State University. Papers written for these courses are expected to have a content and depth commensurate with the graduate status of the student.

Arabic (Arabc)

Arabc 101. Elementary Arabic I. (4-0) Cr. 4. F. Introduction to modern standard Arabic. Development of reading, writing, listening comprehension, and speaking skills. Attention to use of the Arabic alphabet. Presentation of culture and social customs in Arabic-speaking countries.

Arabc 102. Elementary Arabic II. (4-0) Cr. 4. S. Introduction to modern standard Arabic. Development of reading, writing, listening comprehension, and speaking skills. Attention to use of the Arabic alphabet. Presentation of culture and social customs in Arabic-speaking countries.

Chinese Studies (Chin)

Chinese Studies Minor Option 1: Chinese Studies

Minors in Chinese Studies are required to take Chin 202-202 (Intermediate Chinese), and 9 credits at the 300 level; of these at least 3 additional credits are in Chinese (courses taught in Chinese or English) and 3 credits in one of the following:

Chin 375 (China Today, 3 cr.)
Hist 337 (History of Modern China II, 3 cr.)

The remaining 3 credits are chosen from:
Anthr 326 (Peoples and Cultures of East and Southeast Asia, 3 cr.)
Arch 427 (History, Theory, and Criticism of Chinese Architecture, 3 cr.)
Chin 301 (Advanced Chinese Readings I, 3 cr.)
Chin 302 Advanced Chinese Readings II, 3 cr.)
Chin 370 (Contemporary Chinese Film & Fiction, 3 cr.)
Chin 375 (China Today, 3 cr.)
Chin 490 (Independent Study, 1-6 cr.)
Hist 336 (History of Modern China I, 3 cr.)
Hist 337 (History of Modern China II, 3 cr.)

Chinese Studies Minor Option 2: Languages and Cultures for Professions

A. International Business Secondary Major and Languages and Cultures for Professions Minor Emphasis in Chinese Studies (18 credits)
Required Core Courses: (12 cr.)
Chin 202 (Intermediate Chinese, 5 cr.)
Chin 304 (Chinese for Business and Professions, 4 cr.)
Chin 499 (Internship, 3 cr.)
Electives: (6 cr. – choose from only one of the following categories)

Category 1
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 370 (Contemporary Chinese Film & Fiction, 3 cr.)
Chin 375 (China Today, 3 cr.)
Category 2
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 337 (Modern China II, 3 cr.)
Hist 336 (History of Modern China I, 3 cr.)
Hist 337 (History of Modern China II, 3 cr.)
Hist 479 (China and the Cold War, 3 cr.)
Pol S. 341 (Politics of Asia, 3 cr.)

B. Languages and Cultures for Professions (Business without International Business Secondary Major) (30 credits)
Required Core Courses: (12 cr.)
Chin 202 (Intermediate Chinese, 5cr.)
Chin 304 (Chinese for Business and Professions, 4 cr.)
Chin 499 (Internship, 3 cr.)

Electives (6 cr. –choose from onlyone of the following categories)

Category 1
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 370 (Contemporary Chinese Film & Fiction, 3 cr.)
Chin 375 (China Today, 3 cr.)

Category 2
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 337 (Modern China, 3 cr.)
Hist 336 (History of Modern China I , 3 cr.)
Hist 337 (History of Modern China II, 3 cr.)
Hist 479 (China and the Cold War, 3 cr.)
Pol S. 341 (Politics of Asia, 3 cr.)

C. Engineering Major and Languages and Cultures for Professions Minor Emphasis in Chinese Studies (18 credits)
Required Core Courses: (12 cr.)
Chin 202 (Intermediate Chinese, 5cr.)
Chin 304 (Chinese for Business and Professions, 4 cr.)
Chin 499 (Internship, 3 cr.)

Electives (6 cr. –choose from onlyone of the following categories)

Category 1
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 370 (Contemporary Chinese Film & Fiction, 3 cr.)
Chin 375 (China Today, 3 cr.)

Category 2
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 337 (Modern China, 3 cr.)
Hist 336 (History of Modern China I, 3 cr.)
Hist 337 (History of Modern China II, 3 cr.)
Hist 479 (China and the Cold War, 3 cr.)
Pol S. 341 (Politics of Asia, 3 cr.)

Courses primarily for undergraduate students

Chin 101. Elementary Mandarin Chinese I. (5-0) Cr. 5. F. Introduction to spoken and written colloquial Mandarin through pinyin and simplified characters. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Chin 102. Elementary Mandarin Chinese II. (5-0) Cr. 5. S. *Prereq: 101.* Introduction to spoken and written colloquial Mandarin through pinyin and simplified characters. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Chin 201. Intermediate Mandarin Chinese I. (5-0) Cr. 5. F. *Prereq: 102.* Development of speaking, writing, reading, and listening skills. Review and expansion of grammar skills, introduction to traditional characters and dictionaries; intensification of character acquisition. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Chin 202. Intermediate Mandarin Chinese II. (5-0) Cr. 5. S. *Prereq: 201.* Development of speaking, writing, reading, and listening skills. Review and expansion of grammar skills, introduction to traditional characters and dictionaries; intensification of character acquisition. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is not normally available.

Chin 272. Introduction to Chinese Culture. (3-0) Cr. 3. F. Interdisciplinary introduction to Chinese society and culture from earliest times to the present. Part one: ancient literature, philosophy, religion, art, architecture, customs. Part two: transition to a modern society, social changes, urban life, popular culture, and contemporary values and ideas. Cultural traditions of Hong Kong, Taiwan, and Tibet are also included.

Chin 301. Advanced Chinese Readings I. (3-0) Cr. 3. F. *Prereq: 202 or equivalent.* Continuing study of Chinese beyond intermediate level with a focus on reading and writing skills. Cultural literacy through a variety of texts from the humanities, social sciences, mass media and business.

Chin 302. Advanced Chinese Readings II. (3-0) Cr. 3. S. *Prereq: 301 or equivalent.* Continuing study of Chinese beyond intermediate level with a focus on reading and writing skills. Cultural literacy through a variety of texts from the humanities, social sciences, mass media and business.

Chin 304. Chinese for Business and Professions. (4-0) Cr. 4. S. *Prereq: Chin 202 or equivalent.* Introduction to professional language and culture in China and Chinese-speaking regions in Asia. Development of all four language skills, focusing on practical applications in the professional contexts. Development of global awareness and cross-cultural understanding. Preparation for internships.

Chin 370. Chinese Literature in English Translation. (3-0) Cr. 3. F. *Prereq: Engl 150 or equivalent.* Topics may include traditional prose, poetry, and drama; the Chinese novel; twentieth-century fiction and film; gender and cosmology in Chinese literature. All readings and class discussions in English.

Chin 375. China Today. (3-2) Cr. arr. S. *Prereq: Engl 250 or equivalent*. Topics may vary from year to year. Readings, discussions, and papers in English on contemporary society, culture, literature and the arts.

Chin 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Chinese and permission of department chair.* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. Nonmajor graduate credit.

Czech (Czech)

Courses primarily for undergraduate students

Czech 101. Elementary Czech I. (3-2) Cr. 4. F. Introduction to the Czech language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Czech culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Czech 102. Elementary Czech II. (3-2) Cr. 4. S. *Prereq: Czech 101.* Continued introduction to the Czech language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Czech culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Czech 201. Intermediate Czech I. (3-2) Cr. 4. F. *Prereq: Czech 102 or permision of instructor.* Review of first year principles and expanded study of grammar. Development of reading, writing, listening comprehension, and speaking in Czech within the context of Czech culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Czech 202. Intermediate Czech II. (3-2) Cr. 4. S. *Prereq: Czech 201 or permission of the instructor.* Review of first year principles and expanded study of grammar. Development of reading, writing, listening comprehension, and speaking in Czech within the context of Czech culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

French (Frnch)

World Languages and Cultures majors with a concentration in French have two options:

WLC Option I: French Studies
Under WLC Option I, students with a concentration in French Studies must complete at least 30 credits beyond the intermediate (201-202) level.

A. French Studies Required Core Courses (24 credits)

Frnch 301 (Reading and Writing French I, 3 cr.)
Frnch 302 (Reading and Writing French II, 3 cr.)
Frnch 310 (French Pronunciation and Phonetics, 1 cr.)
Frnch 326 (Studies in French and Francophone Art or Film, 3 cr.) or Frnch 333 (Topics in Contemporary French and Francophone Literature, 3 cr.)
Frnch 334 (Topics in Early Modern and Modern French Literature, 3 cr.)
Frnch 440 (Seminar in French or Francophone Studies, 3 cr.)
Frnch 471 (Foundations of French Civilization, 4 cr.)
Frnch 472 (Modern France and French Civilization, 4 cr.)

B. Electives (6 credits) Six additional credits at the 300 or 400 level in courses instructed in French.

Curricular Notes: Frnch 440 and either Frnch 471 or Frnch 472 must be completed on campus and may not be fulfilled through transfer or study abroad.

Minor in French
The French Minor requires a total of 16 credits in French beyond the 102 level, 10 credits of which must be at the 300-level.

Option 1: 16 credits in French, at least 10 of which at the 300-level, including 301, 302, 310 and one of the following courses: 304, 333, 334.

Option 2: 16 credits in French, at least 10 of which at the 300-level, including 395.

Curricular Notes: Frnch 395 (8 credits) counts towards the minor and may be allocated as follows: generic 300-level credits (1-8 cr.), Frnch 310 (1 cr.), Frnch 320 (3 cr.). French courses instructed in English, including Frnch 370, 375, 378, 471, 472, do not count toward the minor.

WLC Option II: Languages and Cultures for Professions
Under WLC Option II, students with a concentration in French must complete at least 30 credits beyond the intermediate (Frnch 201-202) level.

A. Languages and Cultures for Professions (Business)
Students with a primary major in the College of Business may select from one of the following options:

Business Option 1
International Business Secondary Major and French LCP Minor Emphasis (27 credits total)

I. International Business Secondary Major
(12 credits from approved list)

II. LCP Minor Emphasis Courses (15 credits)
Frnch 301 (Reading and Writing French I, 3 cr.)
Frnch 302 (Reading and Writing French II, 3 cr.)
Frnch 304 (French for Business and Professions, 3 cr.)
Frnch 320 (France Today, 3 cr.)
Frnch 499 (Internship, 3 cr.) or Frnch 395 (Study Abroad, 3 cr.) or other study abroad program (3 cr.)

Curricular Notes: Frnch 395 or 499 fulfills the IB 3-month international experience requirement. Frnch 304, 395 and 499 may be double counted under Business Option 1.

Business Option 2
International Business Secondary Major and LCP Major Option (42 credits total)

I. International Business Secondary Major
(12 credits from approved list)

II. LCP Second Major (30 credits)
A. Required Core Courses (24 cr.)
Frnch 301 (Reading and Writing French I, 3 cr.)
Frnch 302 (Reading and Writing French II, 3 cr.)
Frnch 304 (French for Business and Professions, 3 cr.)
Frnch 320 (France Today, 3 cr.)
Frnch 333 (Topics in Contemporary French and Francophone Literature, 3 cr.) or Frnch 334 (Topics in Early Modern and Modern Frnch Literature, 3 cr.)
Frnch 440 (Seminar in French or Francophone Studies, 3 cr.) (May be repeated once for 6 credits maximum.)
Frnch 471 (Foundations of French Civilization, 3 or 4 cr.) or Frnch 472 (Modern French Civilization, 3 or 4 cr.)
Frnch 499 (Internship, 3 cr.) or Frnch 395 (Study Abroad, 3 cr.) or other study abroad program (3 cr.)

B. Electives (6 credits)
Six additional credits at the 300 or 400 level including 471, 472 or courses instructed in French.

*Additional credit from an approved study abroad program may be applied to the major.

Curricular Notes: Students may enroll in the Languages and Cultures for Professions (LCP) Option in French as a Second Major only. They may not graduate with the Second Major alone.

Business Option 3
III. Languages and Cultures for Professions (without International Business Secondary Major) (30 credits)
A. Required Core Courses (24 cr.)
Frnch 301 (Reading and Writing French I, 3cr.)
Frnch 302 (Reading and Writing French II, 3cr.)
Frnch 304 (French for Business and Professions, 3 cr.)
Frnch 320 (France Today, 3 cr.)
Frnch 333 (Topics in Contemporary French and Francophone Literature, 3 cr.) or Frnch 334 (Topics in Early Modern and Modern Frnch Literature, 3 cr.)
Frnch 440 (Seminar in French or Francophone Studies, 3 cr.) (May be repeated once for 6 credits maximum.)
Frnch 471 (Foundations of French Civilization, 3 or 4 cr.) or Frnch 472 (Modern French Civilization, 3 or 4 cr.)
Frnch 499 (Internship, 3 cr.) or Frnch 395 (Study Abroad, 3 cr.) or other study abroad program (3 cr.)
B. Electives (6 credits)
Six additional credits at the 300 or 400 level including 471, 472 or courses instructed in French.

*Additional credit from an approved study abroad program may be applied to the major.
Curricular Notes: Students may enroll in the Languages and Cultures for Professions (LCP) Option in French as a Second Major only. They may not graduate with the Second Major alone.

IV. Languages and Cultures for Professions (Engineering)
Engineering students pursuing the second major option in French are required to take at least 30 credits beyond the intermediate (French 201-202) level.
A. LCP Required Core Courses (24 credits)
Frnch 301 (Reading and Writing French I, 3cr.)
Frnch 302 (Reading and Writing French II, 3cr.)
Frnch 304 (French for Business and Professions, 3 cr.)
Frnch 320 (France Today, 3 cr.)
Frnch 333 (Topics in Contemporary French and Francophone Literature, 3 cr.) or Frnch 334 (Topics in Early Modern and Modern Frnch Literature, 3 cr.)
Frnch 440 (Seminar in French or Francophone Studies, 3 cr.) (May be repeated once for 6 credits maximum.)
Frnch 471 (Foundations of French Civilization, 3 or 4 cr.) or Frnch 472 (Modern French Civilization, 3 or 4 cr.)
Frnch 499 (Internship, 3 cr.) or Frnch 395 (Study Abroad, 3 cr.) or other study abroad program (3 cr.)

B. Electives (6 credits)
Six additional credits at the 300 or 400 level including 471, 472 or courses instructed in French.

*Additional credit from an approved study abroad program may be applied to the major.
Curricular Notes: Students may enroll in the Languages and Cultures for Professions (LCP) Option in French as a Second Major only. They may not graduate with the Second Major alone.

Courses primarily for undergraduate students

Frnch 101. Elementary French I. (4-0) Cr. 4. F.SS. Beginning level development of reading, writing, listening comprehension, and speaking in French, within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Frnch 102. Elementary French II. (4-0) Cr. 4. S.SS. *Prereq: 101.* Beginning level development of reading, writing, listening comprehension, and speaking in French, within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Frnch 201. Intermediate French I. (4-0) Cr. 4. F. *Prereq: 102.* Intermediate level development of reading, writing, listening comprehension, and speaking in French within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Frnch 202. Intermediate French II. (4-0) Cr. 4. S. *Prereq: 201.* Intermediate level development of reading, writing, listening comprehension, and speaking in French within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Frnch 301. Reading and Writing French I. (3-0) Cr. 3. F. *Prereq: 202.* Emphasis on developing functional language skills in reading and writing. Selective review of grammar within the context of cultural and literary prose. Concurrent enrollment in Frnch 310 is encouraged.

Frnch 302. Reading and Writing French II. (3-0) Cr. 3. S. *Prereq: 301.* Readings in French prose, theater and poetry. Introduction to close reading and analysis. Development of reading and writing skills for upper-level courses. Concurrent enrollment in 310 is encouraged.

Frnch 304. French for Business and Professions. (3-0) Cr. 3. S. *Prereq: Credit or concurrent enrollment in 302.* Communication in business and professional contexts in French-speaking countries. Development of effective communication strategies and project management in the workplace. Cultural contexts of business and professional practice. Emphasis on working across French-American cultures. Preparation for internships. Nonmajor graduate credit.

Frnch 310. French Pronunciation and Phonetics. (1-0) Cr. 1. F.S. *Prereq: Credit or concurrent enrollment in 301.* Practice and theory of correct pronunciation of sounds in French. Techniques of teaching French pronunciation. Correlation between sound and spelling in French. Relationship between pronunciation and grammar.

Frnch 320. France Today. (3-0) Cr. 3. F. *Prereq: Credit or concurrent enrollment in 301.* Intensive conversational and listening practice. Communicative study of contemporary French culture. Introduction to materials, resources, and forms of communication available on the Internet, and in other electronic and print media.

Frnch 326. Studies in French or Francophone Art and Film. (3-0) Cr. 3. Repeatable. F. *Prereq: 302.* Offered F 2009 and F 2011. In-depth study of a selected artist, filmmaker, genre, medium, or movement. Emphasis on analytical interpretation and relationship between art or film and French or Francophone culture, history, and society.

Frnch 333. Topics in Contemporary French or Francophone Literatures. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 302.* Repeatable. In-depth study of a selected topic, genre, movement, or writer in 19th-, 20th, and/or 21st century literature, civilization or culture. Emphasis on close reading and discussion.

Frnch 334. Topics in Early Modern and Modern French Literature. (3-0) Cr. 3. S. *Prereq: 302.* Repeatable. In-depth study of a selected topic, genre, movement, or writer in French literature, civilization or culture from the late 15th to the early 19th century. Emphasis on close reading and discussion.

Frnch 370. French Studies in English. (3-0) Cr. 3. Repeatable. Topics vary according to faculty interest. Author, genre or period study in French or Francophone literature, women writers, or contemporary theory. Readings, discussions, and papers in English. F. French topics on women or feminism (cross listed with W S 370F)

Frnch 375. Contemporary France and the Francophone World in English. (3-0) Cr. 3. Readings, discussions, and papers in English on contemporary French or Francophone thought, politics, history, anthropology, arts, etc.

Frnch 378. French Film Studies in English. (3-0) Cr. 3. Repeatable. Analysis and interpretation of film in twentieth-century French society. Topics vary according to faculty interest. Film directors, genres, movements (e.g. The New Wave), historical survey, aesthetics, and cinematography. Readings, discussions and papers in English.

Frnch 395. Study Abroad. Cr. arr. *Prereq: 2 years university-level French.* Supervised instruction in language and culture of France; formal class instruction at level appropriate to student's training, augmented by practical living experience.

Frnch 440. Seminar in French or Francophone Studies. (3-0) Cr. 3. Repeatable. F. *Prereq: 333 or 334.* Seminar in French or Francophone literature, civilization, or cultural studies. Nonmajor graduate credit.

Frnch 471. Foundations of French Civilization. (3-1) Cr. 3-4. F. *Prereq: for fourth credit, six credits in 300-level courses instructed in French.* Study of French history and culture (e.g. art, architecture, music) from Charlemagne to the French Revolution. Readings, discussions and papers in English. Fourth credit: taught in French; supplementary readings and compositions. Nonmajor graduate credit.

Frnch 472. Modern France and French Civilization. (3-1) Cr. 3-4. S. *Prereq: for fourth credit, six credits in 300-level courses instructed in French.* Study of French history and culture (e.g. art, architecture, music) from the Napoleonic era to the present. Readings, discussions and papers in English. Fourth credit: taught in French; supplementary readings and compositions. Nonmajor graduate credit.

Frnch 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of French staff and department chair.* Designed to meet the needs of students who wish to focus on areas other than those in which courses are offered. No more than 9 credits in Frnch 490 may be counted toward graduation.

Frnch 499. Internship in French. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits of French at the 300 level; permission of advisor and WLC Internship Coordinator. Work experience using French language skills in the public or private sector, combined with academic work under faculty supervision.* Credits may be applied only to LCP major. No more than 3 credits of Frnch 499 may be applied to the major. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Frnch 590. Special Topics in French. Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level French.*
A. Literature or Literary Criticism
B. Linguistics
C. Language Pedagogy
D. Civilization

German (Ger)

WLC Option I: German Studies
Under WLC Option I, students with a concentration in German must complete at least 30 credits beyond the intermediate (Ger 201-202) level. Students electing the German Studies option may count only one of the following courses towards the major: Ger 370, Ger 371, Ger 375, Ger 378.

A. German Studies Required Core Courses: (24 credits)
Ger 301 (Reading: Problems of the Early Twentieth Century, 3 cr.)
or Ger 304 (German for Business and Professions, 3 cr.)
Ger 302 (Composition, 3 cr.)
Ger 305 (Conversation: The City in Contemporary Europe, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
or Ger 330 (Introduction to German Literature, 3 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)
Ger 475 (Foundations of German Civilization, 4 cr.)
Ger 476 (Topics in German Cultural Studies, 4 cr.)

B. Electives:

The remaining 6 credits may be chosen from the following courses:

Ger 301 (Reading: Problems of the Early Twentieth Century, 3 cr.)
Ger 304 (German for Business and Professions, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
Ger 330 (Introduction to German Literature, 3 cr.)
Ger 370 (German Studies in English, 4 cr.)
Ger 371 (The Holocaust in Text, Image, and Memory, 4 cr.)
Ger 375 (Grimms' Tales, 4 cr.)
Ger 378 (German Film and Media Studies, 4 cr.)
Ger 395 (Study Abroad, 1-10 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)

C. Study Abroad: The department strongly recommends that all students of German participate in an approved study abroad program based in a German-speaking country.

Curricular Notes: Ger 475 (4 cr.) and Ger 476 (4cr.) are required for the WLC major option in German Studies. Majors must enroll in each of these courses for 4 credits. Majors choosing the German Studies option may select one additional course for 4 cr. from the following: Ger 370, 371, 375, or 378.

Minor in German
The minor in German requires at least 15 credits, nine of which must be at the 300 level or higher, of these, three credits must be in literature or culture taught in German (320, 330 or 440). Eligible courses for the minor are: Ger 301, 302, 304, 305, 320, 330, and 440.

WLC Option II: Languages and Cultures for Professions
Under WLC Option II students with a concentration in German must complete a minimum of 30 credits beyond the intermediate (Ger 201-202) level. Students electing the LCP option may not count the following courses toward the major:
Ger 370, Ger 371, Ger 375, Ger 378.

I. Languages and Cultures for Professions (Business)
Students with a primary major in the College of Business may select from one of the following options:

Business Option 1
International Business Secondary Major and German LCP Minor Emphasis (27 credits total)

A. International Business Secondary Major
(12 credits from approved list)

B. LCP Minor Emphasis Courses (15 credits):
Ger 304 (German for Business & Professions, 3 cr.)
Ger 305 (Conversation: The City in Contemporary Europe, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)
Ger 475 (Foundations of German Civilization, 4 cr.)
or Ger 476 Topics in German Cultural Studies, 4 cr.
Ger 499 (Internship, 3 cr.)

Business Option 2
International Business Secondary Major and LCP Major Option (42 credits total)

A. International Business Secondary Major
(12 credits from approved list)

B. LCP Second Major (30 cr.)
I. LCP Required Core Courses (20 credits)
Ger 304 (German for Business & Professions, 3 cr.)
Ger 305 (Conversation: The City in Contemporary Europe, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)
Ger 475 (Foundations of German Civilization, 4 cr.)
or Ger 476 (Topics in German Cultural Studies, 4 cr.)
Ger 499 (Internship, 3 cr.)

II. Electives (10 credits)
Ger 301 (Reading: Problems of the Early Twentieth Century, 3 cr.)
Ger 302 (Composition, 3 cr.)
Ger 330 (Introduction to German Literature, 3 cr.)

Ger 395 (Study Abroad, 2-6 cr.)*

* Additional credit from an approved study abroad program may be applied to the major.

Curricular Notes: students may only enroll in the Languages and Cultures for Professions (LCP) Option as a Second Major. They may not graduate with the Second Major in LCP alone.

Business Option 3
Languages and Cultures for Professions (without International Business Major) (30 credits total)

I. LCP Required Core Courses (20 credits)
Ger 304 (German for Business & Professions, 3 cr.)
Ger 305 (Conversation: The City in Contemporary Europe, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)
Ger 475 (Foundations of German Civilization, 4 cr.)
or Ger 476 (Topics in German Cultural Studies, 4 cr.)
Ger 499 (Internship, 3 cr.)

II. Electives (10 credits)
Ger 301 (Reading: Problems of the Early Twentieth Century, 3 cr.)
Ger 302 (Composition, 3 cr.)
Ger 330 (Introduction to German Literature, 3 cr.)
Ger 395 (Study Abroad, 2-6 cr.)*

* Additional credit from an approved study abroad program may be applied to the major.

II. Languages and Cultures for Professions (Engineering)
Engineering students pursuing the second major option in German are required to take at least 30 credits beyond the intermediate (Ger 201-202) level.

Engineering LCP: Second Major Option in German (30 credits total)
A. Required Core Courses (20 credits)
Ger 304 (German for Business & Professions, 3 cr.)
Ger 305 (Conversation: The City in Contemporary Europe, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)
Ger 475 (Foundations of German Civilization, 4 cr.)
or Ger 476 (Topics in German Cultural Studies, 4 cr.)
Ger 499 (Internship, 3 cr.)

B. Electives (10 credits)
Ger 301 (Reading: Problems of the Early Twentieth Century, 3 cr.)
Ger 302 (Composition, 3 cr.)
Ger 330 (Introduction to German Literature, 3 cr.)
Ger 395 (Study Abroad, 2-6 cr.)*

* Additional credit from an approved study abroad program may be applied to the major.

Curricular Notes: students may only enroll in the Languages and Cultures for Professions (LCP) Option as a Second Major. They may not graduate with the Second Major in LCP alone.

Courses primarily for undergraduate students

Ger 101. Elementary German I. (4-0) Cr. 4. F.SS. Introduction to German language within the context of German culture; practice in the basic skills. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Ger 102. Elementary German II. (4-0) Cr. 4. S.SS. *Prereq: 101.* Continuation of German 101. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Ger 201. Intermediate German I. (4-0) Cr. 4. F. *Prereq: 102.* Review of grammar, selected readings, further practice in oral and written communication. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Ger 202. Intermediate German II. (4-0) Cr. 4. S. *Prereq: 201.* Continuation of German 201. One section will emphasize the use of German in professional contexts. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Ger 301. Reading: Problems of the Early Twentieth Century. (3-0) Cr. 3. F. *Prereq: 202.* Emphasis on the development of reading skills through a variety of text types with a focus on German Culture from circa 1900 to 1933.

Ger 302. Composition. (3-0) Cr. 3. S. *Prereq: 202.* Emphasis on writing skills, with further development of grammar and reading skills using a variety of current and historical materials.

Ger 304. German for Business and Professions. (3-0) Cr. 3. F. *Prereq: 202.* Communication in business and professional contexts in German-speaking countries. Development of effective communication strategies and project management in the workplace. Cultural contexts of business and professional practice. Preparation for internships. Nonmajor graduate credit.

Ger 305. Conversation: The City in Contemporary Europe. (3-0) Cr. 3. S. *Prereq: 202 minimum, 301 recommended.* Intensive conversational and listening practice in German with an emphasis on a major German-speaking city.

Ger 320. Germany Today. (3-0) Cr. 3. S. *Prereq: 301 or 304.* Selected topics dealing with contemporary German society and culture. Introduction to materials, resources, and forms of communication available on the Internet, and in other electronic and print media.

Ger 330. Introduction to German Literature. (3-0) Cr. 3. F. *Prereq: 301 or permission of instructor.* Selected readings in German literature from Classicism to present. Emphasis on techniques of reading and analysis of literary texts.

Ger 370. German Studies in English. (3-0) Cr. arr. Repeatable. *Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level.* Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Three credits: English, open to all students. Four credits: Required for German concentration credit, supplementary readings and compositions in German.
G. German topics on women or feminism (cross listed to W S 370G)

Ger 371. The Holocaust in Text, Image, and Memory. (3-0) Cr. arr. *Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level.* Examination of such topics as the origins and expressions of Anti-Semitism in central Europe, the political events and structures of the Holocaust, the reality of ghettos and concentration camps, the impact of technological modernization on the Final Solution, and resistance to the Nazis. Materials will include nonfictional texts, literature, art, and music. Three credits: English, open to all students. Four credits: required for German concentration credit, supplementary readings and compositions in German.

Ger 375. Grimms' Tales. (3-0) Cr. arr. *Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level.* Introduction to Germanic antiquities, mythology, and heroic legends; Herder's concept of Naturpoesie. Emphasis on the Grimm tales: theoretical approaches to the tales from the late 19th and early 20th centuries; perversions of these traditional tales by the National Socialists (Nazis). Readings in contemporary Grimm scholarship. Taught in English. Three credits: English, open to all students. Four credits: required for German concentration credit, supplementary readings and compositions in German.

Ger 378. German Film and Media Studies. (3-0) Cr. arr. S. *Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level.* Analysis and interpretation of film or media in German society. Study of media production and reception within multicultural and global contexts. Thematic emphases based on faculty and student interest including: 1) film directors, genres, movements (e.g. New German Cinema), aesthetics, and cinematography or 2) media studies (e.g. television, mass press, popular culture). Three credits: English, open to all students. Four credits: required for German concentration credit, supplementary readings and compositions in German.

Ger 395. Study Abroad. Cr. arr. *Prereq: 2 years university-level German.* Supervised instruction in language and culture of Germany; formal class instruction at level appropriate to student's training, augmented by practical living experience.

Ger 440. Colloquium in German Studies. Cr. arr. Repeatable. *Prereq: 302, and either 320 or 330.* Fourth credit required for the major. Emphasis on student research in a colloquium format. Nonmajor graduate credit.

Ger 475. Foundations of German Civilization. (3-0) Cr. arr. F. *Prereq: Sophomore classification. For fourth credit, six credits in 300-level courses instructed in German.* Study of various aspects of German history and culture from the Germanic tribes and Christianization to 1870. Three credits: English, open to all students. Four credits: required for German concentration credit, supplementary readings and compositions in German. Nonmajor graduate credit.

Ger 476. Topics in German Cultural Studies. (3-0) Cr. arr. S. *Prereq: Sophomore classification. For fourth credit, six credits in 300-level courses instructed in German.* Continuation of 475 and will cover German history and culture up to the modern era. Three credits: English, open to all students. Four credits: required or German concentration credit, supplementary readings and compositions in German. Nonmajor graduate credit.

Ger 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in German and permission of department chair.* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Ger 490 may be counted toward graduation.

Ger 499. Internship in German. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits of German at the 300 level; permission of advisor and the World Languages and Cultures Internship coordinator.* Work experience using German language skills in the public or private sector, combined with academic work under faculty supervision. Available only to majors and minors. Ger 499 may be repeated to a maximum of 6 credits. No more than 3 credits of Ger 499 may be applied to the major. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Ger 590. Special Topics in German. Cr. arr. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level German.*
A. Literature or Literary Criticism
B. Linguistics
C. Language Pedagogy
D. Civilization

Greek (Greek)

For courses in Greek literature taught in English, see *Classical Studies.*

Courses primarily for undergraduate students

Greek 101. Elementary Ancient Greek I. (4-0) Cr. 4. F. Grammar and vocabulary of ancient Greek, within the context of Greek culture; reading knowledge through texts adapted from classical authors. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Greek 102. Elementary Ancient Greek II. (4-0) Cr. 4. S. *Prereq: 101.* Grammar and vocabulary of ancient Greek, within the context of Greek culture; reading knowledge through texts adapted from classical and later authors. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102 and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Greek 201. Intermediate Classical Greek. (4-0) Cr. 4. F. *Prereq: 102.* Emphasis on grammatical principles, composition and reading classical or Hellenistic texts. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102 and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Greek 332. Introduction to Classical Greek Literature. (3-0) Cr. 3. S. *Prereq: 201.* Readings in ancient Greek Literature with emphasis on critical analysis of style, structure or thought.

Greek 441. Advanced Readings in Greek Literature. (3-0) Cr. 3. Repeatable. F. *Prereq: 332.* Study of individual authors or genres; intensive reading in the original supplemented by modern criticism and analysis in English. Authors and genres will vary; courses may be repeated to a maximum of 6 credits each. Nonmajor graduate credit.

Greek 442. Advanced Topics in Greek Literature. (3-0) Cr. 3. Repeatable. S. *Prereq: 332.* Advanced study of authors or topics relating to Greek literature. Authors and topics will vary; courses may be repeated to a maximum of 6 credits each. Nonmajor graduate credit.

Greek 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Greek and permission of department chair.* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Greek 490 may be counted toward graduation.

Latin (Latin)

For courses in Latin literature taught in English, see *Classical Studies.*

Minor requirements
Minors are required to complete 9 credits at the 300 level or higher.

Courses primarily for undergraduate students

Latin 101. Elementary Latin I. (4-0) Cr. 4. F. Grammar and vocabulary of classical Latin, within the context of Roman culture; reading knowledge through texts adapted from classical authors. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102 and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Latin 102. Elementary Latin II. (4-0) Cr. 4. S. *Prereq: 101.* Grammar and vocabulary of classical Latin, within the context of Roman culture; reading knowledge

through texts adapted from classical authors. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102 and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Latin 201. Intermediate Latin. (4-0) Cr. 4. F. *Prereq: 102.* Emphasis on grammatical principles, composition and reading Latin texts. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102 and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Latin 332. Introduction to Latin Literature. (3-0) Cr. 3. S. *Prereq: 201.* Readings in Latin Literature with emphasis on critical analysis of style, structure or thought.

Latin 441. Advanced Readings in Latin Literature. (3-0) Cr. 3. Repeatable. F. *Prereq: 332.* Study of individual authors or genres; intensive readings in the original supplemented by modern criticism and analysis in English. Authors and genres will vary; courses may be repeated to a maximum of 6 credits each. Nonmajor graduate credit.

Latin 442. Advanced Topics in Latin Literature. (3-0) Cr. 3. Repeatable. S. *Prereq: 332.* Advanced study of authors or topics relating to Latin literature. Authors and topics will vary; courses may be repeated to a maximum of 6 credits each. Nonmajor graduate credit.

Latin 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Latin and permission of department chair.* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits in Latin 490 may be counted toward graduation.

Polish (Polsh)

Courses primarily for undergraduate students

Polsh 101. Elementary Polish I. (3-2) Cr. 4. F. Introduction to the Polish language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Polish culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Polsh 102. Elementary Polish II. (3-2) Cr. 4. S. *Prereq: Polish 101.* Continued introduction to the Polish language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Polish culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Polsh 201. Intermediate Polish I. (3-2) Cr. 4. F. *Prereq: Polish 102 or permission of instructor.* Review of first year principles and expanded study of grammar. Development of reading, writing, listening comprehension, and speaking in Polish within the context of Polish culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Polsh 202. Intermediate Polish II. (3-2) Cr. 4. S. *Prereq: Polish 201 or permission of instructor.* Development of reading, writing, listening comprehension, and speaking in Polish within the context of Polish culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Portuguese (Port)

Courses primarily for undergraduate students

Port 101. Elementary Portuguese I. (4-0) Cr. 4. F. An introduction to the Portuguese language through the communicative approach within the context of Luso-Brazilian culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101-202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available. Enrollment not open to students who have completed Port 111.

Port 102. Elementary Portuguese II. (4-0) Cr. 4. S. *Prereq: 101.* An introduction to the Portuguese language through the communicative approach within the context of Luso-Brazilian culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101-202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available. Enrollment not open to students who have completed Port 112.

Port 111. Elementary Portuguese, Accelerated I. (3-0) Cr. 3. F. *Prereq: Four semesters of college Spanish or the equivalent. Students with four semesters at the college level or the equivalent of another Romance language may be admitted by permission of the instructor.* An introduction to the Portuguese language through the communicative approach within the context of Luso-Brazilian culture. Prepares for Port 112. Enrollment not open to students who have completed Port 101.

Port 112. Elementary Portuguese, Accelerated II. (3-0) Cr. 3. S. *Prereq: Portuguese 111.* An introduction to the Portuguese language through the communicative approach within the context of Luso-Brazilian culture. Prepares for Port 201. Enrollment not open to students who have completed Port 102.

Port 201. Intermediate Portuguese I. (4-0) Cr. 4. F. *Prereq: 102 or equivalent.* Intensive review of basic grammar and conversation. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature. Credit by examination in the Department of World Languages and Cultures for courses numbered 101-202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Port 202. Intermediate Portuguese II. (4-0) Cr. 4. S. *Prereq: 201 or equivalent.* Intensive review of basic grammar and conversation. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature. Credit by examination in the Department of World Languages and Cultures for courses numbered 101-202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Port 370. Luso-Brazilian Topics in English Translation. (3-0) Cr. 3. Repeatable. Study of a selected period, theme, genre, or author. Readings, discussion, and written work in English. Port 370 may be repeated for a maximum of 6 credits.

Port 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Portuguese and permission of department chair.* Designed to meet the needs of students who seek to work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Port 490 may be counted toward graduation.
D. Language Pedagogy
E. Civilization

Courses primarily for graduate students, open to qualified undergraduate students

Port 590. Special Topics in Portuguese. Cr. arr. Repeatable. *Prereq: Permission of instructor; 6 credits of 300-level Portuguese.*
A. Literature or Literary Criticism
B. Linguistics

Russian Studies (Rus)

World Languages and Cultures majors with a concentration in Russian Studies have two options:

WLC Option 1: Russian Studies
Required Core Courses: (12 credits)
Rus 301 (Composition and Conversation, 3 cr.)
Rus 314 (Reading Russian Literary and Cultural Texts, 3 cr.)
Rus 401 (Advanced Composition and Conversation, 3 cr.)
Rus 440 (Seminar in Russian Studies, 3 cr.)
Electives: (18 credits)
Hist 421 (History of Russia I, 3 cr.)
Hist 422 (History of Russia II, 3 cr.)
Hist 530 (Proseminar in Modern Russia/Soviet History, 3 cr.)
Pol S 349 (Politics of Russia and Soviet Successor States, 3 cr.)
Rus 304 (Russian for Business and Professions, 3 cr.)
Rus 320 (Russia Today, 3 cr.)
Rus 370 (Russian Studies in English Translation, 3 cr.)
Rus 378 (Russian Film Studies in English, 3 cr.)
Rus 395 (Study Abroad, 1-6 cr.)
Rus 401 (Advanced Composition and Conversation, 3 cr.)
Rus 490 (Independent Study, 1-6 cr.)
Rus 590 (Special Topics in Russian, 2-4 cr.)
Of these courses at least three credits must be taken outside the Russian curriculum.

Minor in Russian Studies

Minors in Russian Studies are required to complete 201 and 202. The remaining 9 credits must be at the 300 level and above, including at least 3 additional credits in Russian (courses taught in English or Russian) and at least 3 credits outside the Russian curriculum.

WLC Option II: Languages and Cultures for Professions
Business Option 1
International Business Secondary Major and Languages and Cultures for Professions Minor Emphasis (27 cr. total)

I. International Business Secondary Major (12 credits from approved list)
II. LCP Courses (15 credits)
Rus 301 (Advanced Composition and Conversation, 3 cr.)
Rus 304 (Russian for Business and Professions, 3 cr.)
Rus 320 (Russia Today, 3 cr.)
Rus 370 (Russian Studies in English Translation, 3 cr.)
Rus 395 (Study Abroad, 3 cr.)
or Rus 499 (Internship 3 cr.)
Curricular notes: Rus 395 or 499 fulfills the IB 3-month international experience requirement. Rus 304, 395 and 499 may be double counted under

OPTION 1. Students may only enroll in the LCP Option as a Second Major. They may not graduate with the Second Major in LCP alone.

Business Option 2
International Business Secondary Major and Language and Cultures for Professions Major
(42 credits)

I. International Business Secondary Major (12 credits from approved list)
II. LCP Core Courses: (15 credits)
Rus 301 (Advanced Composition and Conversation, 3 cr.)
Rus 304 (Russian for Business and Professions, 3 cr.)
Rus 320 (Russia Today, 3 cr.)
Rus 370 (Russian Studies in English Translation, 3 cr.)
Rus 395 (Study Abroad, 3 cr.)*
or Rus 499 (Internship 3, cr.)

*Additional credit from approved study abroad program may be applied to the major

III. Electives: (15 credits)
Rus 314 (Reading Russian Literary and Cultural Texts, 3 cr.)
Rus 378 (Russian Film Studies in English, 3 cr.)
Rus 395 (Study Abroad, 3 cr.)
Rus 401 (Advanced Composition and Conversation, 3 cr.)
Hist 421 (History of Russia I, 3 cr.)
Hist 422 (History of Russia II, 3 cr.)
Pol S 349 (Politics of Russia and Soviet Successor States, 3 cr.)

Curricular Notes: Rus 395 or 499 fulfills the IB 3 month international experience requirement. Students may only enroll in the LCP Option as a Second Major. They may not graduate with the Second Major in LCP alone.Business Option 3

Languages and Cultures for Professions (without International Business Major) (30 Credits)

I. LCP Core Courses (15 credits)
Rus 301 (Composition and Conversation, 3 cr.)
Rus 304 (Russian for Business and Professions, 3 cr.)
Rus 320 (Russia Today, 3 cr.)
Rus 370 (Russian Studies in English Translation, 3 cr.)
Rus 395 (Study Abroad, 1-6 cr.)* or
Rus 490 (Internship in Russian, 1-3 cr.)

*Additional credit from an approved study abroad program may be applied to the major

II. Electives: (15 credits)
Rus 314 (Reading Russian Literary and Cultural Texts, 3 cr.)
Rus 378 (Russian Film Studies in English, 3 cr.)
Rus 395 (Study Abroad, 1-6 cr.)
Rus 401 (Advanced Composition and Conversation, 3 cr.)
Hist 421 (History of Russia I, 3 cr.)
Hist 422 (History of Russia II, 3 cr.)
Pol S 349 (Politics of Russia and Soviet Successor States, 3 cr.)

Curricular Notes: Rus 395 or 499 fulfills the IB 3 month international experience requirement. Students may only enroll in the LCP Option as a Second Major. They may not graduate with the Second Major in LCP alone.

B. Languages and Cultures for Professions (Engineering) (30 credits)

I. LCP Core Courses (15 credits)
Rus 301 (Composition and Conversation, 3 cr.)
Rus 304 (Russian for Business and Professions, 3 cr.)
Rus 320 (Russia Today, 3 cr.)
Rus 370 (Russian Studies in English Translation, 3 cr.)
Rus 395 (Study Abroad, 1-6 cr.) or
Rus 490 (Internship in Russian, 1-3 cr.)

II. LCP Electives: (15 credits)
Rus 314 (Reading Russian Literary and Cultural Texts, 3 cr.)
Rus 378 (Russian Film Studies in English, 3 cr.)
Rus 395 (Study Abroad, 1-6 cr.)
Rus 401 (Advanced Composition and Conversation, 3 cr.)
Rus 440 (Seminar in Russian Studies, 3 cr.)
Rus 590 (Special Topics in Russian, 2-4 cr.)
Hist 421 (History of Russia I, 3 cr.)
Hist 422 (History of Russia II, 3 cr.)
Hist 530 (Proseminar in Modern Russia/Soviet History, 3 cr.)
Pol S 349 (Politics of Russia and Soviet Successor States, 3 cr.)

Curricular Notes: Students may only enroll in the LCP Option as a Second Major. They may not graduate with the Second Major in LCP alone.

Courses primarily for undergraduate students

Rus 101. Elementary Russian I. (4-0) Cr. 4. F. Introduction to the Russian language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Russian culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Rus 102. Elementary Russian II. (4-0) Cr. 4. S. *Prereq: 101.* Introduction to the Russian language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Russian culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Rus 201. Intermediate Russian I. (4-0) Cr. 4. F. *Prereq: 102.* Thorough review of grammar and growth of vocabulary. Selected readings. Continued use of the four basic skills. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Rus 202. Intermediate Russian II. (4-0) Cr. 4. S. *Prereq: 201.* Thorough review of grammar and growth of vocabulary. Selected readings. Continued use of the four basic skills. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Rus 301. Composition and Conversation. (3-0) Cr. 3. F. *Prereq: 202.* Thorough study of the Russian language, with emphasis on strengthening proficiency in writing, speaking, reading, and listening. Increased focus on syntax and word formation.

Rus 304. Russian for Business and Professions. (3-0) Cr. 3. F. *Prereq: 202.* Communication in business and professional contexts in Russian-speaking countries. Development of effective communication strategies and project management in the workplace. Cultural contexts of business and professional practice. Nonmajor graduate credit.

Rus 314. Reading Russian Literary and Cultural Texts. (3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: 301.* Selected readings in Russian literature and culture. Emphasis on techniques of reading and analysis of literary and cultural texts.

Rus 320. Russia Today. (3-0) Cr. 3. A survey of social, political, economic, and cultural topics relevant to contemporary Russia. Taught in Russian.

Rus 370. Russian Studies in English Translation. (3-0) Cr. 3. Repeatable. Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Readings, discussions, and papers in English.
R. Russian topics on women or feminism (cross listed to W S 370R)

Rus 375. Topics in Russian, East European, and Eurasian Studies. (3-0) Cr. 3. Repeatable. F. Selected topics dealing with a particular area, period, or cultural pattern. Readings, discussions, and papers in English. May be offered by the Russian, East European, and Eurasian Studies Distance Learning Consortium. Rus 375 does not fulfill the English proficiency requirement for WLC majors.

Rus 378. Russian Film Studies in English. (3-0) Cr. 3. Analysis and interpretation of cinema in Russia and the Soviet Union. Topics vary according to faculty interest. Film directors, genres, movements, historical survey, aesthetics, and cinematography. Readings, discussions and papers in English.

Rus 395. Study Abroad. Cr. arr. Supervised instruction in language and culture of Russia; formal class instruction at level appropriate to student's training, augmented by practical living experience.

Rus 401. Advanced Composition and Conversation. (3-0) Cr. 3. *Prereq: 314.* Intensive practice in composition and conversation with emphasis on mastery of speaking and writing skills; development of idiomatic usage and effective expression of ideas. Increased emphasis on vocabulary building, grammatical correctness, and compatibility of style and content. Nonmajor graduate credit.

Rus 440. Seminar in Russian Studies. (3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq*: 314.* Study of a selected topic in history, politics, Russian Orthodox religion, literature, art, theater, and/or cinema. Nonmajor graduate credit.

Rus 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Russian and permission of department chair.* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Rus 490 may be counted toward graduation.

Rus 499. Internship in Russian. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits of Russian at the 300 level; permission of advisor and WLC Internship Coordinator.* Work experience using Russian language skills in the public or private sector combined with academic work under faculty supervision. Available only to majors and minors. No more than 3 credits may be applied to the major.

Courses primarily for graduate students, open to qualified undergraduate students

Rus 590. Special Topics in Russian. Cr. arr. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Russian.*
A. Literature or Literary Criticism
B. Linguistics
C. Language Pedagogy
D. Civilization

Serbo-Croatian (SerbC)

Courses primarily for undergraduate students

Serbc 101. Elementary Serbo-Croatian I. (3-2) Cr. 4. Introduction to the Serbo-Croatian language, grammar, and syntax. Basic language communication skills in reading, writing, speaking and listening. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101,

102, 201, and 202 is available only to student who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Serbc 102. Elementary Serbo-Croatian II. (3-2) Cr. 4. Introduction to the Serbo-Croatian language, grammar, and syntax. Basic language communication skills in reading, writing, speaking and listening. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to student who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Spanish (Span)

World Languages and Cultures majors with a concentration in Spanish have two options:
WLC Option I: Hispanic Studies
Under WLC Option I, students with a concentration in Spanish must complete a minimum of 33 credits beyond the intermediate (201-202) level.

A. Hispanic Studies Required Core Courses: (12 cr.)
Span 301 (Spanish Grammar and Composition, 3 cr.)
Span 303 A or B (Spanish Grammar and Conversation, 3 cr.)
Span 314 (Introduction to Reading Hispanic Texts, 3 cr.)
Span 352 (Introduction to Spanish Phonology, 3 cr.)

B. Electives:
Students must take at least 15 credits chosen from a, b, and c below (minimum of 3 credits from each section).

a) At least 3 credits of literary studies chosen from the following:

Span 330 (Studies in Spanish Literature to 1700, 3 cr.)
Span 331 (Studies in Spanish Literature from 1700 to the Present, 3 cr.)
Span 332 (Studies in Latin American Literature from Pre-Columbian Times through the Nineteenth Century, 3 cr.)
Span 333 (Studies in Latin American Literature from the Twentieth Century to the Present, 3 cr.)

b) At least 3 credits of cultural studies chosen from the following:

Span 304 (Spanish for Business and Professions, 3 cr.)
Span 321 (Spanish Civilization, 3 cr.)
Span 322 (Latin American Civilization, 3 cr.)
Span 323 (Spain Today, 3 cr.)
Span 324 (Latin America Today, 3 cr.)
Span 326 (Studies in Hispanic Art or Film, 3 cr.)

c) At least 3 credits of applied language and linguistics chosen from the following:

Span 351 (Introduction to Spanish-English Translation, 3 cr.)
Span 401 (Advanced Composition and Grammar, 3 cr.)
Span 462 (Contrastive Analysis of Spanish/English for Translators, 3 cr.)
Span 463 (Hispanic Dialectology, 3 cr.)
Span 499 (Internship in Spanish, 3 cr.)

Students may apply up to 6 credits of Span 395 (Study Abroad) to section a, b, or c above (appropriate section based upon course content and assigned by the WLC adviser).

C. Students must take at least 6 credits of literature and/or culture at the 400 level, chosen from the following:

Span 440 (Seminar on the Literatures and Cultures of Spain, 3 cr., repeatable to 6 cr.)
Span 441 (Seminar on Cervantes and the Golden Age, 3 cr., repeatable to 6 cr.)
Span 445 (Seminar on the Literatures and Cultures of Latin America, 3 cr., repeatable to 6 cr.)

D. Study Abroad: The department strongly recommends that all students of Spanish participate in an approved study abroad program based in a Spanish-speaking country. Under Option I, any student who chooses not to participate in a department-approved program will be required to take 3 additional elective credits of Spanish at or above the Span 321 level (for a total of 36 credits beyond the intermediate 201-202 level).

E. **Communication Proficiency Requirements:** Degree-seeking students must earn a grade of C- or better in a sequence of English composition courses, usually Engl 150 and 250. The department will certify Communication Proficiency for students who receive a C or better in a WLC or Classical Studies course numbered 370-379. Because of the cultural affinities, historical traditions and geographic boundaries shared between the Spanish-speaking and Portuguese speaking-populations of the Iberian Peninsula and in the Americas Spanish majors are strongly encouraged to fulfill the requirement through Port 370. Such a course will also fill an LAS Group I (Arts and Humanities) requirement.

WLC Option II: Language and Cultures for Professions
Under WLC Option II students with a concentration in Spanish must complete a minimum of 30 credits beyond the intermediate (201-202) level.

A. Languages and Cultures for Professions (Business)
Students with a primary major in the College of Business may select from one of the following options:

Business Option 1
International Business Secondary Major And Languages And Cultures For Professions Minor Emphasis (27 credits total)

I. International Business Secondary Major: (12 credits from approved CoB list)

II. LCP Minor Emphasis Courses: (15 credits)

Span 303 B (Spanish Conversation for Professionals, 3 cr.)
Span 304 (Spanish for Business and Professions, 3 cr.)
Span 351 (Introduction to Spanish-English Translation, 3 cr.)
Span 323 (Spain Today, 3 cr.) or Span 324 (Latin America Today, 3 cr.)*
Span 499 Internship or Span 395 (Study Abroad, 3 cr.)**
* Span 321 Spanish Civilization and Culture and Span 322 Latin American Civilization and Culture may be substituted.
** Additional credit from an approved study abroad program may be applied to the major.
Curricular Notes: Span 395 or Span 499 fulfills the International Business 3-month international experience requirement. Span 304, Span 395 and Span 499 may be double counted under Option 1.

Business Option 2
International Business Secondary Major And Language And Cultures For Professions Major (42 credits total)

I. International Business Secondary Major: (12 credits from approved CoB list)

II. LCP Second Major (30 credits)

A. Required LCP Core Courses: (12 credits)
Span 303 B (Spanish Conversation for Professionals, 3 cr.)

Span 304 (Spanish for Business and Professions, 3 cr.)
Span 351 (Introduction to Spanish-English Translation, 3 cr.)
Span 499 (Internship, 3 cr.) or Span 395 (3 cr.)**

B. Literature and Culture Courses: (12 credits)
Span 301 (Spanish Grammar and Composition, 3 cr.)
Span 314 (Introduction to Reading Hispanic Texts, 3 cr.)
Span 323 (Spain Today, 3 cr.) or Span 322 (Spanish Civilization and Culture, 3 cr.)
Span 324 (Latin America Today, 3 cr.) or Span 322 (Latin American Civilization, 3 cr.)

C. Electives: (6 credits)
Select one course from each of the following two categories:

Category 1:
Span 330 (Studies in Spanish Literature to 1700, 3 cr.)
Span 331 (Studies in Spanish Literature 1700 to the Present, 3 cr.)
Span 332 (Studies in Latin American Literature from Pre-Columbian Times through the Nineteenth Century, 3 cr.)
Span 333 (Studies in Latin American Literature from the Twentieth Century to the Present , 3 cr.)

Category 2:
Span 440 (Seminar on Literatures and Cultures of Spain, 3 cr.)
Span 441 (Seminar on Cervantes and the Golden Age, 3 cr.)
Span 445 (Seminar on Literatures and Cultures of Latin American, 3 cr.)

*Students taking Span 330 or 331 in Category 1 should choose Span 440 or 441 from Category 2; students taking Span 332 or 333 in Category 1 should choose Span 445 from Category 2.

** Additional credit from an approved study abroad program may be applied to the major.

Business Option 3
Languages and Cultures for Professions (Business without International Business Secondary Major) (30 credits)

A. Required LCP Core Courses: (12 credits)
Span 303B (Spanish Conversations for Professionals, 3 cr.)
Span 304 (Spanish for Business and Professionals)
Span 351 (Introduction to Spanish-English Translation, 3 cr.)
Span 499 (Internship, 3 cr.)

B. Literature and Cultural Courses: (12 credits)
Span 301 (Spanish Grammar and Composition, 3 cr.)
Span 314 (Introduction to Reading Hispanic Texts, 3 cr.)
Span 323 (Spain Today, 3 cr.) or Span 322 (Latin American Civilization, 3 cr.)
Span 324 (Latin America Today, 3 cr.) or Span 322 (Latin American Civilization, 3 cr.)

C. Electives: (6 credits)
Select one course from each of the following two categories

Category 1:
Span 330 (Studies in Spanish Literature to 1700, 3 cr.)
Span 331 (Studies in Spanish Lit 1700 to the Present, 3 cr.)

Span 332 (Studies in Latin American Literature from Pre-Columbian Times through the Nineteenth Century, 3 cr.)
Span 333 (Studies in Latin American Literature from the Twentieth Century to the Present, 3 cr.)

Category 2:
Span 440 (Seminar on the Literatures and Cultures of Spain, 3 cr.)
Span 441 (Seminar on Cervantes and the Golden Age, 3 cr.)
Span 445 (Seminar on the Literatures and Cultures of Latin America. 3 cr.)

Curricular Notes: students may only enroll in the Languages and Cultures for Professions (LCP) Option as a second major. They may not graduate with the second major in LCP alone.

B. Languages and Cultures for Professions (Engineering) (30 credits total)
A. Required LCP Core Courses: (12 credits)
Span 303 B (Conversation for Professionals, 3 cr.)
Span 304 (Spanish for Business & Professions, 3 cr.)
Span 351 (Introduction Spanish-English Translation, 3 cr.)
Span 499 Internship (3 cr.) or Span 395 (3 cr.)**

B. Literature and Culture Courses: (12 credits)
Span 301 (Spanish Grammar and Composition, 3 cr.)
Span 314 (Introduction to Reading Hispanic Texts, 3 cr.)
Span 323 (Spain Today, 3 cr.) or Span 322 (Spanish Civilization, 3 cr.)
Span 324 (Latin America Today, 3 cr.) or Span 322 (Latin American Civilization, 3 cr.)

C. Electives: (6 credits)
Select one course from each of the following two literature categories:

Category 1:
Span 330 (Studies in Spanish Literature to 1700, 3 cr.)
Span 331 (Studies in Spanish Lit 1700 to the Present, 3 cr.)
Span 332 (Studies in Latin American Literature from Pre-Columbian Times through the Nineteenth Century, 3 cr.)
Span 333 (Studies in Latin American Literature from the Twentieth Century to the Present, 3 cr.)

Category 2:
Span 440 (Seminar on the Literatures and Cultures of Spain, 3 cr.)
Span 441 (Seminar on Cervantes and the Golden Age, 3 cr.)
\Span 445 (Seminar on the Literatures and Cultures of Latin America, 3 cr.)

Curricular Notes: students may only enroll in the Languages and Cultures for Professions (LCP) Option as a second major. They may not graduate with the second major in LCP alone.

The Spanish minor: Option 1: Hispanic Studies, Option 2: Languages and Cultures for Professions

Option 1: The Spanish minor in Hispanic Studies requires at least 15 credits, 12 of which must be at the 300 level or higher. The department strongly recommends that all students of Spanish participate in an approved study abroad program based in a Spanish-speaking country. Any student who chooses not to participate in a department-approved study abroad program will be required to take 3 additional elective credits of Spanish at the 300 level or higher.

Option 2: Language and Cultures for Professions. The Spanish minor in Languages and Cultures for Professions requires the following courses (12 credits): 303B, 304, 351 and one culture course chosen from the following: 321, 322, 323, or 324. The department strongly recommends that all students of Spanish participate in an approved study abroad program based in a Spanish-speaking country. Any student who chooses not to participate in a department-approved study abroad program will be required to take 3 additional credits in culture chosen from the following: 321, 322, 323, or 324. Note: students taking either 321 or 323 must take either 322 or 324; students taking either 322 or 324 must take either 321 or 323.

Courses primarily for undergraduate students

Span 097. Accelerated Spanish Review. (3-2) F.S. *Prereq: Two years but less than three years of high-school Spanish.* For students who require additional review at the first year (101-102) level. Course components include a compact review of 101 and the essential elements of 102. Course completed with a passing grade fulfills the LAS foreign language requirement. Not recommended for students who wish to continue language at the second year (201-202) level without completing 102.

Span 101. Elementary Spanish I. (4-0) Cr. 4. F.SS. A communicative approach to grammar and vocabulary within the context of Hispanic culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Span 102. Elementary Spanish II. (4-0) Cr. 4. S.SS. *Prereq: 101, 97 or placement by departmental exam.* Continuation of Spanish 101. A communicative approach to grammar and vocabulary within the context of Hispanic culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Span 195. Study Abroad. Cr. 3. SS. Supervised instruction in Spanish and Hispanic culture; formal class instruction at level appropriate to student's training, augmented by practical living experience. Taught in Spanish. Consult the department regarding equivalency with SPAN 101 or 102.

Span 201. Intermediate Spanish I. (4-0) Cr. 4. F. *Prereq: 102 or placement by departmental exam.* Intensive review of basic grammar and conversation. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Span 202. Intermediate Spanish II. (4-0) Cr. 4. S. *Prereq: 201 or placement by departmental exam.* Continuation of Spanish 201. Intensive review of basic grammar. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course.

Span 295. Study Abroad. Cr. 3. SS. *Prereq: 102 or equivalent.* Supervised instruction in Spanish and Hispanic culture; formal class instruction at level appropriate to student's training, augmented by practical living experience. Taught in Spanish. Consult the department regarding equivalency with Span 201 or 202.

Span 301. Spanish Grammar and Composition. (3-0) Cr. 3. F.S. *Prereq: 202 or placement by departmental exam.* Review and application of grammar concepts in the development of writing skills within the context of Hispanic culture. Taught in Spanish.

Span 303. Spanish Grammar and Conversation. (3-0) Cr. 3. F.S. *Prereq: 202 or placement by departmental exam.* Intensive oral practice and improvement of oral proficiency. Application of specific grammatical concepts for development of conversational skills within the context of Hispanic culture. Taught in Spanish.
A. Conversation through Culture
B. Conversation for Professionals

Span 304. Spanish for Business and Professions. (3-0) Cr. 3. F.S. *Prereq: 202 or placement by departmental exam (301 recommended).* Introduction to professional communication within a cultural context. Grammar review as needed. Individual projects will focus on special interests. Taught in Spanish. Nonmajor graduate credit.

Span 314. Introduction to Reading Hispanic Texts. (3-0) Cr. 3. F.S. *Prereq: 301.* Critical reading of Hispanic literary and cultural texts. Presentation of techniques and terminology of literary criticism. Study of basic genres such as: narrative, poetry, drama, essay. Taught in Spanish. Required as prerequisite for 330, 331, 332 and 333.

Span 321. Spanish Civilization. (3-0) Cr. 3. F. *Prereq: One course at the 300 level.* A survey of the social, political, religious, and cultural history of Spain. Taught in Spanish.

Span 322. Latin American Civilization. (3-0) Cr. 3. S. *Prereq: One course at the 300 level.* A survey of the social, political, religious, and cultural history of Spanish America. Taught in Spanish.

Span 323. Spain Today. (3-0) Cr. 3. *Prereq: One course at the 300 level.* A survey of social, political, economic, and cultural topics relevant to contemporary Spain. Taught in Spanish.

Span 324. Latin America Today. (3-0) Cr. 3. *Prereq: One course at the 300 level.* A survey of social, political, economic, and cultural topics relevant to contemporary Latin America. Taught in Spanish.

Span 326. Studies in Hispanic Art or Film. (Dual-listed with 526). (3-0) Cr. 3. *Prereq: One course at the 300 level.* Survey of major currents and figures in Spanish and Latin American art and/or film. Taught in Spanish.

Span 330. Studies in Spanish Literature to 1700. (3-0) Cr. 3. F. *Prereq: 314.* Introduction to Spanish literature from the earliest times through the Golden Age; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish. Nonmajor graduate credit.

Span 331. Studies in Spanish Literature from 1700 to the Present. (3-0) Cr. 3. S. *Prereq: 314.* Introduction to Spanish literature from the eighteenth century to the present; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish. Nonmajor graduate credit.

Span 332. Studies in Latin American Literature from Pre-Columbian Times through the Nineteenth Century. (3-0) Cr. 3. F. *Prereq: 314.* Introduction to Latin American literature from the earliest times to circa 1900; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish. Nonmajor graduate credit.

Span 333. Studies in Latin American Literature from the Twentieth Century to the Present. (3-0) Cr. 3. S. *Prereq: 314.* Introduction to Latin American literature from the twentieth century to the present; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish. Nonmajor graduate credit.

Span 351. Introduction to Spanish-English Translation. (3-0) Cr. 3. F. *Prereq: 301, 303 or 304.* Introduction to the theory, methods, techniques, and problems of translation. Consideration of material from business, literature, and the social sciences. Taught in Spanish. Nonmajor graduate credit.

Span 352. Introduction to Spanish Phonology. (Cross-listed with LING). (3-0) Cr. 3. F.S. *Prereq: 301, 303 or 304.* An introductory study of the articulation, classification, distribution, and regional variations of the sounds of the Spanish language. Taught in Spanish. Nonmajor graduate credit.

Span 370. Hispanic Topics in English Translation. (3-0) Cr. 3. Repeatable. Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Readings, discussions, and papers in English. May not be counted as a prerequisite.
S. Hispanic topics on women or feminism (cross listed to W S 370S)

Span 395. Study Abroad. Cr. arr. *Prereq: 2 years university-level Spanish or equivalent.* Supervised instruction in Spanish and Hispanic culture; formal class instruction at level appropriate to students' training, enhanced by practical living experience.

Span 401. Advanced Composition and Grammar. (Dual-listed with 501). (3-0) Cr. 3. F. *Prereq: 314 and one course at the 320-level or above.* Advanced study of Spanish grammar and syntax. Students' writing of compositions incorporates an advanced understanding of grammar, syntax, and principles of organization of thought and ideas. Taught in Spanish. Nonmajor graduate credit.

Span 440. Seminar on the Literatures and Cultures of Spain. (Dual-listed with 540). (3-0) Cr. 3. Repeatable. *Prereq: 330, 331, 332, or 333. (Recommended 330 and 331).* Discussion and analysis of selected topics in Spanish literature and culture from the Middle Ages to the Present. Taught in Spanish. Nonmajor graduate credit.

Span 441. Seminar on Cervantes and the Golden Age. (Dual-listed with 541). (3-0) Cr. 3. Repeatable. *Prereq: 330, 331, 332, or 333. (330 recommended).* Discussion and analysis of selected works of Cervantes within the social and cultural context of the Golden Age. Taught in Spanish. Nonmajor graduate credit.

Span 445. Seminar on the Literatures and Cultures of Latin America. (Dual-listed with 545). (3-0) Cr. 3. Repeatable. *Prereq: 330, 331, 332, or 333. (332 and 333 recommended).* Discussion and analysis of selected topics in Latin American literature and culture from Pre-Colonial times to the Present. Taught in Spanish. Nonmajor graduate credit.

Span 462. Contrastive Analysis of Spanish/ English for Translators. (Cross-listed with LING). (3-0) Cr. 3. *Prereq: 351.* Linguistic study of the major differences between the Spanish and English grammatical systems and their applications in the translation of Spanish to English. Taught in Spanish. Nonmajor graduate credit.

Span 463. Hispanic Dialectology. (Cross-listed with LING). (3-0) Cr. 3. *Prereq: 352.* Intensive study of the phonology, morphosyntax and lexicon of the Hispanic dialects of Spain and Latin America in their historical context. Taught in Spanish. Nonmajor graduate credit.

Span 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Spanish and permission of department chair.* Designed to meet the needs of students in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 6 credits in Span 490 may be counted toward graduation.

Span 499. Internship in Spanish. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits of Spanish at the 300 level; permission of advisor and WLC Internship Coordinator.* Work experience using Spanish language skills in the public or private sector, combined with academic work under faculty supervision. Up to 3 credits may apply toward the major. Available only to majors and minors.

Courses primarily for graduate students, open to qualified undergraduate students

Span 501. Advanced Composition and Grammar. (Dual-listed with 401). (3-0) Cr. 3. F. *Prereq: 314 and one course at the 320-level or above.* Advanced study of Spanish grammar and syntax. Students' writing of compositions incorporates an advanced understanding of grammar, syntax, and principles of organization of thought and ideas. Taught in Spanish.

Span 526. Studies in Hispanic Art or Film. (Dual-listed with 326). (3-0) Cr. 3. *Prereq: 6 credits in Spanish literature or culture at 400 level.* Survey of major currents and figures in Spanish and Latin American art and/or film.

Span 540. Seminar on the Literatures and Cultures of Spain. (Dual-listed with 440). (3-0) Cr. 3. *Prereq: Six credits in Spanish literature or culture at 400 level..* Discussion and analysis of selected topics in Spanish literature and culture from the Middle Ages to the Present. Taught in Spanish.

Span 541. Seminar on Cervantes and the Golden Age.. (Dual-listed with 441). (3-0) Cr. 3. *Prereq: Six credits in Spanish literature of culture at 400 level.* Discussion and analysis of selected works of Cervantes within the social and cultural context of the Golden Age. Taught in Spanish.

Span 545. Seminar on the Literatures and Cultures of Latin America.. (Dual-listed with 445). (3-0) Cr. 3. *Prereq: Six credits in Spanish literature or culture at 400 level..* Discussion and analysis of selected topics in Latin American literature and culture from Pre-Colonial Times to the Present. Taught in Spanish.

Span 580. Graduate Seminar in Hispanic Literature or Culture. Cr. arr. Repeatable. *Prereq: 6 credits of 400 level Spanish.* Topics may include a particular period, a genre, an author, a theme, or a particular type of cultural production. Taught in Spanish.

Span 590. Special Topics in Spanish. Cr. arr. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Spanish.*
A. Literature or Literary Criticism
B. Linguistics
C. Language Pedagogy
D. Civilization

Special Courses in World Languages and Cultures (WLC)

Courses primarily for undergraduate students

WLC 119. Introduction to World Languages. (Cross-listed with Ling). (3-0) Cr. 3. Study of language diversity and the personal, social and political effects of diversity. Language families, attitudes toward language and dialects, language and culture, multilingualism, foreign language learning, written codes, official languages, and language policy.

WLC 417. Student Teaching. (Cross-listed with C I). Cr. arr. F.S. *Prereq: Admission to teacher education, approval of coordinator during semester before student teaching.* Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

G. Foreign Language (Same as C I 417G.)

WLC 484. Technology, Globalization and Culture. (Dual-listed with 584). (Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: senior classification for 484; graduate classification for 584.* Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

WLC 486. Methods in Elementary School World Language Instruction. (Cross-listed with C I, Ling). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language.* Current educational methods and their application in the elementary school classroom. Special emphasis on planning, evaluation, and teaching strategies. Nonmajor graduate credit.

WLC 487. Methods in Secondary School World Language Instruction. (Cross-listed with Ling, C I). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language, admission to the teacher education program.* Theories and principles of contemporary world language learning and teaching. Special emphasis on designing instruction and assessments for active learning.

WLC 491. Language in Motion. (1-0) Cr. 1. Repeatable. *Prereq: Minimum of six ISU credits for study abroad and/or internship abroad and completion of at least a fourth-semester (202 level) foreign language course or equivalent.* First 8 weeks of semester only. Enrollment by instructor permission only. Students returning from study abroad prepare presentations about an aspect of the culture they experienced and spend one day in a high school where they give their presentations to multiple classes. Satisfactory/fail only.

Courses primarily for graduate students, open to qualified undergraduate students

WLC 584. Technology, Globalization and Culture. (Dual-listed with 484). (Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: senior classification for 484; graduate classification for 584.* Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

Zoology

Interdepartmental Graduate Major

John E. Mayfield, Director of Graduate Education

Undergraduate Study

The undergraduate major in zoology is no longer available to new students. Those wishing to pursue an undergraduate degree in basic animal study are encouraged to investigate the numerous possibilities available to them at Iowa State University. The undergraduate Biology Program, jointly administered by faculties of the departments of Ecology, Evolution, and Organismal Biology (EEOB) and Genetics, Development and Cell Biology (GDCB), includes a wide spectrum of opportunities for students to develop their academic interests through the study of animal biology. Contact the Biology Program office for more information, or see www.biology.iastate.edu for more information. For those students interested in applied animal study, undergraduate majors in Animal Science and Entomology are available.

Graduate Study

The Zoology Graduate Program is closed to new students. Prospective students should contact the Genetics, Development and Cell Biology (GDCB) Graduate Program Director of Graduate Education for specific details about the program's status.

Related interdepartmental graduate majors in Ecology and Evolutionary Biology, Genetics, Immunobiology, Molecular, Cellular, and Developmental Biology, Neuroscience, and Toxicology should be investigated as possible alternative graduate programs.

The Faculty

Distinguished Professor denotes those faculty members who have been recognized for having attained outstanding national and international reputations within their professional disciplines.

University Professor denotes those faculty members who have been recognized for having made outstanding contributions to the quality of education at Iowa State University.

Inquiries concerning the faculty list should bedirected to the Office of the Provost, 1550 Beardshear Hall.

ABBOTT, ERIC ALAN, Professor of Greenlee School of Journalism and Communication. B.S., 1967, Iowa State; M.S., 1970, Ph.D., 1974, Wisconsin.

ABELSON, ABRAHAM G., Professor of Curriculum and Instruction. B.A., 1964, M.Ed., 1970, Pennsylvania State; Ph.D., 1976, Michigan.

ABENDROTH, ROBERT E., Associate Professor of Civil, Construction and Environmental Engineering. B.S., 1966, M.S., 1968, Ph.D., 1983, Wisconsin.

ABRAHAM, ROBERTA G., Emeritus Professor of English. B.A., 1953, Cornell; M.A., 1976, Iowa State; Ph.D., 1981, Illinois.

ABRAHAM, WILLIAM H., Emeritus Professor of Chemical and Biological Engineering. B.Ch.E., 1952, Cornell; Ph.D., 1957, Purdue.

ACHTER, CHARLES T., Lecturer in Curriculum and Instruction. B.A., 1969, St. John's; M.S., 1975, St. Cloud State.

ACKER, DAVID G., Professor of Agricultural Education and Studies; Associate Dean of the College of Agriculture and Life Sciences. B.A., 1975, Wilmington; M.Ed., 1980, M.S., 1980, California (Davis); Ph.D., 1989, Oregon State.

ACKERMAN, BRENDA P., Lecturer in Apparel, Educational Studies and Hospitality Management. B.S., 2005, M.S., 2008, Iowa State.

ACKERMAN, RALPH A., Professor of Ecology, Evolution and Organismal Biology. B.A., 1967, Rutgers; Ph.D., 1975, Florida.

ACKERMANN, MARK R., Professor of Veterinary Pathology. D.V.M., 1986, Ph.D., 1990, Iowa State.

ADAMS, DEAN, Associate Professor of Ecology, Evolution and Organismal Biology; Associate Professor of Statistics. B.A., 1992, Franklin and Marshall College; M.Sc., 1994, Louisiana; Ph.D., 1999, New York (Stony Brook).

ADAMS, DONALD R., Emeritus Professor of Biomedical Sciences; University Professor. A.B., 1960, California (Davis); M.A., 1967, Chico State; Ph.D., 1970, California (Davis).

ADAMS, JEAN W., Emeritus Professor of Economics. B.A., 1969, M.A., 1971, Ph.D., 1973, Illinois.

ADAMS, ROY DEAN, Emeritus Professor of Economics. B.A., 1968, M.A., 1971, Ph.D., 1972, Illinois.

ADELEKE, RAIMI OLATUNJI, Professor of History. B.A., 1978, Ife (Nigeria); M.A., 1981, Ph.D., 1985, Western Ontario.

ADURI, PAVANKUMAR R., Associate Professor of Computer Science. B.Tech., 1993, Jawaharlal Nehru Technological; M.S., 1995, Indian Institute of Technology; Ph.D., 2001, New York (Buffalo).

AGARWAL, SANJEEV, Professor of Marketing. B.E., 1979, Roorkee (India); M.S., 1980, California (Davis); Ph.D., 1986, M.A., 1986, Ohio State.

AHN, DONG UK, Professor of Animal Science. B.S., 1978, M.S., 1983, Seoul National; Ph.D., 1988, Wisconsin.

AHRENS, FRANKLIN A., Emeritus Professor of Biomedical Sciences. B.S., 1959, D.V.M., 1959, Kansas State; M.S., 1965, Ph.D., 1968, Cornell.

AITCHISON, GARY L., Emeritus Associate Professor of Management. B.A., 1956, Northern Iowa; M.A., 1961, Northern Colorado; Ph.D., 1972, Iowa State.

AJJARAPU, VENKATARAMANA, Professor of Electrical and Computer Engineering. B.Tech., 1979, Jawaharal Nehru Tech; M.Tech., 1981, Indian Institute of Technology; Ph.D., 1986, Waterloo.

AKERS, ARTHUR, Emeritus Professor of Aerospace Engineering. B.Sc., 1953, London; M.Sc., 1955, Cranfield; Ph.D., 1969, London.

AKINC, MUFIT, Professor of Materials Science and Engineering. B.S., 1970, M.S., 1973, Middle East Technical (Turkey); Ph.D., 1977, Iowa State.

AKKURT, CIGDEM T., Associate Professor of Art and Design. B.A., 1961, Cornell College; M.A., 1970, Iowa; M.S., 1982, Massachusetts.

AL-KAISI, MAHDI, Associate Professor of Agronomy. B.S., 1974, Baghdad; M.S., 1982, Ph.D., 1986, North Dakota State.

ALCORN, JANET W., Emeritus Associate Professor of Music. B.Mus., 1958, Northwestern; M.Mus., 1960, Boston University.

ALCOTT, CODY J., Adjunct Instructor in Veterinary Clinical Sciences. B.S., 2000, California State Polytechnic; D.V.M., 2004, Iowa State.

ALEKEL, D. LEE, Professor of Food Science and Human Nutrition. B.S., 1979, Cornell; M.S., 1985, Pennsylvania State; Ph.D., 1993, Illinois.

ALEXANDER, DAVID, Assistant Professor of Philosophy and Religious Studies. B.A., 1999, M.A., 2001, Toronto; Ph.D., 2008, Washington.

ALEXANDER, ROGER K., Associate Professor of Mathematics. B.A., 1968, Kansas; M.A., 1974, Ph.D., 1975, California (Berkeley).

ALEXANDER, TERRY J., Senior Lecturer in Economics. B.A., 1980, M.A., 1984, Ph.D., 1989, Maryland.

ALIPRANTIS, DIONYSIOS, Assistant Professor of Electrical and Computer Engineering. B.S., 1999, National Technical-Athens, Greece; Ph.D., 2003, Purdue.

ALLEMAN, JAMES EDWARD, Professor of Civil, Construction and Environmental Engineering and Chair of the Department. B.S.C.E., 1971, M.S., 1972, Ph.D., 1978, Notre Dame.

ALLEN, ALISON JO, Lecturer in Mathematics. B.S., 2004, North Carolina; M.S., 2006, Iowa State.

ALLEN, BEVERLYN LUNDY, Associate Professor of Sociology. BSW, 1975, M.S.W., 1977, Temple; Ph.D., 1995, Iowa State.

ALLEN, LINDA QUINN, Associate Professor of World Languages and Cultures; Associate Professor of Curriculum and Instruction. B.A., 1978, Purdue; M.A., 1982, Ball State; Ph.D., 1994, Purdue.

ALLEN, PHILIP MANNING, Emeritus Professor of Art and Design. B.F.A., 1960, M.F.A., 1961, Drake.

ALREAD, JASON, Associate Professor of Architecture. B.A., 1988, Florida; M.Arch., 1991, Yale.

ALURU, SRINIVAS, Professor of Electrical and Computer Engineering; Professor of Computer Science. B.Tech., 1989, Indian Institute of Technology; M.S., 1991, Ph.D., 1994, Iowa State.

AMARASINGHE, GAYA, Assistant Professor of Biochemistry, Biophysics and Molecular Biology. B.S., 1997, City University of New York; Ph.D., 2001, Maryland (Baltimore County).

AMBROSIO, LINDA, Associate Professor of Biochemistry, Biophysics and Molecular Biology. B.S., 1976, New York (Stony Brook); Ph.D., 1985, Princeton.

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AMOS, ROSALIE JEANNE, Emeritus Associate Professor of Apparel, Educational Studies and Hospitality Management; Emeritus Associate Professor of Curriculum and Instruction. B.S., 1953, Iowa State; M.S., 1960, Ph.D., 1976, Cornell.

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ANDERSON, CRAIG A., Professor of Psychology; Distinguished Professor in Liberal Arts and Sciences. B.A., 1976, Butler; M.A., 1978, Ph.D., 1980, Stanford.

ANDERSON, DEAN, Professor of Kinesiology. B.S., 1968, M.A., 1972, Ph.D., 1978, Minnesota.

ANDERSON, E. WALTER, Professor of Physics and Astronomy. A.B., 1959, Harvard; M.A., 1961, Ph.D., 1965, Columbia.

ANDERSON, IVER ERIC, Adjunct Professor of Materials Science and Engineering. B.S., 1975, Michigan Tech; M.S., 1977, Ph.D., 1982, Wisconsin.

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ANDERSON, JULIA F., Emeritus Professor of Apparel, Educational Studies and Hospitality Management. B.S., 1941, Iowa State; M.S., 1947, Washington.

ANDERSON, KEVIN F., Assistant Professor of Veterinary Microbiology and Preventive Medicine (Collaborator). B.S., 1975, Iowa Wesleyan; M.S., 1983, Western Illinois.

ANDERSON, LLOYD LEE, Professor of Animal Science; Professor of Biomedical Sciences; Charles F. Curtiss Distinguished Professor in Agriculture and Life Sciences. B.S., 1957, Ph.D., 1961, Iowa State.

ANDERSON, MARC, Assistant Professor of Management. B.S., 1991, Carnegie Mellon; M.B.A., 1993, Michigan; Ph.D., 2002, Minnesota.

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ANDERSON, PAUL F., Professor of Landscape Architecture; Professor of Agronomy. B.S.L.A., 1972, M.L.A., 1974, Iowa State.

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ANDERSON-HSIEH, JANET, Emeritus Professor of English. BPH, 1967, Northwestern; M.A., 1972, Ph.D., 1976, Illinois.

ANDRE, THOMAS, Professor of Curriculum and Instruction; Professor of Psychology. B.S., 1967, Massachusetts; M.A., 1970, Ph.D., 1971, Illinois.

ANDREASEN, CLAIRE B., Professor of Veterinary Pathology and Chair of the Department; Professor of Veterinary Clinical Sciences and Interim Chair of the Department. B.S., 1979, D.V.M., 1982, Texas A&M; M.S., 1987, Ph.D., 1990, Georgia.

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APPLEQUIST, JON BARR, Emeritus Professor of Biophysics. B.S., 1954, California (Berkeley); Ph.D., 1959, Harvard.

ARBUCKLE, J. GORDON JR., Assistant Professor of Sociology. B.A., 1991, Guilford College; M.S., 2002, Ph.D., 2007, Missouri.

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ATWOOD, DAVID M., Senior Lecturer in Physics and Astronomy. B.S., 1984, Toronto (Canada); M.S., 1987, Ph.D., 1989, McGill.

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BAENZIGER, MARDITH A., Associate Professor of Civil, Construction and Environmental Engineering. B.Arc.E., 1968, M.S., 1969, Iowa State; M.S., 1979, Ph.D., 1981, Wisconsin.

BAER, ROGER EDWARD, Professor of Art and Design and Chair of the Department. B.A., 1968, California State (Long Beach); M.F.A., 1978, Illinois.

BAHADUR, SHYAM, Emeritus Professor of Mechanical Engineering; University Professor. B.E., 1957, M.E., 1962, Roorkee (India); Ph.D., 1970, Michigan.

BAILEY, MICHAEL DAVID, Assistant Professor of History. B.A., 1993, Duke; Ph.D., 1998, Northwestern.

BAILEY, THEODORE B. JR., Professor of Statistics. B.S., 1964, Iowa State; M.S., 1969, Ph.D., 1972, Minnesota.

BAIN, CARMEN M., Assistant Professor of Sociology. M.A., 2001, Canterbury (New England); Ph.D., 2007, Michigan State.

BAKAC, ANDREJA, Adjunct Professor of Chemistry. B.S., 1968, M.S., 1972, Ph.D., 1976, Zagreb.

BAKER, JAMES L., Emeritus Professor of Agricultural and Biosystems Engineering; University Professor. B.S., 1966, South Dakota School of Mines; Ph.D., 1971, Iowa State.

BAKER, JANICE A., Assistant Professor of Kinesiology; Assistant Professor of Music. B.F.A., 1975, Utah; M.S., 1979, Kansas State.

BAKER, JENNY LYNN, Lecturer in Civil, Construction and Environmental Engineering. B.S., 2001, M.S., 2001, Kansas State.

BAKER, RODNEY BURNS, Senior Clinician in Veterinary Diagnostic and Production Animal Medicine. B.S., 1974, Western Kentucky; D.V.M., 1978, Auburn; M.S., 1999, Iowa State.

BAL, HARPAL S., Emeritus Professor of Biomedical Sciences. B.V.Sc., 1953, Punjab (India); M.S., 1966, Ph.D., 1969, Iowa State.

BALASUBRAMANIAM, SHANKER, Assistant Professor of Electrical and Computer Engineering (Collaborator). B.Tech., 1989, Indian Institute of Technology; M.S., 1992, Ph.D., 1993, Pennsylvania State.

BALDWIN, CLAUDIA J., Associate Professor of Veterinary Clinical Sciences. D.V.M., 1982, Michigan State; M.S., 1983, Wisconsin.

BALTZER, LYNNE E., Associate Professor of Apparel, Educational Studies and Hospitality Management. B.S., 1972, Wisconsin (Stout); Ph.D., 1983, Iowa State.

BANG, EUNJIN, Assistant Professor of Curriculum and Instruction. B.S., 1997, Chun Chun (Korea); M.S., 2004, Ph.D., 2008, Arizona State.

BANNANTINE, JOHN P., Assistant Professor of Veterinary Microbiology and Preventive Medicine (Collaborator). B.S., 1988, Wisconsin (Oshkosh); M.S., 1991, Ph.D., 1995, Iowa State.

BARAK, ROBERT J., Professor of Educational Leadership and Policy Studies (Collaborator). B.S., 1967, Michigan State; M.A., 1972, Missouri (Kansas City); Ph.D., 1976, New York (Buffalo).

BARCLAY, SALLY L., Clinician in Food Science and Human Nutrition. B.S., 1978, Iowa State; M.S., 1980, Purdue.

BARKER, JESSICA, Assistant Professor of Apparel, Educational Studies and Hospitality Management. B.S., 2000, Louisiana State; M.S., 2003, Ph.D., 2007, Florida State.

BARNES, RICHARD G., Emeritus Professor of Physics and Astronomy. B.S., 1948, Wisconsin; M.A., 1949, Dartmouth; Ph.D., 1952, Harvard.

BARNES, WILFRED E., Emeritus Professor of Mathematics. S.B., 1949, S.M., 1950, Chicago; Ph.D., 1954, British Columbia.

BARNHART, RUTH S., Emeritus Professor of Curriculum and Instruction. B.S., 1960, M.A., 1964, Western Michigan; Ph.D., 1975, Michigan State.

BARNHART, STEPHEN K., Professor of Agronomy. B.S., 1970, M.S., 1975, Ohio State; Ph.D., 1979, Iowa State.

BARRATT, MARY F., Adjunct Instructor in English. A.B., 1973, California (Berkeley); M.A., 1975, Ohio; Ph.D., 1993, Iowa State.

BARTA, THOMAS A., Emeritus Professor of Industrial and Manufacturing Systems Engineering. B.S., 1957, Iowa State; M.S., 1962, Iowa; Ph.D., 1975, Iowa State.

BARTHOLOMAY, LYRIC, Assistant Professor of Entomology. B.S., 1998, Colorado State; Ph.D., 2004, Wisconsin.

BARTON, CHARLES, Assistant Professor of Biomedical Sciences (Collaborator). B.S., 1992, M.S., 1993, Ph.D., 1998, Louisiana.

BARTON, TOMMY J., Professor of Chemistry; Distinguished Professor in Liberal Arts and Sciences. B.S., 1962, Lamar; Ph.D., 1967, Florida.

BASART, JOHN PHILIP, Emeritus Professor of Electrical Engineering. B.S., 1962, M.S., 1963, Ph.D., 1967, Iowa State.

BASMAJIAN, CARLTON, Assistant Professor of Community and Regional Planning. A.B., 1996, Chicago; M.C.P., 2000, Georgia Institute of Technology; Ph.D., 2008, Michigan.

BASSHAM, DIANE C., Associate Professor of Genetics, Development and Cell Biology. B.Sc., 1990, Birmingham (England); Ph.D., 1994, Warwick (England).

BASSLER, BRUCE LEE, Associate Professor of Architecture. B.S., 1972, Iowa State; M.Arch., 1975, Texas A&M.

BASSLER, EUNICE M., Senior Lecturer in Food Science and Human Nutrition. B.A., 1974, Northern Iowa; M.S., 1979, Kansas State.

BASTAWROS, ASHRAF, Associate Professor of Aerospace Engineering; Associate Professor of Mechanical Engineering. B.Sc., 1988, M.Sc., 1991, Cairo (Egypt); M.S., 1995, Ph.D., 1997, Brown.

BASTAWROS, HALA FAROUK, Lecturer in Genetics, Development and Cell Biology. M.D., 1992, Cairo University School of Medicine; M.S., 2007, Iowa State.

BASU, SAMIK, Assistant Professor of Computer Science. B.E., 1998, Jadavpur (India); M.S., 2001, Ph.D., 2003, New York (Stony Brook).

BASZCZYNSKI, MARILYN J., Lecturer in World Languages and Cultures. B.A., 1979, M.A., 1981, Ph.D., 1990, Western Ontario (Canada).

BATAILLE, ROBERT R., Emeritus Professor of English. B.A., 1962, Rutgers; M.A., 1965, Ph.D., 1970, Kansas.

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ZHENG, TIANSHU, Assistant Professor of Apparel, Educational Studies and Hospitality Management. B.S., 2002, M.S., 2003, Ph.D., 2008, Nevada (Las Vegas).

ZHU, DAN, Associate Professor of Logistics, Operations and Management Information Systems; Associate Professor of Computer Science. B.E., 1985, Beijing Polytech; M.S., 1988, Academia Sinica (China); Ph.D., 1995, Carnegie-Mellon.

ZHYLYEVSKYY, OLEKSANDR, Assistant Professor of Economics. B.A., 2000, M.A., 2002, Kiev-Mohyla Academy (Ukraine); Ph.D., 2008, Virginia.

ZIMMERMAN, DAVID, Assistant Professor of English. B.F.A., 1992, Emerson College; M.F.A., 1995, Alabama.

ZIMMERMAN, DEAN R., Emeritus Professor of Animal Science. B.S., 1954, Ph.D., 1960, Iowa State.

ZIMMERMAN, JEFFREY J., Professor of Veterinary Diagnostic and Production Animal Medicine; Professor of Veterinary Microbiology and Preventive Medicine. B.A., 1978, Nebraska (Omaha); D.V.M., 1984, M.S., 1986, Ph.D., 1990, Iowa State.

ZIMMERMAN, ZORA DEVRNJA, Professor of English; Associate Dean of the College of Liberal Arts and Sciences. B.A., 1967, Ph.D., 1974, New York (Buffalo).

ZMOLEK, WILLIAM G., Emeritus Professor of Animal Science. B.S., 1944, M.S., 1951, Iowa State.

ZOBER, MARTIN, Emeritus Professor of Marketing. B.A., 1940, M.Litt., 1943, Ph.D., 1950, Pittsburgh.

ZOU, QINGZE, Assistant Professor of Mechanical Engineering. B.S., 1994, Electronic Science and Technology (China); M.S., 1997, Tsinghua (China); Ph.D., 2003, Washington.

ZUERNER, RICHARD L., Associate Professor of Veterinary Microbiology and Preventive Medicine (Collaborator). B.A., 1980, California State (Chico); M.S., 1983, Ph.D., 1986, West Virginia.

ZWANZIGER, ELIZABETH, Lecturer in World Languages and Cultures. B.A., 1991, Luther; M.A., 1993, Missouri; Ph.D., 2008, Boston.

ZWICK-TAPLEY, SARAH LYNN, Lecturer in Music. B.A., 1991, Illinois State; M.F.A., 1999, Harvard.

ZYTOWSKI, DONALD G., Emeritus Professor of Psychology. A.B., 1952, Harris; M.S., 1957, Ed.D., 1965, Washington (St. Louis).

College of Agriculture and Life Sciences

Wendy Wintersteen, Dean
Joe Colletti, Senior Associate Dean
David Acker, Associate Dean
Gerald Miller, Associate Dean
www.ag.iastate.edu

Departments of the College

Agricultural Education and Studies
Agricultural and Biosystems Engineering
Agronomy
Animal Science
Biochemistry, Biophysics, and Molecular Biology
Ecology, Evolution, and Organismal Biology
Economics
Entomology
Food Science and Human Nutrition
Genetics, Development and Cell Biology
Horticulture
Natural Resource Ecology and Management
Plant Pathology
Sociology

Students enrolled in the College of Agriculture and Life Sciences are provided a broad-based education that includes coursework in communications; biological, physical, and social sciences; humanities; and technical subject matter.

Upon graduation students find diverse career opportunities because of the well balanced education they have received as undergraduates. Opportunities for graduates include production agriculture, business and industry, public agencies, education, biological and environmental sciences, value-added processing, natural resource management, rural development, animal and human health professions, and graduate studies.

High School Preparation

Requirements for students entering from high school or transferring with less than 24 college credits into the College of Agriculture and Life Sciences include four years of English; three years of mathematics which must include one year each of algebra, geometry, and advanced algebra; three years of science which must include one year each of biology and chemistry, or biology and physics, or chemistry and physics; and two years of social studies. No foreign language is required for admission to the College of Agriculture and Life Sciences.

Majors in the College of Agriculture and Life Sciences

A student has many majors from which to choose. Each major is unique although many courses are common. This is helpful to students in that they may transfer from one major to another before the second year with little loss of credits. Options and areas of specialization further define the majors and required coursework within some majors. In all cases, majors are designed to help students succeed in their chosen professions. Majors in agriculture and life sciences are:

Primary Majors

Agricultural Biochemistry
Agricultural Business
Agricultural and Life Sciences Education
Agricultural Studies
Agricultural Systems Technology
Agronomy
Animal Ecology
Animal Science
Biochemistry
Biology
Culinary Science
Dairy Science
Dietetics
Diet and Exercise
Environmental Science
Food Science
Forestry
Genetics
Global Resource Systems
Horticulture
Industrial Technology
Insect Science
Microbiology
Nutritional Science
Public Service and Administration in Agriculture

Secondary Majors

Environmental Studies
International Agriculture
Seed Science

A secondary major must be taken in conjunction with a primary major.

Minors

Agricultural Biochemistry
Agricultural Education and Studies
Agricultural Systems Technology
Agronomy
Animal Ecology
Animal Science
Biology
Emerging Global Diseases*
Entrepreneurial Studies*
Environmental Science
Environmental Studies
Food Safety*
Food Science
Forestry
Genetics
Horticulture
Industrial Technology
Insect Science
International Agriculture
Meat Science
Microbiology
Nutrition

*The College of Agriculture and Life Sciences participates in these interdepartmental minors.

Certificate

Occupational Safety

See statement on minors in the *Colleges and Curricula* section of this catalog.

Special Programs

Agriculture Exploration

Agriculture Exploration is a starting place for students who wish to pursue careers in the life sciences, food science, natural resources, production agriculture, business, or communications but who are unsure of which majors to choose. Students entering this program will be advised in the Student Services Office until they select their majors.

Preveterinary Medicine

Students in the College of Agriculture and Life Sciences may complete the requirements for admission to the College of Veterinary Medicine by enrolling in any major within the college. Because a solid foundation in the sciences is basic to the program in veterinary medicine, those majors that emphasize the sciences are usually more compatible with preveterinary medicine (see College of Veterinary Medicine section of this catalog for specific admissions requirements).

Students who are undecided about choice of major may enroll in general preveterinary studies (Gen PV). These students will also enroll in an orientation course, which describes the various college majors. A Gen PV student has up to 1.5 semesters to select a major.

Preveterinary medicine students also have an opportunity, with careful planning, to complete the requirements for a bachelor of science degree in an individual curriculum within the College of Agriculture and Life Sciences after admission to the College of Veterinary Medicine. This may be done by completing the prescribed course of study established by an individual major. Students also may meet degree requirements of an individual major through the College of Agriculture and Life Sciences Honors Program. Further details are available from an academic adviser or from members of the College of Agriculture and Life Sciences Honors Committee.

Honors Program

The College of Agriculture and Life Sciences Honors Program provides an opportunity for students of high ability to maximize their educational experience by individualizing their program of study. (See statement on Honors Program in the Colleges and Curricula section of this catalog). For more information, contact the chair of the College of Agriculture and Life Sciences Honors Committee, or a department Honors contact person.

Off-Campus Programs

Coursework leading to a master of science degree in agricultural education, master of agriculture degree in professional agriculture and a master of science degree in agronomy are offered to students who choose to study off-campus; see *Extended and Continuing Education* for further information.

Study Abroad and International Travel Opportunities

Agriculture and life sciences are part of a highly interconnected global system; decisions made in one sector have profound impacts worldwide. It is important for students to develop an understanding and appreciation for the global system and the role that U.S. agriculture plays in providing a safe and predictable food supply for a growing world population. The College of Agriculture and Life Sciences provides study abroad and international internship opportunities in more than 25 countries around the world. For additional information, contact the Office of Global Agriculture Programs in the College of Agriculture and Life Sciences.

Internships and Cooperative Education Programs

Practical work experience can provide a unique learning opportunity that complements academic coursework. This experience is provided through internships or cooperative education programs. For additional information, contact a departmental adviser or internship coordinator.

College of Agriculture and Life Sciences Core Curriculum and Electives

All curricula in the College of Agriculture and Life Sciences lead to a bachelor of science degree. Each major has specific degree requirements for graduation based on department and college student learning outcomes. College of Agriculture and Life Sciences core curriculum requirements for the four areas listed below are established to provide the foundation for successful accomplishment of both departmental and college level learning outcomes.

Students pursuing a primary major in another college and taking a second major in the College of Agriculture and Life Sciences must fulfill the core curriculum requirements of the College of Agriculture and Life Sciences, and all the requirements of the second major. The College of Agriculture and Life Sciences core curriculum follows.

Minimum Credits	Subject Area
9.5	Interpersonal and public communication skills
6	English composition with grades of C or better
3	Speech fundamentals with grades of C or better; 0.5 credit in Lib 160
17	Mathematical, physical, and life sciences 3 credits of mathematics; 3 credits of statistics; 5 credits of physical science (e.g., chemistry, geological and atmospheric sciences, physics); 6 credits of life sciences including Biology 101 or 211, and 3 credits of life sciences from a college-approved list: (http://www.ag.iastate.edu/student/student_services.php)
12	Humanities, social sciences 3 credits of humanities; 3 credits of social sciences; 3 credits of U.S. diversity from an approved list; 3 credits of international perspectives from an approved list.
3	Ethics Requirement met in one of two ways designated by the student's major program of study: 1) 3 credits from a college-approved list; or 2) a course in foundational elements of ethical/critical thinking offered by the Department of Philosophy specifically to meet this requirement for College of Agriculture and Life Sciences majors, and a course designated by the student's major program designated to coordinate with this foundational course. Refer to the College of Agriculture and Life Sciences web site for details of the ethics requirement.

All students graduating with majors within the College of Agriculture and Life Sciences are expected to be proficient in the following college-level outcomes:

Professional, Interpersonal and Cross-cultural Communications
- Speak and write clearly and persuasively.
- Prepare effective visual, oral, written and electronic presentations.
- Effectively read, listen, observe and reflect.

Problem-Solving/Critical Thinking
- Apply a holistic approach to solving complex issue laden problems.
- Apply a rational and objective process to:

  -Distinguish verifiable facts from value claims,

  -Determine the accuracy of statements,

  -Identify assumptions and detect bias,

  -Distinguish relevant from irrelevant information,

  -Prioritize needs.
- Summarize, analyze, and interpret simple research data and policy issues.

Leadership
- Organize, facilitate, and participate effectively in a group, team, or organization.
- Define a problem or opportunity, implement an action planning process, work towards a goal and justify actions taken.

Entrepreneurship
- Demonstrate innovativeness and creativity regardless of context.
- Identify and pursue opportunities that produce value.
- Be persistent in shepherding necessary resources and managing associated risk to facilitate change.

Life-long learning
- Articulate how continued learning after graduation will enrich their lives.
- Identify and participate in new areas for learning beyond the classroom and after graduation.

Ethics
- Define and assess their ethical perspective, moral responsibility, and values.
- Identify and critically evaluate contemporary ethical and moral issues in professional and private life.

Environmental Awareness
- Explain the physical and biological interactions within ecosystems
- Explain how human activities impact the environment and how societies area affected by environmental change.

International/Multi-Cultural Awareness
- U.S. Diversity – Students should achieve two of the following outcomes. They should be able to:

  Articulate how their personal life experiences and choices fit within the context of the larger mosaic of U.S. society, indicating how they have confronted and critically analyzed their perceptions and assumptions about diversity-related issues,

  Analyze and evaluate the contributions of various underrepresented social groups in shaping the history and culture of the U.S.,

  Analyze individual and institutional forms of discrimination based on factors such as race, ethnicity, gender, religion, sexual orientation, class, etc.,

  Analyze the perspectives of groups and individuals affected by discrimination,

  Analyze how cultural diversity and cooperation among social groups affect U.S. society.
- International Perspectives – Students should achieve two of the following outcomes. They should be able to:

  Analyze the accuracy and relevancy of their own worldviews and anticipate how people from other nations may perceive that worldview,

  Describe and analyze how cultures and societies around the world are formed, are sustained, and evolve,

  Analyze and evaluate the influence of global issues in their own lives,

  Describe the values and perspectives of cultures other than their own and discuss how they influence individuals' perceptions of global issues and/or events,

  Communicate competently in a second language.

In addition to the College level learning outcomes, each department within the college has additional discipline-specific outcomes that apply to graduates of that department.

Electives

Students use electives to broaden their education or to strengthen an area of specialization. Electives may be used to meet the requirements for a double major (see statement on double majors in this catalog). Those who wish to change their major, or who decide to graduate with a double major, must be enrolled for the last two semesters in the curriculum in which they expect to graduate. Students in ROTC may apply ROTC credits toward elective requirements.

Advising

Each student in the College of Agriculture and Life Sciences works closely with an academic adviser who is associated with the major in which the student is enrolled.

All entering students are strongly encouraged to participate in the summer orientation program in which they will have the opportunity to meet and work with academic advisers in planning their first semester schedule of classes.

The advisers also assist students in making personal adjustments to university life, offer suggestions on academic and co-curricular choices, and provide information on career choices. Advisers make a special effort to adjust course schedules in accordance with students' interests and capabilities.

A student may wish to prepare for admission to a professional program such as law, medicine, or veterinary medicine while pursuing a bachelor of science degree in the College of Agriculture and Life Sciences. This may be accomplished through several majors; however, it is recommended that the student work closely with an academic adviser.

Each department prepares a guide to help students chart their long-term programs and to specify the exact requirements for graduation. Visit the college web site www.ag.iastate.edu.

Graduate Study

Graduate study in agriculture is conducted through the Graduate College. Details are found in the Graduate College section of this catalog.

Various departments in the College of Agriculture and Life Sciences also participate in the following graduate-level interdepartmental offerings:

Biorenewable Resources and Technology
Ecology and Evolutionary Biology
Environmental Science
Genetics
Immunobiology
Microbiology
Molecular, Cellular, and Developmental Biology
Neuroscience
Nutritional Sciences
Plant Biology
Professional Agriculture (off-campus)
Seed Technology and Business
Sustainable Agriculture
Technology and Social Change (interdepartmental minor)
Toxicology

For details, consult the Graduate College section of this catalog.

Curriculum in Agricultural Biochemistry

Administered by the Department of Biochemistry, Biophysics and Molecular Biology.

Cr.	Degree Requirements
9.5	**Interpersonal and public communication skills** Engl 150, 250; Sp Cm 212; Lib 160
62-63	**Mathematical, physical, and life sciences** Math 165, 166, 265 or 266; Phys 221, 222; Chem 201 (or 177, 178), 177N (or 177L), 210 or 211, 211L, 322L, 324, 325, 331, 331L, 332; Biol 211, 212, 211L or 212L, 313, 314
15	**Humanities, ethics, and social science** 3 cr. in ethics from an approved list; 3 cr. in humanities; 3 cr. in social sciences; 3 cr. in U.S. diversity from an approved list; 3 cr. in international perspectives from an approved list
9	**Agricultural sciences** 9 cr. from an approved list available in the department. Two courses with environmental awareness emphasis will be chosen from an approved list.
11-13	**Agricultural biochemistry** BBMB 101, 102, 201, 404, 405 or 501, 502; 411. Students wishing research experience in agricultural biochemistry are encouraged to enroll in BBMB 499
21.5-22.5	**Electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
5	Advanced General Chemistry—Chem 201
1	Laboratory in General Chemistry— Chem 177N
4	Calculus I—Math 165
0.5	Library Instruction—Lib 160
3	Principles of Biology—Biol 211
1	Principles of Biology Laboratory—Biol 211L
1	Introduction to Biochemical Activities—BBMB 101
Cr.	**Spring**
3	Critical Thinking and Communication—Engl 150
4	Calculus II—Math 166
3	Communications—Sp Cm 212
3	Principles of Biology—Biol 212
1	Principles of Biology Laboratory—Biol 212L
1	Introduction to Biochemistry—BBMB 102

Curriculum in Agricultural Business

Administered by the Department of Economics. Students majoring in Agricultural Business often choose elective coursework leading to minors in the College of Business or in the College of Agriculture and Life Sciences, or emphasizing specific areas within agricultural business such as finance, management, commodity analysis, research, agricultural sales and marketing, environmental economics, farm and ranch operations, international economics, agricultural extension, or government service.

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Lib 160 Engl 150, 250 Engl 302 or Engl 309 or Engl 314 Sp Cm 212 or AgEdS 311
13	**Mathematics** Math 160, Econ 207, or Math 165, Econ 207, or Math 165, 166 Stat 226, 326
4-5	**Physical Sciences** Chem 163-163L or Phys 111
6	**Life and Environmental Sciences** Biol 101 or 211 NREM 120 or Biol 173 or other credits that meet the environmental intensive requirement
15	**Social science, humanities, and ethics** Courses in individual areas below may overlap but the total credits taken must equal 12 or more Ethics International Perspectives U.S. diversity Humanities (if the student has taken a humanities course among the ethics, international perspectives, or U.S. diversity requirements, the humanities requirement may be fulfilled by taking a course in a social science other than economics)
12	**Business** Acct 284, 285 Fin 301 One of the following: Mgmt 310, 370, Mkt 340, MIS 330, OSCM 320, or LSCM 360
6	**Electives in agricultural, food, or natural resources sciences**
26.5	**Economics** Econ 101, 101L, 110, 235, 301,302 or 353 Twelve credits in economics courses selected from an approved departmental list.
32-33	**Free electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
4	Microeconomics—Econ 101, 101L
0.5	Orientation in Agricultural Business—Econ 110
4	Mathematics I — Math 160 or 165
3	Elective in agricultural, food, or natural resource science.
3	Critical Thinking and Communication—Engl 150
0.5	Library Instruction — Lib 160
Cr.	**Spring**
3	Intro. to Agricultural Markets—Econ 235
3-4	Mathematics II—Econ 207 or Math 166
3	Macroeconomics—Econ 102
3	Environmental Biology—Biol 173
3	Agricultural, Food, or Natural Resources Science Course

Curriculum in Agricultural Education

Administered by the Department of Agricultural Education and Studies. Students majoring in Agricultural Education choose between two options: Teacher Certification or Communications.

Teacher Certification Option

Cr.	Degree Requirements
9.5	**Interpersonal and public communication skills** Engl 150, 250, Lib 160, AgEdS 311 (3 cr.)
18-19	**Mathematical, physical, and life sciences** Chem 163, 163L or 177, 177L; Stat 104; Biol 211, 211L; Biol 212, 212L; Math 104 or 150
18	**Humanities, ethics, and social sciences** Psych 230; C I 333 and 406; American history elective (3 cr.); from approved lists: 3 cr. in ethics; 3 cr. in international perspectives
37	**Agricultural sciences and economics** AgEds 488; Agron 114 and 154; An S 101 and 114; Hort 221; Econ 101, 331; NREM 120; 6 credits in agriculture and life sciences; 6 credits in courses 300-level or above to be chosen from technology systems management, animal science, agronomy, agricultural economics, forestry, or horticulture
31.5	**Professional credits** AgEdS 110A, 211A, 310, 401, 402, 416, 417 (14 Cr.); C I 201, 204, Sp Ed 450.
13-14	**Electives**

Communications Option

Cr.	Degree Requirements
9.5	**Interpersonal and public communication skills—** Engl 150, 250, Lib 160, AgEds 311
23-24	**Mathematical, physical, and life sciences—** Chem 163, 163L or 177, 177L; Biol 211, 212; BMBB 221 or Phys 106; life science elective (3 cr.); demonstration of computer proficiency; (3 cr.) Math 104 or 150; Stat 104
18	**Humanities, ethics, and social sciences—** Econ 101 or 102; psychology elective (3 cr.); ethics elective (3 cr.); international perspectives elective (3 cr.); U.S. diversity elective (3 cr.); humanities elective (3 cr.).
32	**Agricultural sciences and economics—** 10 credits in a selected area of agricultural sciences and economics including 6 credits at the 300-400 level; 6 cr. each in two additional areas of agricultural sciences and economics; agricultural sciences and economics electives (10 cr.)
32.5	**Professional communications—** AgEdS 110A, 211, 215, 315, 412 (6 cr.); select 21 cr. from Jl MC 101, 342, 347, Engl 205, 302, 309, 310, 314, 411, 415, 416, Mgmt 310, 370, 371, Sp Cm 110, 212, 312, 323, 327, ComSt 102, 214, 310, 314, 317
12-13	**Electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
0.5	Orientation–AgEdS 110A
3	Critical Thinking and Communication —Engl 150
3	Probability and Matrices—Math 104 or Discrete Mathematics for Business and Social Sciences – Math 150
3	Principles of Micro Economics—Econ 101
3	Principles of Biology I–Biol 211
1	Principles of Biology Laboratory – Biol 211L
2	Survey of the Animal Industry–- An S 114
2	Working with Animals–An S 101L
0.5	Library Instruction—Lib 160
Cr.	**Spring**
3	Statistics—Stat 104
3	Principles of Agronomy—Agron 114
3	Introduction to Instructional Technology—C I 201
3	Introduction to Agricultural Markets–Econ 235
3	Principles of Biology II—Biol 212
1	Principles of Biology Laboratory– Biol 212L

Curriculum in Agricultural Studies

Administered by the Department of Agricultural Education and Studies. Students are encouraged to develop one or more areas of concentration in agricultural sciences and economics.

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Engl 150, 250; written communications elective (3 cr.); speech elective (3 cr.); Lib 160
20	**Mathematical, physical, and life sciences** Chem 163, 163L or 177, 177L; Math 104 or 150; Stat 104; Biol 101 or 211; life science elective (6 cr.)
18	**Humanities, ethics, and social sciences** Econ 101; AgEdS 315; from approved lists: 3 cr. in ethics; 3 cr. in international perspectives; 3 cr. in U.S. diversity; humanities electives (3 cr.)
43.5	**Agricultural sciences and economics** AgEdS 110B, 215, 450; Agron 114, 154, 212; An S 114 and 101, electives (6 cr.); Econ 235, 330; Ent electives (2 cr.); 300-400 level agricultural sciences and economics electives (9 cr.); electives from the College of Agriculture (2cr.).
Other required courses	
3	Acct 284
31	**Electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
0.5	Orientation—AgEdS 110B
2	Survey of the Animal Industry—An S 114
2	Working with Animals—An S 101
3	Introduction to Probability and Matrices—Math 104 or Discrete Mathematics—Math 150
3	Critical Thinking and Communication—Engl 150
3	Social science elective
3	Introductory Biology—Biol 101
0.5	Library Instruction—Lib 160
Cr.	**Spring**
3	Principles of Agronomy—Agron 114
3	Principles of Microeconomics—Econ 101
3	Life science elective
3	Humanities elective
3	Statistics—Stat 104

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the agricultural studies curriculum.

Curriculum in Agricultural Systems Technology

Administered by the Department of Agricultural and Biosystems Engineering. A minor in agricultural systems technology is available; the requirements appear under Technology Systems Management, Courses and Programs.

Students majoring in Agricultural Systems Technology choose between two options: Agricultural and Biosystems Management or Machine Systems.

Agricultural and Biosystems Management Option

Cr.	Degree Requirements
12.5	Interpersonal and public communication skills Engl 150, 250; Sp Cm 212 or AgEdS 311; Engl 302 or 309 or 314; Lib 160
29	Mathematical, physical, and life sciences Math 142 and 160; Stat 104; Chem 163, 163L; Phys 111 and 112; and 6 cr. of life science from department-approved list
15	Humanities, ethics, and social sciences Econ 101; 3 cr. in humanities from college-approved list; 3 cr. in ethics from college-approved list, 3 cr. in International Perspectives from University-approved list; and 3 cr. U.S. Diversity from University approved list.
30	Technology core TSM 110, 111, 115, 116, 201, 210, 270, 301, 310, 363, 397, 399, 401, 415, and 416.
6	Business core Acct 284; Econ 330 or 355 or 336, or Mgmt 370 or 414.
33	Option core TSM 322, 324, 327, 330, 325, 333, 424, and 12 cr. in technical electives from department-approved list.
125.5	Total credits

Machine Systems Option

Cr.	Degree Requirements
12.5	Interpersonal and public communications skills Engl 150, 250; Sp Cm 212 or AgEdS 311; Engl 302 or 309 or 314; Lib 160
29	Mathematical, physical, and life sciences Math 142 and 160; Stat 104; Chem 163, 163L; Phys 111 and 112; and 6 cr. of life science from department-approved list.
15	Humanities, ethics, and social sciences Econ 101; 3 cr. in humanities from college-approved lists; 3 cr. in ethics from college-approved list; 3 cr. in international perspectives from university-approved list; and 3 cr. in U.S. diversity from university-approved list.
30	Technology core TSM 110, 111, 115, 116, 201, 210, 270, 301, 310, 363, 397, 399, 401, 415, and 416.
6	Business core Acct 284; Econ 330 or 355 or 336, or Mgmt 370 or 414.
33	Option core TSM 216, 240, 330, 333, 335, 337, 370, 443, 465, and 5 cr. of technical electives from department-approved list.
125.5	Total credits

Typical Program for the First Year

Cr.	Fall
1	Introduction to Technology—TSM 110
3	Trigonometry and Analytic Geometry—Math 142
3	Critical Thinking and Communication—Engl 150
5	General Chemistry—Chem 163, 163L
3	Life science elective
0.5	Library Instruction—Lib 160
Cr.	**Spring**
1	Experiencing Technology—TSM 111
3	Solving Technology Problems—TSM 115
3	Principles of Microeconomics—Econ 101
4	General Physics—Phys 111
4	Survey of Calculus—Math 160

Curriculum in Agronomy

Students majoring in agronomy study crop, soil, and environmental sciences under one of five options: agroecology; agronomy management and business; plant breeding; research and development; or soil and environmental science. A minimum of 15 credits in agronomy courses must be earned at Iowa State.

Core Requirements

Cr.	Degree Requirements
12.5	Interpersonal and public communication skills Engl 150, 250; Lib 160; Sp Cm 212 or AgEdS 311; Engl 302, or 309, or 314
6-14	Mathematical sciences Math 140 or 150 or 165/166 or 181/182, depending on option; and Stat 104
15-25	Physical sciences Chem 163/163L, or 177/177L and 178/178L; and 231/231L or BBMB 221 or Chem 331/331L and 332/332L; and Phys 106 or 111 or 221 depending on option
11-26	Biological sciences Biol 211, 211L, 212, 212L; other courses by option
15	Humanities, ethics, and social science 3 cr. each in ethics, U.S. diversity, international perspectives, humanities, and social sciences from approved lists
21.5-31.5	Agronomic sciences Agron 105, 110, 114, 154, 206, 210, 310 or 311, 316, 354, 354L, 410 and agricultural issues course.

Options

Agroecology

The Agroecology option provides the scientific foundation for understanding and managing agricultural systems with ecological and environmental perspectives. Students may pursue graduate study or careers in sustainable agriculture. More information is available from an agronomy adviser or www.agron.iastate.edu/academic/undergraduate/agro_ecol.aspx.

Agronomy Management and Business

The Agronomy Management and Business option is designed for those individuals who seek employment as agronomists working in agribusinesses such as cooperatives, seed companies, herbicide and fertilizer dealers, or crop consulting firms. More information is available from an agronomy adviser or www.agron.iastate.edu/academic/undergraduate/mgt_bus.aspx.

Plant Breeding and Biotechnology

The Plant Breeding and Biotechnology option is a science-oriented option recommended for those who would like to work in plant breeding or plant biotechnology. More information is available from an agronomy adviser or www.agron.iastate.edu/academic/undergraduate/plantbreeding.aspx.

Research and Development

The Research and Development is recommended for individuals who plan to work toward a graduate degree, or anyone who would like a strong science orientation in their degree program. More information is available from an agronomy adviser or www.agron.iastate.edu/academic/undergraduate/res_dev.aspx.

Soil and Environmental Quality

The Soil and Environmental Quality option is designed for those individuals interested in careers in environmental science, soil science, or natural resource managment. More information is available from an agronomy adviser or www.agron.iastate.edu/academic/undergraduate/soil_env.sci.aspx.

Typical Program for the First Year

Cr.	Fall
0.5	Orientation in Agronomy—Agron 110
3	Principles of Agronomy—Agron 114
3	Introduction to Meteorology—Agron 206
5	General Chemistry—Chem 163 and 163L
3	Critical Thinking and Communication—Engl 150
Cr.	**Spring**
3	Fundamentals of Soil Science—Agron 154
4	Principles of Biology I and Lab—Biol 211/211L
3	Mathematics or Statistics—Stat 104
0.5	Library Instruction—Lib 160
3	Principles of Microeconomics—Econ 101

Curriculum in Animal Ecology

Cr. Degree Requirements
15.5 Interpersonal and public communication skills
Engl 150 and 250; Sp Cm 212; Lib 160; two additional 3-cr. courses in written or oral communication from an approved list; and communications-intensive requirement
9-10 Mathematical sciences
Math 140 and 142; Stat 101 or 104
13 Physical sciences
Chem 163, 163L or 177, 177L; 231, 231L; Phys 106
20 Biological sciences
A Ecl 312, 365; Biol 211, 211L, 212, 212L; NREM 110, 120, 211
15 Humanities, ethics, and social science
From approved lists: 3 cr. in humanities; 3 cr. in social sciences; 3 cr. in ethics, 3 cr. in U.S. diversity, and 3 cr. in international perspectives; and environmental-intensive and problem-solving intensive requirements
R Practical experience requirement (NREM 104)

Students majoring in Animal Ecology are required to choose one of the following options by the end of their sophomore year: Aquatic Sciences, Fisheries, Interpretation of Natural Resources, Preveterinary and Wildlife Care, or Wildlife.

Options

Cr.
34 Aquatic Sciences
A Ecl 418, 486, 486L; Math 160 or 165, or 181; NREM 407; remaining credits to complete 34 total from approved list
34 Fisheries
A Ecl 321, 440, 441, 486, 486L; Math 160, 165, or 181; remaining credits to complete 34 total from approved list.
33 Interpretation of Natural Resources
A Ecl 366, Biol 366, Ent 370, NREM 303, 330, 430; one course from For 356 or Biol 474; one course from Agron 154, 206, Astro 120, Geol 100, 101, or Geol 108/Env S 108; remaining credits from approved list to equal 33 total.
33 Preveterinary and Wildlife Care
An S 214, NREM 330; one course from An S 336 or Biol 354; one course from Anthr 438, BMS 329, 415 and 416, Biol 155, 335, 351, 352, 434; one course from An S 331, Biol 313, 423, or Gen 320, one course from A Ecl 366, 458, 459 (one of the 400-level courses preferred for pre-vet students); three or more credits from A Ecl 401, 442, 454
An S 319, 493, Micro 201 and 201L, or Biol 353; 3 credits of A Ecl or NREM coursework at 300-level or above; remaining credits to complete 33 total from approved lists.
42 Wildlife
A Ecl 371, 451; Biol 313 or Gen 320, Biol 366; Math 160 or 165, or 181; 6 credits from A Ecl 457, 458, 459; 6 credits from A Ecl 455, NREM 450X, 460, 385/585, 532, FOR 453, Env S 293, 482, C R P 491; 3 credits from A Ecl 454X, 515, 551, Biol 315, 336X, 354, 354L, 471X, Ent 370, EEOB 507, NREM 475X, Anthr 438; 5 credits from Biol 355, 454, 456, 474, For 356, EEOB 564, Agron 317; remaining credits to complete 42 total from approved lists
12.5-22.5 Free electives
128 Total Credits

Typical Program for the First Year

Cr. Fall
4 Principles of Biology—Biol 211, 211L
R Orientation in Natural Resource Ecology and Management—NREM 110
3 Critical Thinking and Communication—Engl 150
3 College Algebra—Math 140
5 General Chemistry—Chem 163, 163L
Cr. Spring
4 Principles of Biology—Biol 212, 212L
3 Introduction to Renewable Resources—NREM 120
3 Statistics—Stat 101 or 104
0.5 Library Instruction—Lib 160
3 Trigonometry and Analytic Geometry—Math 142
3 Elective

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the animal ecology curriculum. The Preveterinary and Wildlife Care option has been designed for this purpose.

Curriculum in Animal Science

Students majoring in animal science will complete the degree requirements listed below. If desired, a student may also choose a specialized option. To earn a degree in Animal Science (AnS) from Iowa State University (ISU) a minimum of 15 credits in AnS must be earned from courses taught in the AnS department at ISU. Students desiring to complete a minor in AnS must complete 17 credits in AnS courses from a list maintained in the department, and a minimum of 9 credits in AnS must be earned from courses taught in the AnS department at ISU.

Cr. Degree Requirements
12.5 Interpersonal and public communication skills
Engl 150, 250, 302 or 309 or 314; Sp Cm 212 or AgEdS 311 or ComSt 214; Lib 160; and communications-intensive requirement*
10 Mathematical and computer sciences
Stat 101 or 104 or 226
Com S 103
Math 140 or 150 or 160 or 165 or 181 (some options may restrict choices)
3 Business elective
Econ 101 or 102 or Acct 284 (some options may restrict choices)
8 Physical sciences
Chem 163 & 163L or Chem 177 and 177L (some options may restrict choices); BBMB 221 or Chem 231 & 231L or Chem 331 & 331L (some options may restrict choices)
8 Biological sciences
Biol 211, 211L; 212, 212L; Biol 313 or Gen 320; Micro 201 & 201L or Micro 302 & 302L
18 Personal development, human relations, and global awareness
a minimum of: 3 credits in humanities; 3 cr. in social sciences; from approved lists : 3 cr. in ethics, 3 cr. in international awareness, 3 credits in U.S. multicultural awareness; and problem solving-intensive requirement;
36 Animal science
An S 101, 110, 114, 211, 214, 214L, 311, 319, 331, 352, 411; three courses from: AnS 216, 223, 224, 225, 226, 229, 235, 270 (some options may restrict choices); one course from: AnS 336, 337, 345, 360, Biol 305, 314, 352, 353, Ent 372, 374, Micro 310, VDPAM 487 (some options may restrict choices); one course from: AnS 415, 423, 424, 425, 426, 429, 434 (some options may restrict choices); one course from AnS 415, 419, 423, 424, 425, 426, 429, 434, 460, FS HN 405, 410, 420, Micro 407 (some options may restrict choices)
26.5 Pre-Veterinary Medicine
Chem 177, 177L, 178, 331, 331L, 332; BBMB 301 or Biol 314; Math 141 or 142 (if trigonometry not taken in high school) Phys 111; one course from AnS 415, 423, 424, 425, 426, 429 or 434; one course from AnS 415, 419, 423, 424, 425, 426, 429, 434, 460, FSHN 405, 410, 420, Micro 407; free electives 13.5
26.5 Livestock Management
Acct 284; AgEdS 451; Econ 101, 330, 331; An S 270; two courses from An S 223, 225, 226, 229, 235; two courses from An S 336, 337, 345, 360; one course from AnS 423, 424, 425, 426, 429, 434; one course from AnS 415, 419, 423, 424, 425, 426, 429, 434, 460, FS HN 405, 410, 420, Micro 407; VDPAM 487; free electives 8.5
26.5 Animal Products
Chem 177 & 177L; two courses from An S 223, 225, 226, 229, 235; An S 270, 360, 460; one course from 423, 425, 426, 429, 434, FS HN 405 or 410; one course from FS HN 420 or Micro 407; free electives 23.5

26.5 Pre-Graduate/Pre-Professional Studies
Chem 177, 177L, 178; Chem 231 & 231L or Chem 331 & 331L; 3 courses from departmental list ; Math 160 or 165 or 181; free electives 14.5

26.5 Companion Animal Management
Acct 284; business or economics electives 9; two courses from: AnS 216, 223, 225, 226, 229, 235, 270; AnS 224, 336, 424; one course from AnS 415, 419, 423, 425, 426, 429, 434, 460, FS HN 405, 410, 420, Micro 407; free electives 17.5

26.5 Equine Management
Acct 284; business or economics electives 9; ; two courses from: AnS 223, 224, 225, 226, 229, 235, 270; AnS 216, 415; 6 cr. equine electives from AnS 115, 217, 306, 316, 417, 475E, BMS 421; one course from AnS 419, 423, 424, 425, 426, 429, 434, 460, FS HN 405, 410, 420, Micro 407; free electives 11.5

Typical Program for the First Year

Cr.	Fall
R	Orientation in Animal Science—An S 110
2	Working with Animals—An S 101
3	Principles of Biology—Biol 211
1	Principles of Biology Lab—Biol 211L
3	Critical Thinking and Communication—Engl 150
0.5	Library Instruction—Lib 160
3	Mathematics—Math 140 or 150 or 160 or 165 or 181
3	Elective
Cr.	Spring
2	Survey of the Animal Industry—An S 114
4	General Chemistry—Chem 177 or 163
1	General Chemistry Lab—Chem 177L or 163L
3	Communications—Sp Cm 212 or AgEdS 311 or ComSt 214
3	Statistics—Stat 101 or 104 or 226
3	Humanities elective

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the animal science curriculum.

Curriculum in Biology

Administered by the Departments of Ecology, Evolution, and Organismal Biology; and Genetics, Development and Cell Biology.

Cr. Degree Requirements*

9.5 Interpersonal and public communication skills
Engl 150, 250; oral communication Sp Cm 212; Lib 160

7 Mathematics
7 credits of Math or Statistics, to include one semester each of Calculus and Statistics.

25 Physical sciences
25 credits selected from an approved list of chemistry, biochemistry and physics. List available on Biology Program web site.

24 Biological sciences core
Biol 110, 111, 211, 211L; 212, 212L, 312, 313, 313L, 314, 314L, 315

20 Advanced biology courses
20 credits in approved biology courses numbered 300 and above from department-approved list; 8 credits must be taken from biology designator; minimum of two laboratory or field courses must be included.

15 Humanities and social science
3 cr. in humanities, social sciences, ethics, international perspectives and U.S. diversity chosen from an approved list. The environmental intensive requirement is met by the core requirement of Biol 312.

17-20 Free electives

120 Total credits

Typical Program for the First Year

Cr.	Fall
0.5	Orientation in Biology— Biol 110
3	Critical Thinking and Communication—Engl 150
5	General Chemistry— Chem 163, 163L; or 177, 177L
4	Mathematics or Statistics—Math 160, 165 or 181; or Stat 101 or 104
4	Principles of Biology—Biol 211, 211L
0.5	Library— Lib 160
Cr.	Spring
0.5	Opportunities in Biology—Biol 111
4	General Chemistry— Chem 164, 164L; or 178, 178L; 164L; or 178, 178L; or approved physical sciences course
4	Mathematics or Statistics—Math 160, 165 or 181; or Stat 101 or 104
4	Principles of Biology—Biol 212, 212L
3-6	Elective

Curriculum in Culinary Science

Administered by the Department of Food Science and Human Nutrition

Cr. Degree Requirements*

9.5 Communications/Library
Engl 150, 250; Sp Cm 212 or ComSt 214; Lib 160

6-7 Mathematical sciences
Math 140, 142, 160, 165, or 181 Stat 101 or 104

9 Physical sciences
Chem 163;163L; 231, 231L

12-13 Biological sciences
BBMB 301; Biol 211, 212; Micro 201 or 302; and Micro 201L or 302L

11-12 Humanities/Social sciences
Econ 101; FS HN 342; 3 credits Humanities; 2-3 credits ENV S 120 or 201

44 Food science and human nutrition
FS HN 101, 104, 110, 167, 203, 214, 265, 311, 314, 403, 405, 406, 411, 412, 420, 480, 491B, 491D

3 Animal science
An S 270

22 Hotel, restaurant institutional management
HRI 233, 333, 340, 380, 380L, 383, 487 and AESHM 474

0-2 Electives

122.5 Total credits

*Additional requirement: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Curriculum in Dairy Science

Students majoring in Dairy Science will complete the courses below for a professional degree or alternatively may complete the specialized option in Pre-Veterinary medicine.

Cr. Degree Requirements

9.5 Interpersonal and public communication skills
Engl 150, 250; Sp Cm 212 or AgEds 311; Lib 160; and communications intensive requirement

9-13 Mathematical and business sciences
TSM 115 or Com S 103 or proficiency exam; Econ 101; Math 150; Stat (3 cr.)

8 Physical sciences
Chem 177, 177L; BBMB 221 or Chem 231 or 331

10-11 Biological sciences
Biol 211, 211L; Biol 313 or Gen 320; Micro 201 and 201L or FS HN 273; and environmental-intensive requirement

15 Personal development, human relations, and global awareness
3 cr. in humanities; 3 cr. in social sciences; from approved lists: 3 cr. in ethics, 3 cr. in international awareness, 3 cr. in U.S. multicultural awareness; and problem solving-intensive requirement

34 Professional dairy science
An S 101, 110, 114, 211, 214, 214L, 235, 311, 319, 331, 337, 352, 411, 434; FSHN 101 or An S 270; minimum of two courses from list maintained in department; a mini-mum of 15 credits in this category must be earned from courses taught in the ISU Animal Science department.

37.5-42.5 Free electives

Specialized Option

22 Pre-Veterinary Medicine
Additonal courses required for entrance to Veterinary Medicine 22; free electives 15.5-20.5

128 Total Credits

Typical Program for the First Year

Cr.	Fall
R	Orientation in Dairy Science—An S 110
2	Survey or the Animal Industry—An S 114
2	Working with Animals—An S 101
3	Principles of Biology—Biol 211
1	Principles of Biology Lab—Biol 211L

3 First-Year Composition—Engl 150
0.5 Library Instruction—Lib 160
3 Mathematics—Math 150
3 Elective

Cr. Spring
3 Technology Problems—TSM 115
4 General Chemistry—Chem 177
1 General Chemistry Lab—Chem 177L
3 First-Year Composition—Engl 250
3 Introduction to Statistics—Stat 104
3 Elective

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the dairy science curriculum.

Curriculum in Diet and Exercise B.S./M.S.

Administered by the Department of Food Science and Human Nutrition and Health and Kinesiology.

Courses included have been approved as meeting the academic requirements of the American Dietetic Association in preparation for admission to dietetic internship programs. There is a $30 fee for a statement of verification of completion of the approved program. Courses also are included to meet the ACSM requirements for certification at the level of Health Fitness Instructor.

Cr. Degree Requirements*
9.5 Interpersonal and public communication skills
Engl 150, 250; Lib 160; Sp Cm 212
38-41 Mathematical, physical, and life sciences
Math 140, 142, 160, 165, or 181; Stat 101, 104, or 226; Chem 163 and 163L or 177, 177L, and 178; 231; 231L; Phys 106 or 111; BBMB 301; Biol 211, 212, 255, 255L, 256, 256L; Micro 201
15 Humanities and social science
select 3 credits from approved humanities course list; select 3 credits from approved Ethics course list (if ethics course selected is not on the humanities list, 3 additional credits of humanities must be taken.); Psych 101, 230
20-22 Diet and Exercise
Kin 252-253 or FS HN 110; Kin 258; FS HN 167, 214, 265, 360; H S 110
41 Diet and exercise
H S 380; Kin 220, 259, 345,358, 462; FS HN 403. 411, 463, 466, NutrS 561;
HRI 380, 380L, 392; Kin 355, 360, 366, or 372
123.5 Total credits

*Additional requirement: Students must fulfill international perspectives, U.S. diversity requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Graduate Program

Cr. Degree Requirements
39-40 Graduate level coursework
FS HN 581; NutrS 501, 561, 562, 564; Kin 501, 505, 551, 558; Kin 699 or NutrS 699A; Stat 401; Kin 550, 570, or NutrS 502.
Additional requirement: FS HN 490C for students in the FSHN Department.

Curriculum in Dietetics

Administered by the Department of Food Science and Human Nutrition.

The student is prepared for admission to dietetic internship programs and other professional experience programs approved/accredited by The American Dietetic Association. Courses included have been approved as meeting the academic requirements of The American Dietetic Association. There is a $30 fee for a statement of verification of completion of the approved program.

Cr. Degree Requirements*
9.5 Communications
Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212
6-7 Mathematical sciences
3 credits Math 140, 142, 160, 165 or 181; Stat 101 or 104
9-12 Physical sciences
Chem 163 and 163L or 177, 177L, and 178; 231; 231L;
20-22 Biological sciences
BBMB 301 or Biol 314; Biol 211, 212, 212L, 255, 255L; 300-level 300-level physiology course (Biol 306 or 335)
11-12 Humanities/Social sciences
3 crs. Humanities course; Env S 120 or 201; FS HN 342; Psych 101
40 Food science and human nutrition
FS HN 110, 167, 203, 214, 261, 340, 360, 361, 362, 403, 411, 461, 463, 464, 466, 480
11 Management
HRI 380, 380L, 391, 392
0-7 Electives
120.5 Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Curriculum in Environmental Science

Cr. Degree Requirements
9.5 Communication
Engl 150, 250; Lib 160; speech elective (3 cr.)
7 Mathematical sciences
One course in statistics and one course in calculus
24 Physical and Life Sciences
24 credits of approved coursework in biology, chemistry, physics, and earth sciences
15 Humanities, ethics, and social science
3 cr. ethics, 3 cr. U.S. diversity, 3 cr. of international perspectives, 3 cr. of humanities, and 3 cr. of social sciences.
29 Environmental Science
EnSci 110, 201, 250, 381, 382, and 15 additional credits of approved EnSci coursework.
35.5 Free electives
120 Total credits

Typical Program for the First Year

Cr. Fall
1 Orientation – EnSci 110
2 Environmental Issues – EnSci 201
3-4 Statistics —Stat 101 or 104
4 Gen Chem —Chem 177
1 Gen Chem Lab —Chem 177L
3 Communication — Engl 150
0.5 Library Instruction —Lib 160

Cr. Spring
3 Princ. Biology—Biol 211
1 Princ. Biology Lab —211L
4 Calculus —Math 160, 165 or 181
3 Gen Chem II — Chem 178
1 Gen Chem II Lab –Chem 178L
3 Humanities or social science choice

Curriculum in Food Science

Administered by the Department of Food Science and Human Nutrition.

Option 1. Food Science and Technology

Cr. Degree Requirements*
12.5 Communications/Library
Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212; TSM 115
11-12 Mathematical Sciences
Math 165 and 166, or 181 and 182; Stat 101 or 104
23 Physical Sciences
Chem 177, 177L, 178, 331, 331L, 332; Phys 111, 112
13 Biological sciences
BBMB 301; Biol 211, 212; Micro 302, 302L
11-12 Humanities/Social Sciences
3 credits Humanities courses; 3 credits Social Sciences courses; FS HN 342; and Env S 120 or 201
44 Food science and human nutrition
FS HN 101, 110, 167, 203, 311, 351, 403, 405, 406, 410, 411, 412, 420, 421, 471, 472, 480
0-2 Electives
120.5 Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Option 2. Food Science and Industry

Cr. Degree Requirements*
15.5 Communication/Library
Engl 150, 250; Lib 160; Jl MC 305, or 220, or 347; Sp Cm 212 or ComSt 214; TSM 115
7-8 Mathematical Sciences
Math 160, 165, or 181; Stat 101 or 104

16 Physical Sciences
Chem 163 and 163L or 177, 177L and 178; 231; 231L; Phys 106
12-13 Biological Sciences
BBMB 301; Biol 211, 212; Micro 201 or 302; Micro 201L or 302L
11-12 Humanities/Social Sciences
Econ 101; FS HN 342; select 3 credits of humanities courses; and Env S 120 or 201.
6 Business
Select 6 credits from Acct 215, 284, 285; Econ 301, 320; Mgmt 310, 370, 371, 414, 472; MIS 330; Mkt 340, 447, 448
44 Food science and human nutrition
FS HN 101, 110, 167, 203, 311, 351, 403, 405, 406, 410, 411, 412, 420, 421, 471, 472, 480
0-5 Electives
120.5 Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Option 3. Consumer Food Science

Cr. Degree Requirements*
21.5 Communications/Library
Engl 150, 250; Jl MC 305 or 220; select 6 cr. from Jl MC 347, Engl 205, 302, 309, 313, or 314; Sp Cm 212 or ComSt 214; Lib 160; TSM 115
6-7 Mathematical sciences
Math 140, 142, 160, 165, or 181; Stat 101 or 104
16 Physical sciences
Chem 163 and 163L or 177, 177L and 178; 231, 231L; Phys 106
12-13 Biological sciences
BBMB 301; Biol 211, 212; Micro 201 or 302; and Micro 201L or 302L
11-12 Humanities/Social sciences
Econ 101; FS HN 342; 3 credits Humanties courses; and Env S 120 or 201
41 Food science and human nutrition
FS HN 101, 110, 167, 203, 214, 265, 311, 403, 405, 406, 411, 412, 420, 471, 480
6 Business
Mkt 340 and 447
0-3 Electives
120.5 Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Concurrent B.S. and M.S. Program:

Well qualified students in Food Science who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both a bachelor of science in Food Science and a master of science degree in Food Science and Technology. For more information, refer to www.fshn.hs.iastate.edu

Curriculum in Forestry

Cr. Degree Requirements
12.5 Interpersonal and public communication skills
Engl 150, 250; 314, or 302 or 309; Lib 160; Sp Cm 212
22 Mathematical, physical, and life sciences
Math 140, 150; Stat 101 or 104; Chem 163, 163L; Biol 211, 211L; Agron 154
15 Humanities, ethics, and social science
3 cr. in humanities; 3 cr. in ethics from approved list; Soc 130 or 134 and 3 cr. in U.S. diversity and 3 cr. in international perspectives
29 Forestry courses
For 201, 202, 203, 204, 205, 206, 302, 451, 454; NREM 110, 120, 211
R Practical experience requirement
NREM 104

Students majoring in forestry are required to choose one of the following options at the end of their sophomore year: forest ecosystem management; sustainable material science and technology; urban and community forestry; natural resource conservation and restoration; or interpretation of natural resources.

Options

Cr.
40 Sustainable Materials Science and Technology
Chem 231, 231L, Econ 101, For 280, 480, 481, 483, 485, 486, 487; Math 151; Mkt 340, Stat 401
35 Forest Ecosystem Management
Biol 212, 212L, For 280, 342, 356, 452; one course from NREM 385, 460; For 453; Math 151 or 181; NREM 301, 345; Pl P 416
37 Urban and Community Forestry
Biol 212, 212L; For 280, 356, 452, 475; Hort 342 or 344; one course from NREM 385,460 or For 453; Math 151 or 181; Pl P 416; Soc 310 or 382; C R P 253 or 270
44 Natural Resource Conservation and Restoration
A Ecl 312; Biol 212, 212L, 204; For 356, 452; one course from NREM 385, 460 or For 453; Math 151 or 181; NREM 301, 330, 390, 407; Pl P 416; 3 credits from approved departmental list
34 Interpretation of Natural Resources
A Ecl 365 and 366; Biol 212, 212L, 366, Ent 370, NREM 303, 330, 430; For 452, one course from (For 453 or NREM 460 or 385); one course from Agron 206, Astro 120, Geol 100, 101, 108; select remaining credits to complete 34 credits from approved departmental list.
5.5-15.5 Free electives
128 Total credits

Typical Program for the First Year

Cr. Fall
3 Critical Thinking and Communication—Engl 150
R Orientation in Natural Resource Ecology and Management—NREM 110
3 College Algebra—Math 140
3 Principles of Biology I—Biol 211
1 Principles of Biology Laboratory I—Biol 211L
3 Introduction to Renewable Resources—NREM 120
3 Social Science—Soc 130 or 134
16

Cr. Spring
3 Foundations of Soil Science—Agron 154
0.5 Library —Lib 160
3 or 4 Statistics—Stat 101 or 104
4 General Chemistry I —Chem 163
1 General Chemistry Lab I—Chem 163L
3 or 4 Wood Properties and Identification—For 280 or U.S. Diversity/International Perspectives
14.5 or 16.5

Curriculum in Genetics

Undergraduate study in genetics is jointly administered by the Department of Biochemistry, Biophysics, and Molecular Biology, the Department of Genetics, Development, and Cell Biology, and the Department of Ecology, Evolution, and Organismal Biology.

Cr. Degree Requirements
12.5 Communications
Engl 150, 250; an advanced English writing course (Engl 302-316); oral communication (AgEdS 311, Sp Cm 212; Lib 160
11 Math
Must include at least one course from both calculus and statistics chosen from Math 160, 165, 166, 181, 182; Stat 101 or 104, 401, 402, 403
3 Computer Studies
Three credits in computer science or computer applications chosen from an approved list. See department for list.
31 Physical sciences
Chem 177, 177L, 178, 178L (or 211), 331, 331L, 332, 332L; BBMB 404 or 420; Chem 211 or 321 or BBMB 405 or 411; Physics 111, 112 or 221, 222
23 Biological sciences
Biol 211, 211L, 212, 212L, 313, 313L, 314, 314L; Micro 302; Biol 315
15 Humanities, ethics, and social sciences
15 credits including at least 3 cr. each in the humanities, social sciences, ethics, international perspectives and U.S. diversity chosen from an approved list.
The environment-intensive and problem solving-intensive college requirements can be satisfied by selection of appropriate courses. See department for lists.

9.5 Genetics
Gen 110, 410, 411, 460 or 462, 491
9 Support electives
Choose 9 credits from approved list. See department for list.
Biol (A Ecl) 312 must be included in the program
Electives
Additional electives sufficient to equal the 128 credits required for graduation.
128 Total credits

Typical Program for the First Year

Cr.	Fall
5	General Chemistry—Chem 177, 177L
3	English—Engl 150
4	Calculus—Math 165 or 181
4	Principles of Biology—Biol 211, 212L
0.5	Orientation and Career Opportunities—Gen 110
0.5	Library Instruction—Lib 160
Cr.	**Spring**
4	General Chemistry—Chem 178, 178L
3	Statistics 101 or 104
4	Calculus—Math 161 or 166 or 182
4	Principles of Biology—Biol 212, 212L

Curriculum in Global Resource Systems

Administered by a supervisory committee in the College of Agriculture and Life Sciences. Students choose a region of the world, either industrialized or developing, to develop an expertise; they choose a language to learn and develop proficiency through the intermediate level; they choose and possess an area of technical expertise by completing a minor or certificate program in the College of Agriculture and Life Sciences; they complete a required internship in an international setting; and they select and complete a senior research project with faculty mentoring.

Cr.	Degree Requirements
12.5	Interpersonal and Public Communications Skills
3	Critical Thinking and Communication—Engl 150
3	Written, Oral, Visual, and Electronic Composition—Engl 250
0.5	Library Instruction—Lib 160
3	Report and Proposal Writing —Engl 309 or
3	Business Communication —Engl 302 or
3	Technical Communication—Engl 314
3	Fundamentals of Public Speaking—Sp Cm 212 or
3	Presentation and Sales Strategies for Agricultural Audiences—AgEds 311

6-8 credits

Cr.	Mathematical Sciences
3-4	Mathematics (Math 140 or higher course number)
3-4	Statistics—101 or 104

15 credits

Cr.	Humanities, Ethics, and Social Science
3	Humanities (from approved list)*
3	Social Sciences—Econ 101 or 102
3	International Perspectives from approved list*
3	U.S. Diversity from approved list
3	Ethics (from approved list

* Requirement embedded within other curriculum requirements

27-35 credits (depending upon language study)

Cr.	Global Competency
12-20	Students will emphasize a region of the globe. World Language proficiency through intermediate levels. Complete 100 and 200 levels of a single college-level world language.
15	Coursework in culture, history, politics and economics in which students emphasize a global region outside the United States, up to 3 credits may be earned through travel courses. Courses in the WLC Language and Cultures for Professions are also eligible.

15 - 18 credits

Cr.	Physical and Life Sciences
5	General Chemistry—Chem 163, 163L; or 177, 177L
4	Principles of Biology—Biol 211, 211L
3	300-level or higher life sciences course

One of the following is required, two are recommended:

3	Environmental Geology—Geol 101
3	Fundamentals of Soil Science—Agron 154 or
3	Soils for Horticulture Scientists—Agron 155
3	Introduction to Meteorology—Agron 206
3	World Climates—Agron 406

22 credits

Cr.	Global Resource Systems
1	Orientation—Globe 110
3	Global Resource Systems (1Cr.)—Globe 201
3	Issues in Global Resource Systems—Globe 211
3	Resource Systems of Industrialized Nations—Globe 301
3	Resource Systems of Developing Nations—Globe 302
3 - 12	Internship Global or United States
3	Senior Research—Globe 401
3	Responses to Global Resource System Challenges—Globe 402

15 -18 credits

Cr.	Technical Concentration

15 -18 credits: Satisfied by any of the 23 minors or a certificate offered in the College of Agriculture and Life Sciences.

14 - 16 credits: Free Electives

128.5 Total Credits

Curriculum in Horticulture

Students majoring in horticulture will select an option in which to specialize before reaching junior standing and will fulfill the requirements described below under Specialization Options.

A horticulture minor is available. The requirements appear under *Horticulture, Courses and Programs*.

Cr.	Degree Requirements
12.5	Interpersonal and Public Communication Skills Engl 150, 250, 302 or 314; Lib 160; Sp Cm 212 or AgEdS 311; and a communications-intensive requirement (see department for procedure)
6-9	Mathematical sciences Math 140 or 150 or 165 or 181; and Stat 101 or 104 or 226 or 401
13	Physical sciences Chem 163, 163L; or 177, 177L; and 231, 231L, or 331, 331L; and one complete course from: Chem 164, 164L; 178, 178L; or Phys 106 or 111. A student must take either (1) Chem 163/163L and 164/164L series and Chem 231/231L series or (2) Chem 177/177L and 178/178L series and Chem 331/331L. A student may take Phys 106 or 111 instead of Chem 164/164L or 178/178L.
18	Biological sciences Biol 211, 211L, 212, 212L select 10 credits from the following group: Agron 260, 316, 317, 354, 354L; Biol 312, 314, 314L, 330, 355, 366, 454, 474; Ent 370, 375, 376; For 416; Pl P 391, 408; Gen 320 or Biol 313, 313L.
15	Humanities, ethics, and social sciences One 3-credit course from an approved list in each of the following areas: humanities,ethics, social science, U. S. diversity, and international perspectives; see department for procedure in meeting problem-solving, environmental-intensive, and communication-intensive requirements.
3	Soil science Agron 154 or 155
30	Horticulture Hort 110, 221, 321, 497; select a minimum of 22 credits from the following group: Hort 233, 240, 280, 282, 283, 322, 330, 332, 338, 341, 342, 351, 351L, 354, 354L, 380, 381, 391, 398, 422, 423, 424, 434, 435, 442, 444, 445, 446, 451, 452, 453, 454, 461, 471, 471L, 475, 480, 481, 484, 490, 491, 493, 495, 496, 497, 511, 551. Transfer students may transfer up to 10 credits of 200- and 300-courses in the horticulture area.
	Specialization Options (A minor in an approved area of study may be substituted for the Specialization Option with permission of student's adviser)
12	Environmental horticulture option: Hort 424 must be among the courses that fulfill the horticulture requirement. Other recommended course is Hort 484. The student must

take Biol 312 and 9 or more credits from the following group: Agron 260, Biol 355, Econ 334, Ent 375, Env S 293, 324, 382, 450, 460, 491; TSM 324, 424.

12 Fruit and vegetable production and management option:
Hort 422, 445, 461, 471 and 471L must be among the courses that fulfill the horticulture requirement. Acct 284; and 9 or more credits from the following group: Acct 215, 285, 316; Com S 103; Econ 230, 334; FS HN 272, 403, 405, 471, 472; Mgmt 310, 313, 370, 371; Mkt 340, 442, 446, 447; TSM 270.

12 Greenhouse production and management option:
Hort 233, 322, 330, 332, 422, 434, 435 and 445 must be among the courses that fulfill the horticulture requirement. Acct 284; and 9 or more credits from the following group: Acct 215, 285, 316; Com S 103; Econ 334; Ent 375; Mgmt 310, 313, 370; Mkt 340, 442, 446, 447.

15 Horticultural communications and public education:
Students in this option must take Engl 314 under Interpersonal and Public Communications Skills and a minimum of 12 credits from the following group: ComSt 102, 214, 317; Engl 220, 303, 305, 313; Jl MC 201, 220, 310, 341, Sp Cm 312, 313.

12 Landscape Design, Installation and Management option:
Hort 240, 280, 330, 341, 342, 351, 380, 381, 444, 446, 480 and 481 must be among the courses that fulfill the horticulture requirement. Up to 3 credits can be used in the biological sciences area. Another recommended course is Hort 445. Acct 284; and 9 or more credits from the following group: Acct 215, 285 316; Mgmt 310, 313, 370, 371; Mkt 340, 343, 442, 447; TSM 324.

12 Nursery crops production and garden center management option:
Hort 240, 322, 330, 341, 342, 351, 442, and 445 must be among the courses that fulfill the horticulture requirement. Acct 284; and 9 or more credits from the following group: Acct 215, 285, 316; Agron 206; Com S 103; Econ 230, 334; EnSci 446 or 461I; Mgmt 310, 313, 370, 371; Mkt 340, 442, 446, 447; TSM 270.

12 Public garden management and administration option:
Hort 233, 240, 282, 322, 330 and 445 must be among the courses that fulfill the horticulture requirement. Other recommended courses are Hort 280, 332, 341, 342, 351, 351L, 380 and 381. The student must select a minimum of 12 credits from the following: Acct 284, 285, 316; Econ 334; Engl 303, 309, 313, 415; EnSci 446 or 461I; Fin 301; JLMC 220; Mgmt 310, 313, 370, 371 471; Sp Cm 312, 313.

12 Science option:
Those who choose the Science Option must take: Biol 330 for part of the biological sciences requirement; Math 165 or 181 for the mathematical sciences requirement; Chem 177, 177L, 178, 178L, 331, 331L, 332, 332L, Phys 111 and 112 for the physical sciences requirement. BBMB 301 or 404, Math 166 or 182; and 5 or more credits from the following group: BBMB 311, 404, 405, 411; Biol 313, 313L, 314, 314L, 315; Chem 211, 211L, 316, 316L, 321L, 322L, 324; Com S 107, 207; Gen 409, 410.

12 Turfgrass management option:
Hort 240, 351, 351L, 445, 451, 452, 453 and 551 must be among the courses that fulfill the horticulture requirement. Other recommended course: Hort 330. Acct 284 and 9 or more credits from the following group: Acct 285, 316; Agron 206, 260, 317, 338, 356, 360, 459; Com S 103; Econ 334; Ent 375; Env S 201, 324; EnSci 446 or 416I; HRI 289; Mgmt 370, 371; Pl P 391; TSM 270, 324, 424; additional business courses may be used with permission of adviser.

14-18 Electives

128.5 Total credits

Typical Program for the First Year

Cr.	Fall
3	Humanities or Free Elective
5	General Chemistry—Chem 163, 163L or 177, 177L
3	First-Year Composition—Engl 150
1	Orientation in Horticulture—Hort 110
0.5	Library Instruction—Lib 160
3	Fundamentals of Algebra for Science and Higher Mathematics—Math 140
2	Home Horticulture—Hort 121
Cr.	**Spring**
3	General Biology—Biol 211
3-4	Principles or Introduction to Statistics—Stat 101, 104
3	Humanities or social science from an approved list
3	Soils for Horticultural Scientists—Agron 155
3	Principles of Horticulture—Hort 221

Curriculum in Industrial Technology

Administered by the Department of Agricultural and Biosystems Engineering.

An undergraduate certificate in occupational safety is available; the requirements appear under Technology Systems Management courses and programs. A minor in Industrial Technology is available; the requirements appear under Technology Systems Management courses and programs.

Students majoring in Industrial Technology choose between two options: Manufacturing or Occupational Safety.

Manufacturing Option

Cr. Degree Requirements

12.5 Interpersonal and public communications skills
Engl 150, 250; Sp Cm 212 or AgEds 311; Engl 302 or 309 or 314; Lib 160

29 Mathematical, physical, and life sciences
Math 142 and 160; Stat 104; Chem 163, 163L; Phys 111 and 112; and 6 cr. of life science from department-approved list

15 Humanities, ethics, and social sciences
Econ 101; 3 cr. in humanities from college-approved list; 3 cr. in ethics from college-approved list; 3 cr. in international perspectives from university-approved list; and 3 cr. in U.S. diversity from university-approved list.

30 Technology core
TSM 110, 111, 115, 116, 201, 210, 270, 301, 310, 363, 397, 399, 401, 415, and 416.

6 Business core
Acct 284; Econ 330 or 355 or 336, or Mgmt 370 or 414.

33 Option core
TSM 216, 240, 337, 340, 370, 440, 443, 444, 445, 465, and 3 cr. of technical electives from department-approved list

125.5 Total credits

Occupational Safety Option

Cr. Degree Requirements

12.5 Interpersonal and public communications skills
Engl 150, 250; Sp Cm 212 or AgEds 311; Engl 302 or 309 or 314; Lib 160

29 Mathematical, physical, and life sciences
Math 142 and 160; Stat 104; Chem 163, 163L; Phys 111 and 112; Biol 155 and 3 cr. of life science from department-approved list.

15 Humanities, ethics, and social sciences
Econ 101; 3 cr. in humanities from college-approved list; 3 cr. in ethics from college-approved list; 3 cr. in international perspectives from university-approved list; and 3 cr. in U.S. diversity from university-approved list.

30 Technology core
TSM 110, 111, 115, 116, 201, 210, 270, 301, 310, 363, 397, 399, 401, 415, and 416

6 Business core
Acct 284; Econ 330 or 355 or 336, or Mgmt 370 or 414.

33 Option core
H S 105; I E 271; TSM 240, 272, 276, 370, 372, 470, 471, 477, and 8 cr. of technical electives from department-approved list.

125.5 Total credits

Typical Program for the First Year

Cr.	Fall
1	Introduction to Technology—TSM 110
3	Trigonometry and Analytic Geometry—Math 142
3	Critical Thinking and Communication—Engl 150
5	General Chemistry—Chem 163, 163L
3	Life science elective
0.5	Library Instruction—Lib 160
Cr.	**Spring**
1	Experiencing Technology—TSM 111
3	Solving Technology Problems—TSM 115
3	Principles of Microeconomics—Econ 101
4	General Physics—Phys 111
4	Survey of Calculus—Math 160

Curriculum in International Agriculture

Administered by an Interdepartmental Committee. International agriculture can be taken only as a secondary major in conjunction with a primary major in the College of Agriculture and Life Sciences. A minor is available to interested students regardless of their major.

Cr.	Degree Requirements
	(Additional prerequisites may be required for some courses.)
12.5	**Interpersonal and public communication skills** Engl 150, 250; Sp Cm 212 or AgEdS 311; Lib 160; electives (3 cr.) select from Engl 302 or 314, or JI MC 205
19	**Mathematics, physical, and life sciences** Math 150, Chem 163, 163L, or Chem 177, 177L, math or physical science electives select from BBMB, Chem, Com S, Math, Phys, or Stat (5 cr.); biological sciences electives select from Biol, Gen, Micro, or PI P (6 cr.) and demonstration of computer proficiency (See primary major department.)
15	**Humanities, ethics, and social sciences** Soc 130 or 134, or Econ 101; 3 cr. in ethics; 3 cr. in U.S. diversity; 3 cr. in international perspectives
15	International Agriculture Internship in International Agriculture or Study Abroad Program or Foreign Language (6cr.)
3	Agron 342 Select courses with international agriculture focus in any major in the College of Agriculture and Life Sciences (6 cr.) (See Supervisory Committee list)
66.5	**Primary major requirements and free electives**
128	**Total credits**

Program for the First Year

Because international agriculture is a secondary major, the courses taken by the student during the first year will vary, depending on the primary major (see typical program for the primary major).

Curriculum in Insect Science

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Engl 150, 250, 314; Sp Cm 212; Lib 160
3	**Mathematical and physical sciences** Stat 104
14	**Life sciences** Biol 211, 211L, 212, 212L, 312; Micro 201, 201L
15	**Humanities, ethics, and social science** Econ 101; 3 cr. in humanities; from approved lists: 3 cr. in ethics; 3 cr. in international perspectives; 3 cr. in U.S. diversity requirement
19	**Entomology** Ent 110, 201, 211, 370, 374, 376; 490E; Ent electives; for students entering entomology with one year or more of college-level biological sciences courses, Ent 201 and 211 are waived, and the group requirement reduced to 16 cr.

Students majoring in Entomology are required to choose one of the following options by the end of their sophomore year; Agricultural and Horticultural Insect Management, or Insect Biology.

Agricultural and Horticultural Insect Management Option

Cr.	Degree Requirements
5	**Mathematics** Math 140, 141
13	**Physical Sciences** Chem 163, 163L, 231, 231L; Phys 106
6	**Biological Sciences** BBMB 301; Biol 330
12	**Agricultural Sciences** Agron 114 or Hort 221; Agron 154 or 155, 317; PI P 408
5	**Entomology** Ent 283, 375
6	**Social Sciences** Acct 215; Econ 235
17.5	**Free electives**

Insect Biology Option

Cr.	Degree Requirements
4	**Mathematics** Math 181
28	**Physical Sciences** Chem 177, 177L, 178, 178L, 211, 211L, 331, 331L, 332; Phys 111, 112
17-18	**Biological Sciences** Biol 313, 313L, 314, 314L, 315; 330 or 335; 364
14.5-15.5	**Free electives**

Typical Program for the First Year

Cr.	Fall
3	Critical Thinking and Communication—Engl 150
3	Principles of Biology—Biol 211
1	Laboratory in Principles of Biology—Biol 211L
4	General Chemistry—Chem 163 or 177
1	Laboratory in General Chemistry—Chem 163L or 177L
4	Fundamentals of Algebra for Science and Higher Mathematics—Math 140 or Calculus and Differential Equations—Math 181
R	Orientation in Entomology—Ent 110
Cr.	**Spring**
3	Introduction to Statistics—Stat 104
4	General Chemistry—Chem 231, 231L, or 178, 178L
4	Principles of Biology—Biol 212, 212L
1	Introduction to Insects—Ent 201
2	Insects and Society—Ent 211
0.5	Library Instruction—Lib 160

Curriculum in Microbiology

www.micro.iastate.edu
Administered by an interdepartmental committee

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Engl 150, 250; Engl 302 or Engl 309 or Engl 314; Sp Cm 212; Lib 160
10-12	**Mathematical sciences** Stat 101 or 104 required; 2 semesters of math with at least one semester of calculus
26-29	**Physical sciences** **Chemistry**—Chem 177, 177L, 178 **Organic Chemistry:** Chem 331, 331L, 332. **Biochemistry**—BBMB 404 and 405 (recommended) or 301 **Physics**: Phys 111, 112.
16	**Biological sciences** Biol 211, 211L, 212, 212L, and 313, 313L, 314, 314L.
15	**Humanities, ethics, and social sciences** Minimum of 3 credits each in courses in humanities and social sciences. Also, 3 credits each in ethics, international perspectives, and U.S. diversity courses selected from approved lists.
28.5	**Microbiology** Required: Micro 110, 302, 310, 320, 430 or 477 or 456, 450, 451. Required labs: Micro 302L, 310L or 475L, 440. A minimum of 9 credits of microbiology courses at a 400-level and above or from departmental approved list with no more than 3 credits from laboratory courses.
15-20	**Electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
4	General Chemistry—Chem 177
1	Laboratory in General Chemistry—Chem 177L
3	First-Year Composition—Engl 150
3	Principles of Biology—Biol 211
1	Laboratory in General Biology—Biol 211L
3	Humanities, ethics, or social science
0.5	Library 160
R	Orientation in Microbiology—Micro 110

Cr. Spring
3 General Chemistry—Chem 178
3 Principles of Biology—Biol 212
1 Laboratory in General Biology—Biol 212L
3 Biology of Microorganisms—Micro 302
1 Microbiology Laboratory—Micro 302L
3 Statistics 101 or 104
3 Humanities, ethics or social science

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the microbiology curriculum.

Curriculum in Nutritional Science

Administered by the Department of Food Science and Human Nutrition.

Cr.	Degree Requirements*
12.5	**Communications/Library** Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212; Engl 314
7-12	**Mathematical sciences** Math 160, 165-166, or 181-182 Calculus (2 semesters recommended); Stat 101 or 104
24	**Physical sciences** Chem 177, 177L, 178, 331, 331L, 332, 332L; Phys 111, 112
26-27	**Biological sciences** Biol 211, 211L, 212, 212L, 313, 314, 255, 255L, 335; Micro 201 or 302; Micro 201L or 302L
11-12	**Humanities/Social sciences*** FS HN 342; select 3 crs. of humanities courses; select 3 crs. of social science courses; and Env S 120 or 201
34-35	**Food science and human nutrition** FS HN 110, 167, 203, 214 or 311, 265, 360, 361, 362, 461, 480, 492; select at least 9 additional credits from FS HN 403, 412, 419 or 519, 463, 464, 466, 490C, 499, 575; NutrS 501, 502, 562, 565
0-2	**Electives**
120.5	**Total credits**

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists.

Concurrent B.S. and M.S. Program:
Well qualified students in Nuritional Science who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both a bachelor of science in Nutritional Science and a master of science degree in Nutritional Sciences. For more information, refer to www.fshn.hs.iastate.edu

Curriculum in Public Service and Administration in Agriculture

Administered by the Department of Sociology.

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Engl 150, 250; Jl MC 205; Sp Cm 212; Lib 160; communication-intensive requirement
18	**Mathematical, physical and life sciences** Math 150; Stat 101; electives in physical sciences (5 cr.); Biol 101; electives in biological sciences (3 cr.) (To fulfill the College's environmental intensive requirement, students are encouraged to choose Environmental Studies 120 or 173 as the elective in the biological sciences; demonstration of computer proficiency) (see Sociology Department for requirements).
12	**Humanities, ethics, and social sciences** Humanities elective (3 cr.); from approved lists: 3 cr. in ethics; 3 cr. in U.S. diversity; 3 credits in international perspectives. The 3-credit College of Agriculture and Life Sciences requirement in the social sciences is included as part of the Public Service and Administration Core as are the environmental-intensive requirement and problem solving-intensive requirement.
46	**Public service and administration core** **Economics**: 101, 102, 344 or Acct 284, 336; AgEds 451 **Political science:** 215, 310, 371, 475, and 3 additional credits of political science courses at the 300-level or above. **Sociology**: 110, 130, 325 or 382, 415, 420 or 380, and 464
9	**Agricultural sciences**
15	**Required area of concentration**
15.5	**Free electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
3	First-Year Composition—Engl 150
3	Introductory Biology—Biol 101
3	Mathematics for Business and Social Sciences I—Math 150
3	Rural Institutions and Organizations—Soc 130
3	Principles of Microeconomics—Econ 101
R	Orientation to Public Service and Administration in Agriculture—Soc 110
Cr.	**Spring**
3	Principles of Macroeconomics—Econ 102
3	American Government: Institutions and Policies—Pol S 215
3	Fundamentals of Speech Communication—Sp Cm 212
6	Agricultural Science
0.5	Library Instruction—Lib 160

Curriculum in Seed Science

Administered by the Departments of Agricultural and Biosystems Engineering, Agronomy, Horticulture, and Plant Pathology. Must be taken as a secondary major in conjunction with a primary major. The seed science program is designed for students with career interests in one or more aspects of the seed industry. Areas of study include: seed production, conditioning, pathology, physiology, quality control, and marketing, as well as seed plant designs.

Cr.	Degree Requirements
12.5	**Interpersonal and public communication skills** Engl 150, 250; Sp Cm 212 or AgEdS 311; Lib 160; Engl 302 or 309 or 314 or Sp Cm 312
38	**Mathematical, physical, and life sciences** Math 140 or 150; Stat 101 or 104; Chem 163, 163L; BBMB 221 or Chem 231, 231L; Phys 106 or 111, or Chem 164, 164L; Biol 211, 211L; Biol 212, 212L; Ent 376; Gen 320 or Biol 313; Agron 317; Pl P 408; and demonstration of computer proficiency (see department of primary major for procedures)
15	**Humanities, ethics, and social science** 3 cr. each of humanities, social sciences, ethics (from an approved list), U.S. diversity (from an approved list), and international perspectives
21	**Agricultural sciences** Agron 114 or Hort 221; Agron 154, 206, 354; Agron or Hort electives (6 cr.); TSM electives (3 cr.)
9	**Economics and business** Econ 101, 235; and one course from the following group: Acct 284; Econ 102, 330, 336; Mgmt 370; Mkt 340
10	**Seed science** Agron 338, 421, 491, and 2 cr. of Agron, Hort, Pl P or TSM electives at the 300-400 level
22.5	**Primary major requirements and free electives**
128	**Total credits**

Typical Program for the First Year

Because seed science is a secondary major, the courses taken by the student during the first year will vary, depending on the primary major (see typical program for the primary major).

College of Business

Labh S. Hira, Dean
Michael R. Crum, Associate Dean
Kay M. Palan, Associate Dean
www.bus.iastate.edu

Departments of the College

Accounting
Finance
Logistics, Operations and Management
Information Systems
Management
Marketing

Objectives of the Curriculum in Business

The instructional objective of the College of Business is to provide a high quality professional education in business. Such an education should provide the student with: (1) an appreciation of the evolution of the profession and an awareness of the ethical, global, technological, economic, political and social forces shaping its future; (2) an understanding of the major functional areas of business with the opportunity for specialization for a career in business; (3) an ability to recognize and appreciate the affect of diversity in the work place; (4) an opportunity for advanced study.

A comprehensive education in business includes a broad foundation in the liberal arts, courses in the major functional areas of business activity, proficiency in analytical methods, and the ability to identify problems and arrive at logical solutions. In addition, a professional education is designed to inspire students to assume business and community leadership.

The curriculum in business is accredited by the International Association for Management Education (AACSB), the national business accrediting agency.

Organization of Curriculum

The undergraduate curriculum in business is divided into two phases: a general education (pre-business) program and a professional program. The pre-business requirements provide a broad foundation in the liberal arts. The professional program includes two parts: (1) the business core which provides a common body of knowledge in all the functional areas in business, and (2) a major area of study. The eight majors offered for the degree bachelor of science (B.S.) are accounting; finance; management; management information systems; marketing; logistics and supply chain management; operations and supply chain management; and business economics. The college also offers a secondary major in international business. Elective courses are part of the curriculum.

Bachelor of Science

The bachelor of science (B.S.) degree offers a high quality professional education in business. It prepares students for professional careers in specialized functions of business and government. Candidates for this degree must satisfy the requirements established by the College of Business and also the requirements for individual majors specified by the departments of the College. All candidates for the B.S. degree are required to complete one of the following majors: accounting; finance; management; management information systems; marketing; logistics and supply chain management; operations and supply chain management; or business economics.

Required High School Preparation

Students entering the pre-business curriculum must present evidence of the following high school preparation:

a. Four (4) years of English/Language Arts, emphasizing writing, speaking, and reading as well as an understanding and appreciation of literature.

b. Three (3) years of mathematics, including one year each of algebra, geometry, and advanced algebra.

c. Three (3) years of science, including one year each of courses from two of the following fields: biology, chemistry, and physics;

d. Two (2) years of social studies.

Admission Standards to Professional Programs

All new entering students are enrolled in the pre-business curriculum. To enter the professional program in the College of Business, students must complete any Engl 101 courses, Engl 150, and the following foundation courses or their approved substitutions: Math 150, Econ 101, Econ 102, Stat 226, Acct 284, and BusAd 101. See Curriculum in Business.

In addition, all students must achieve an Iowa State University cumulative grade point of 2.5 or a grade-point average of 2.5 in the foundation courses. Admission into the professional program is a prerequisite for pre-business students to gain admission into upper-level business classes.

Students who meet the following requirements qualify for early admission to the professional program. First Semester Freshman: ACT score of 30 or higher, or ranked in the top 5% of high school class, or National Merit/Achievement Finalist, or member of the Freshman Honors Program. All other Students: minimum ISU cumulative GPA of 3.35 in at least 12 credits, or full member of the University Honors Program.

If using the foundation courses for admission to the Professional Program, both transfer grades and Iowa State University grades are used to compute the grade point average. If foundation courses initially taken at Iowa State University need to be repeated, they must be repeated at Iowa State University. With the exception of Acct 285 and MIS 330, pre-business students do not have access to business core classes. To facilitate registration, qualified students may be conditionally admitted during the semester in which they complete the admission requirements.

Admission requirements are subject to change. Applications and the current requirements for admission to the College of Business are available on the Web at https://apps.bus.iastate.edu/ProfessionalProgram/ or from the Undergraduate Programs Office in the College of Business.

Academic Standards and Graduation Requirements

Policies for students enrolled in the College of Business may be obtained on the Web at http://www.business.iastate.edu/undergraduate/ or from the Undergraduate Programs Office in the College of Business.

Students are responsible for knowing and adhering to these College of Business policies as well as the university regulations found in this catalog. The following policies are in effect for students graduating from a professional curriculum in business with a B.S. degree under the 2009-2011 catalog:

(1) A minimum of 122 semester credits are required.

(2) At least 50 percent of the required business credits must be earned at Iowa State. All 300 level and higher business credits must be earned at a four-year college.

(3) At least 50% of the 122 credits required for graduation must consist of general education (non-business credits).

(4) A minimum of 12 credits of the last 32 credits earned in residence must be applied to the business core and/or the major.

(5) The major departments reserve the right to determine the appropriate section of the degree program to which transfer credits will be assigned.

(6) Students must achieve Communication proficiency by earning a grade of C or better in two of the three required English courses.

(7) A student must earn a grade of C or higher in a minimum of 30 credits applied to the business core and the major.

(8) A student must earn at least 42 credits of 300 level and higher coursework from a four-year institution.

(9) Business majors may not take business courses Pass-Not Pass (P/NP).

(10) General education courses may not be taken P/NP.

(11) No more than 9 elective credits may be taken P/NP.

Curriculum in Business

The college offers programs of study leading to the degree bachelor of science with a major in accounting; finance; management; management information systems; marketing; logistics and supply chain management; operations and supply chain management; or business economics. The college also offers a secondary major in international business. Total credits required: 122

Pre-business Curriculum

Cr.	
18.5	Foundation Courses
R	BusAd 150[3]
3	BusAd 250
3	Math 150[1, 2]
3	Econ 101
3	Econ 102
3	Stat 226 [2]
3	Acct 284
0.5	BusAd 101
12.5	Communications
3	Engl 150
3	Engl 250
3	Engl 302
3	Sp Cm 212
0.5	Lib 160
7	Supporting courses[1]
0.5	BusAd 201
0.5	BusAd 301
3	Acct 215
3	Math 151[1,2]
24	General Education Requirements
6	Global/International Perspectives[4]
9	Humanities
3	Phil 230
6	Select from approved list
3	Natural science
6	Social science
	U.S. diversity course[5]

1 Acct, Fin, and Bus Econ majors will also take State 326 as part of the supporting courses. Bus Econ majors will take Math 160 instead of 150, and Econ 207 instead of Math 151. See the Undergraduate Programs Office in the College of Business.

2 Students not adequately prepared in mathematics may have to take remedial courses in addition to courses listed above. Remedial mathematics courses may not be used to satisfy credit requirements for graduation in the business curricula.

3 Students without adequate computer background may take Com S 103 to satisfy the computer literacy requirement.

4 Students may satisfy this requirement either by taking six credit hours from the University International Perspectives list, or three credit hours from the International Perspectives list and three credit hours from the College of Business Global Perspectives list. Approved list of courses is available on the web at http://www.business.iastate.edu/undergraduate/ or from the Undergraduate Programs Office in the College of Business.

5 Courses for this requirement may also be used to fulfill other curriculum requirements or electives and therefore credits are not included in the sum needed.

Professional Program

Cr.	
24	Business Core
	Block A
3	Acct 285
3	MIS 330
	Block B
3	Fin 301
3	OSCM 320
	Block C
3	Mgmt 370
3	Mkt 340
3	LSCM 360
	Block D
3	Mgmt 478

Scheduling note for core courses: Block A, B, C may be taken in any order in sequential semesters. Blocks A, B, C must be completed prior to enrollment in Block D, Mgmt 478, in the student's final semester.

18-21	Business Major
Select one:	
18	Accounting
18	Acct 383, 384, 386, 387, 485, 497
21	Finance
6	Fin 310, 320
12	Select from Fin 327, 330, 361, 371, 415, of which six credits must be at the 400 level
3	Select from department-approved list
18	Management
12	Mgmt 371, 377, 414, 471
6	Select from department-approved list
21	Management Information Systems
15	MIS 331, 432, 433, 435, 438
6	Select from department-approved list
18	Marketing
9	Mkt 443, 444, 447
6	Select from Mkt 343, 410, 442
3	Select from department-approved list
18	Logistics and Supply Chain Management
15	LSCM 460, 461, 485, 486, 487
3	Select from department-approved list
18	Operations and Supply Chain Management
15	OSCM 422, 424, 485, 486, 487
3	Select from department-approved list
18	Business Economics
9	Econ 301, 353, 431, 492
9	Select from departmental approved list
9-15	Elective Courses
	Select courses to broaden or complement required courses to meet degree requirement of 122 credits. (See adviser).

CPA Note: See Accounting Curriculum for information on the additional requirements for students who wish to be candidates for the CPA exam.

Sample Four-Year Plan of Study

Cr	Freshman Year
0.5-1	Bus Ad 101/102
R	Bus Ad 150
3	English 150
3	Bus Ad 250
6	Econ 101 and 102
6	Math 150 and 151
4	Computer Science 103 (Placement out via assessment)
0.5	Library 160
3	International Perspectives
3	Humanities
6	Social Science
35.5	

Cr.	Sophomore Year
0.5	Bus Ad 201
0.5	Bus Ad 301
3	Acct 284
6	Acct 285, MIS 330 (Block A)
3	Stat 226
3	Acct 215
3	Speech Communications 212
3	Engl 250
3	International Perspective/Global Perspective
3	U.S. Diversity
3	Philosophy 230
31	

Cr.	Junior Year
6	Fin 301, OSCM 320 (Block B)
9	Mkt 340, LSCM 360, Mgmt 360 (Block C)
6	Major Courses
3	Humanities
6	General Electives
30	

Cr.	Senior Year
3	Mgmt 478 (Block D)
3	English 302
12-15	Major Courses
3	Global Perspective
6	General Electives
30	

Block A
Acct 285
MIS 330

Block B
FIN 301
OSCM 320

Block C
Mkt 340
LSCM 360
Mgmt 370

Block D
Mgmt 478
Block A, Block B, and Block C are prerequisites for Block D

Advising System

The Undergraduate Programs staff, under the leadership of the Director for Undergraduate Programs, facilitates student progress toward graduation while supporting the academic standards of the College of Business and Iowa State University. To accomplish this, the Undergraduate Programs staff provides services for all College of Business students, including academic advising, learning opportunities, and teaching and developmental activities.

Students in the College of Business have advisers located in the Undergraduate Programs Office. The adviser assists students with developing an academic program; accessing pertinent university resources; and meeting their educational objectives.

The college offers an orientation program for entering students. All entering students and family members are encouraged to attend orientation. During orientation the adviser and the student prepare an appropriate schedule and the student registers for courses. Placement assessments may be required in Mathematics and English to assist in placing students in the appropriate level of courses if this cannot be determined by ACT/SAT scores, high school preparation classes or transfer courses.

Honors

Entering freshmen who meet one of the following criteria, and have a minimum English ACT of 24, will be invited to apply for membership in the Freshman Honors Program: earned an ACT composite of 30, or ranked in the top 5% of their high school classes; or selected as a National Merit or National Achievement finalist.

Enrolled students who have completed 12 graded credits at Iowa State University and earned a 3.35 can be admitted as a full member of the Honors Program. To qualify for full membership, students must have declared a major, developed a program of study, and have a minimum of 48 credits remaining before graduation. Special advisers will assist honors students in developing an appropriate program of study.

Internships

Credit and non-credit internships in business may be approved for College of Business students in all majors including pre-business. Credit hours and requirements vary. Arrangements must be made in the college prior to the beginning of the internship. An internship adviser from the Career Services Center will assist students in making these arrangements.

Multiple Majors

Undergraduates pursuing a degree in the College of Business may complete additional majors in the College of Business. Those desiring additional majors outside the college should refer to the catalog section of the appropriate college and department for the additional major requirements. A multiple major in business economics and agricultural business or economics is not permitted. A major in business economics with a minor in economics is not permitted.

Undergraduates with a primary major outside the College of Business who want a second major in business must meet the admission requirements for the professional program as well as complete the following requirements: the business core courses; the major specialization; computer proficiency; Acct 215; and Math 151.

All students pursuing multiple majors or multiple degrees within the College of Business are required to have a minimum of 15 credits of coursework in each additional major that is not used in the other majors.

Students are limited to three business majors/degrees within the College of Business, or a total of three business major/minors within the college. This limit is on business majors/degrees/minors only, and does not apply to multiple majors/degrees/minors taken outside the College of Business.

Students are limited to three business majors/degrees within the College of Business, or a total of three business major/minors within the college. This limit is on business majors/degrees/minors only, and does not apply to multiple majors/degrees/minors taken outside the College of Business.

Curriculum Changes

Iowa State University students who want to change their curriculum to the College of Business must attend a curriculum change meeting. See Changing Curriculum or Major for more details on this process. Students on Academic Probation will not be allowed to change curriculum to the College of Business during enrollment period three. See Making Schedule Changes.

International Business Secondary Major

A student in the College of Business may earn a secondary major in International Business. The requirements for this major include 12 credits in international business courses, one year of the same university-level foreign language (minimum 6 credits) and an approved international experience (minimum 3 months). Students who pursue this secondary major will be required to complete the requirements for a primary major in Business. Fifteen of the 18 credits required for the International Business major may not be used for the primary major.

Minor

The College of Business offers a structured minor in general business to students outside the College. The minor requires a minimum of 15 credits, not including pre-requisite courses. Requirements for the minor are ACCT 284, Acct 285 or ACCT 215 or BUSAD 250 (6 credits), three courses selected from Fin 301, Mgmt 370, MIS 330, Mkt 340, LSCM 360, or OSCM 320 (9 credits). The minor must include at least 6 credits in courses numbered 300 or above taken at Iowa State University. A "C" average or higher is required in all courses used to satisfy the minor requirements. All requirements for the minor must be taken for a grade.

Students with a major in the College of Business may qualify for a minor specialization in one of the college's departments by taking at least 15 credit hours in the minor specialization, nine hours of which may not be used to satisfy any other department, college, or university requirement. The minor must include at least 6 credits in courses numbered 300 or above taken at Iowa State University with a grade of C or higher. Students with declared majors have priority over students with declared minors in courses with space constraints.

Students with a major outside the College of Business are eligible for a general business minor only—not a specialization in a business department.

Students are limited to three business majors/degrees within the College of Business, or a total of three business major/minors within the college. This limit is on business majors/degrees/minors only, and does not apply to multiple majors/degrees/minors taken outside the College of Business

Entrepreneurial Studies Cross-Disciplinary Minor

The College of Business participates in a cross-disciplinary minor in Entrepreneurial Studies. This minor is available to any undergraduate student. Requirements for the minor include Mgmt 310, Mgmt 313 (6 credits), two business-oriented electives from an approved list (6 credits), and an experiential learning component (3 credits). The approved list of courses is available in the Undergraduate Programs Office in the College of Business and on the web at http://www.business.iastate.edu/undergraduate/minors/entrepreneurship.

Non-degree Seeking Students

Students who wish to take courses in the College of Business, but are not seeking an undergraduate degree, should apply to the college as non-degree seeking students. Non-degree seeking students are eligible to take up to 9 credits in 300-level and above business courses without meeting the college's admission requirements.

Upper Division Courses for Students Outside the College

Students from outside the College of Business are eligible to take up to 9 credits of 300-level and above business courses without meeting the college's admission requirements, as long as they meet course prerequisites.

Graduate Study

Four programs are offered at the graduate level: a master of business administration (M.B.A.) program, a master of accounting (M.Acc.), a master of science (M.S.) in business, and a master of science in information systems (M.S.I.S.). These programs are intended to meet distinct sets of educational objectives.

The M.B.A. is the professional management education program for those pursuing careers in business. The purpose of this professional program is to provide professional business education by preparing students to understand the impact of technology on business organizations in a global environment. The M.B.A. program consists of a 48-credit curriculum leading to a non-thesis, non-creative component master of business administration. Students may pursue a specialization in accounting, agribusiness, family financial planning, finance, information systems, international business, supply chain management or marketing.

The master of accounting (M.Acc.) is a 32-hour degree. The program requires 15 hours of graduate accounting courses, at least 9 hours of non-accounting graduate electives, a communications course, and an international course from an approved list. The M.Acc. is appropriate for any student wanting to pursue a variety of accounting careers. Additionally, the program is designed to help interested candidates meet the 150-hour education requirement for CPA certification in Iowa.

The master of science in information systems (M.S.I.S.) is designed to provide students with strong technical skills and a broad background in business needed to effectively develop and manage information systems projects. Using the latest software, students will apply information systems theory and concepts to modern information systems development. Program requirements range from 30-40 credits depending upon the student's background. The M.S.I.S. curriculum includes business foundation courses, information systems core courses and electives, and a research requirement (creative component).

The M.S. program, consisting of 30 minimum credits, is oriented toward further business specialization at the master's level for students with undergraduate degrees or academic backgrounds in business. The program is intended to serve those students who desire specialized study of an area within business. Students in the program must complete a thesis. This program is also a suitable vehicle for students planning to pursue a Ph.D. in business.

Double degree programs are offered with architecture (M.Arch./M.B.A.), community and regional planning (M.B.A./M.C.R.P), informational systems (M.B.A./M.S.I.S), and statistics (M.B.A./M.S.-Statistics). The Department of Logistics, Operations, and Management Information Systems in the College of Business participates in the following graduate level interdepartmental programs: Information Assurance, Human Computer Interaction, Seed Science and Business, and Transportation. The College of Business also offers a business administration minor to students with majors outside the college. A concurrent B.S./M.B.A. is available to eligible engineering undergraduate students majoring in civil engineering, computer engineering, electrical engineering, industrial engineering, and mechanical engineering.

Ph.D in Business and Technology

The College of Business offers graduate work leading to the Doctor of Philosophy degree in business and technology, with one of three specializations—customer management (CM), supply chain management (SCM), or management information technology (MIT). Many departments in the college (Logistics, Operations, Management Information Systems, Marketing and Management), and the departments of Statistics, Economics, Psychology, and Sociology cooperate in providing coursework toward this degree. The program will prepare individuals for academic careers in research, teaching, and public service at institutions of higher learning in the United States and other countries. The PhD program consists of a 44 credit course curriculum followed by 12 credit thesis or dissertation. Students do not need to have an undergraduate degree or master's degree in business in order to qualify for enrollment in the PhD program. However, students without a graduate degree in business will be required to complete 18 credit hours of business foundation courses. For more details or application information see the Business Administration Department listing in this catalog.

College of Design

Mark C. Engelbrecht, Dean
Kate Schwennsen, Associate Dean
Timothy O. Borich, Associate Dean
www.design.iastate.edu

Departments of the College

Architecture
Art and Design
Community and Regional Planning
Landscape Architecture

Objectives of the Curricula in Design

The College of Design is among a small, elite number of comprehensive design schools offering outstanding opportunities for both disciplinary and interdisciplinary education.

The College of Design strives to provide each student with a broad educational background and preparation in a specific environmental design or art discipline. Each program is designed to develop knowledge and appreciation of the physical and cultural environment, to stimulate creative thinking and analysis, and to prepare students for participation in a wide variety of careers.

The college's programs also encompass many opportunities for individualized study and extracurricular activities such as visiting lectures and symposia, workshops, gallery exhibits, practicum and internship programs, field trips, and international study programs.

Graduates of the college are employed in private firms, government, industry, and education, or are self-employed as designers or artists. Opportunities for graduates include careers as architects, landscape architects, community and regional planners, graphic designers, interior designers, studio artists, arts administrators and environmental designers.

Graduate Curricula

The College of Design offers graduate study in the areas shown below. Graduate study is conducted through the Graduate College. Details are found in the Graduate College section of this catalog.

Majors

Architecture
Architectural Studies
Art and Design
Community and Regional Planning
Graphic Design
Integrated Visual Arts
Interior Design
Landscape Architecture
Transportation*

Double Degree Programs

Architecture / Business
Architecture / Community and Regional Planning
Community and Regional Planning / Landscape Architecture
Community and Regional Planning/ Public Administration

Minor

Gerontology*

*The College of Design participates in this interdepartmental graduate program.

Undergraduate Curricula

Majors

Architecture
Art and Design
Community and Regional Planning
Graphic Design
Interior Design
Integrated Studio Arts
Landscape Architecture

Secondary Majors

Environmental Studies*
International Studies*

Minors

Design Studies
Digital Media
Entrepreneurial Studies*
Environmental Studies*
Gerontology*
International Studies*
Technology and Social Change*

*The College of Design participates in these interdepartmental secondary majors and minors.

Organization of Curricula

The undergraduate curricula in design are divided into two phases: a pre-professional Core Design Program and a professional program. The Core Design Program grounds the undergraduate degree programs, provides a rich, rigorous inclusive base for the curricula. It creates shared language, experience, and community for programs, faculty and students and exposes students to all design disciplines, allowing them to make more informed degree choices, apply to multiple programs, and experiment with interdisciplinary work.

For students entering the Core Design Program, the college highly recommends purchase of a digital camera.

The intense, discipline-specific professional curricula that follow the Core focus on developing students' ability and knowledge in their major. Within the major area, students advance creative and professional skills through classroom and studio work, critiques of student projects, discussion with professional practitioners, and field studies.

General education, contained in both the Core and the professional programs, is composed to insure that students receive a well-rounded undergraduate education.

High School Preparation

Courses in fine arts and design that develop visualization and freehand drawing abilities are highly recommended through not required for entrance. Students planning to enroll in an academic program in the College of Design must complete the following high school requirements: 4 years of English, including coursework in composition and literature and up to 1 year of speech and/or journalism, to develop communication skills and critical reading/writing ability; 3 years of mathematics to develop problem solving skills, including 1 year each of algebra, geometry, and advanced algebra; 3 years of science, including at least two of the following: 1 year of biology, 1 year of chemistry, or 1 year of physics; 2 years of social studies, including at least 1 year of U.S. history and 1 semester of U.S. government.

Admission Standards to Enrollment Managed Professional Programs

Admission into the enrollment managed professional programs of Architecture, Community and Regional Planning, Graphic Design, Interior Design, and Landscape Architecture requires a separate application after completing the Core Design Program, depends on available resources, and is subject to review by faculty committee. Applicants are reviewed on the basis of a portfolio of original work, scholarship performance, and a written essay.

Advising

Each student receives personal assistance from an academic advisor within the student's curriculum area. Students enrolled in the college's Core Design Program are advised by professional advisers. Once admitted to professional programs, students are assigned to faculty advisers. Advisers help students develop a program of study, access pertinent university resources as well as provide information on career choice.

The college's career services office works with students to develop their career goals as well as prepare and search for employment.

Honors Program

The College of Design participates in the Honors Program which provides opportunities for outstanding students to individualize their programs of study. See *Index, Honors Program*.

Requirements in the College of Design

All students in the College of Design are expected to meet the following requirements of the college.

Core Design Program

Cr.	Fall/Spring
4	Dsn S 102
4	Dsn S 131
3	Dsn S 183
6	Social Science/Humanities Electives*
6	Math/Science Electives**
6	English 150/250
0.5	Library 160
29.5	**

* General education credits in the Core Design Program may count toward the minimum credits.

** Students applying to Architecture for admission must take Math 142 and Physics 111 in the first year. These two courses total seven credits for a total of 30.5 core credits.

General Education

Minimum Credits.

- 6 **Biological sciences, physical sciences and mathematics**
  Includes courses in the fields of agronomy, astronomy and astrophysics, biology, botany, chemistry, civil engineering, computer science, geology, mathematics, physics, statistics, and zoology.
- 9.5 **Communications**
  Engl 150*, 250*, Lib 160. Includes courses in the fields of English (composition), and speech communication (interpersonal and rhetorical).
- 6 **Humanities**
  Includes courses in the fields of classical studies, English (literature), foreign languages, history, philosophy, religious studies, as well as history/theory/literature courses in dance, music, theater, journalism, African American studies, American Indian studies, environmental studies, Latino/a studies, women's studies, and university studies.
- 6 **Social sciences**
  Includes courses in the fields of African American studies, American Indian studies, anthropology, economics, environmental studies, geography, human development and family studies, Latino/a studies, political science, psychology, sociology, and women's studies.
- 9 **Additional credit hours selected from any of the above areas.**
  Six credits must be at the 300 level or above.
- 9 **Selected from the above areas.**
  Six credits must be at the 300 level or above.
- 36.5 **Minimum credits**

See departmental curricula for specific course requirements within the general education areas.

*To meet requirements for graduation, a minimum grade of C– must be received.

Minor in Design Studies

The undergraduate minor in Design Studies is constructed to facilitate design awareness among interested students and to provide a vehicle for interdisciplinary study within the College of Design. This minor is open to all undergraduate students at Iowa State University.

This minor requires fifteen credits of course work: three credits of history selected form College of Design course offerings and twelve additional credits selected from College of Design course offerings.

At least six of the fifteen credits must be taken at Iowa State University in courses numbered 300 or above. At least nine of the fifteen credits must not be used to meet any other college or university requirements except the credit requirement for graduation.

Students enrolled in the College of Design may not use courses in their major or in the Core Design Program to satisfy this minor.

Minor in Digital Media

Manipulation of digital media has emerged as an essential skill for design inquiry alongside traditional methods of building models and drawing sketches. To familiarize students with the use of digital media in the design process, the College of Design offers an undergraduate Minor in Digital Media. This minor is open to all undergraduate students at Iowa State University.

This minor requires 15 credits, including at least 6 credits taken at Iowa State University in courses numbered 300 or above. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement; and at least 3 credits from the listed courses numbered 200. Courses taken for this minor may not be taken on a pass-not pass basis.

Students enrolled in the College of Design may not use courses in their major or in the Core Design Program to satisfy this minor.

Curriculum in Architecture

The Department offers undergraduate and graduate degree programs:

A 138-credit undergraduate professional program, preceded by a 28-credit preprofessional program, leading to the bachelor of architecture degree.

A 100-credit graduate professional program leading to the Master of Architecture. Applicants holding B.S. or B.A. degrees in Architecture or other affiliated design fields may be given advanced standing in this program. (M.Arch.)

A 30-credit post-professional graduate program leading to the Master of Architecture. (M.Arch. II)

A 30-credit interdisciplinary graduate research program leading to the Master of Science in Architectural Studies. (M.S.A.S.)

For more complete graduate program descriptions see Graduate Study under Architecture in the Courses and Programs section.

In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes three types of degrees: the Bachelor of Architecture, the Master of Architecture, and the Doctor of Architecture. A program may be granted a 6-year, 3-year, or 2-year term of accreditation, depending on the extent of its conformance with established educational standards.

Master's degree programs may consist of a preprofessional undergraduate degree and a professional graduate degree that, when earned sequentially, constitute an accredited professional education. However, the preprofessional degree is not, by itself, recognized as an accredited degree.

Preprofessional Program

First Year

Cr.	Fall/Spring
4	Dsn S 102 (Studio)
0.5	Dsn S 115
3	Dsn S 183 (Cultures)
3	Engl 150
3	Math142
4	Physics 111
6	Social sciences/humanities Electives*
4	Dsn S 131 (Representation)
0.5	Lib 160
28	

Professional Program

Second Year

Cr.	Fall
6	Arch 201 Studio 1
3	Arch 230 Comm.
3	Arch 221 Hist
3	Arch 240 Mat'l/Assemblies 1
3	Engl 250
18	
Cr.	**Spring**
6	Arch 202 Studio 2
3	Arch 222 Hist.
3	Arch 242 Struct. 1
3	Arch 357 Env Forces 1
3	Social Science/Humanity Option*
18	

Third Year

Cr.	Fall
6	Arch 301 Studio 3
3	Arch 271 Env. Theory
3	Arch 344 Struct. 2
3	Arch 458 Env. Control
3	Social Science/Humanity Option*
18	
Cr.	**Spring**
6	Arch 302 Studio 4
3	Arch 346 Struct. 3
3	Arch 448 Mat'l/Assemblies 2
3	SAC Elective*
3	General Elective
18	

Fourth Year

Cr.	Fall
6	Arch 401 Studio 5
3	Arch 482 Prof. Practice
3	University Communication Elective*
3	SAC Elective*
3	General Elective*
18	

Cr.	Spring
6	Arch 402 Studio 6
3	SAC Elective*
3	SAC Elective*
3	Prof. Elective*
15	

Fifth Year

Cr.	Fall
6	Arch 403 Studio 7
3	Professional Elective
3	General Elective
3	General Elective
3	General Elective
18	

Cr.	Spring
6	Arch 404 Studio 8
3	Prof. Elective*
3	General Elective
3	General Elective
15	Electives

*from approved departmental lists

166 Total credits

Curriculum in Art and Design—B.A.

Administered by the Department of Art and Design and leading to a 120.5 credit undergraduate Bachelor of Arts degree including a 29.5 credit pre-professional program (college core).

This curriculum offers two concentrations: Art and Culture, and Art and Design History and Theory. Both concentrations are combined with an applied career minor or approved program.

Consideration for admission into the B.A. curriculum is based upon department resources, GPA earned in the college Core Courses and the freshman year.

Transfer students with studio credits from other programs, colleges and universities must present for department review a portfolio of work done in those courses in order to have the credits apply toward studio requirements. Students are required to present this portfolio upon admission and prior to registration for classes. Arrangements for this process must be made with department advisers.

Cr.	Degree Requirements
36.5	General education
6 min.	Biological and physical sciences and mathematics Select from Astro 120, 150, Biol 101, 173, 211, 212, Bot 111, 265, Chem 160, 163, 163L, Com S 103, 107, Geol 100, 101, Gen 260, Math 104 or 150, 105, 140, 141, 151, Mteor 206, Phys 101, 106, Stat 101, 104 or any higher level course in these disciplines for which these courses are prerequisite
9.5 min.	Communications
6	Engl 150 and 250
3	Select from CmDis 286, ComSt 101, 102, Sp Cm 212
0.5	Lib 160
6 min.	Humanities Select from Af Am 201, 252, Am In 310, Cl St – all courses, Dance 270, 360, Engl 201, 230, 231, 237, 335, 340, 346, 347, 348, 353, 354, 360, 361, 362, 363, 364, 373, 374, 375, 376, 377, 378, 379, 384, 389, WLC 101, 102, 110, 201, 202, 301, 302, Hist—all courses, Music 102, 302, 304, 383, 384, Phil— all courses, Relig— all courses, T C 354, 355, Thtre 106, 110, 252, 465, 466, W S 336, 340, 345, 377, 422
6 min.	Social sciences Select from Anthr 201, 202, 306, Econ 101, 102, Pol S 215, 230, 241, 251, Psych 101, 230, Soc 130 or 134, or any higher level course in these disciplines for which these courses are prerequisite, or select from Am In 210, Env S 201, 223, HD FS 102, 239, 276, 283, 349, 367, 370, 373, 377, 378, 380, 395, Jl MC 101, 205, 320, 453, 474, 476, W S 201, 301, 321, 323, 327, 346, 350, 385, 386, 401
9 min.	Selected from the above areas and/or from CmDis 275, 286, ComSt 101, 102, 214, 310, 311,314, 317, 318, Engl 205, 219, 220, 302, 303, 304, 305, 306, 309, 310, 314, 315, 316, Fin 361, 371, L A 271, Mgmt 370, Mkt 340, Sp Cm 212, 305, 312, 321, 322, 323, 325, 327.Six credits must be at the 300 level or above.
6 min.	General design education
3	Select a history course from Arch, Art H, Dsn S, or L A.
3	Select from Art H 181, 426, 446, or other approved design studies course
11	College of Design Core (4 cr); Dsn S 131 (4 cr); Dsn S 183 (3 cr)
12	Art History
6	Art H 280 & 281 Art History I & II
6	selections 300 level or above
	Art and Culture Concentration
12	Design and Art Options Select from all 200-level courses in Art, ArtIS, graphic design, and interior design, or approved list ofcourses in architecture, landscape architecture, community and regional planning, and textiles and clothing that are open to nonmajors.
30	Applied minor* or approved program of study (at least 6 credits 300 or above courses). See department for specific curriculum sheets with course information.
13	Electives
120.5	Total credits
	History and Theory Concentration
15	Art and Design Options Select 12 credits from Art H 300-400 level courses, graphic deign history. or interior design history courses; 3 credits Art 498 (Museum/Gallery Internship)
30	Applied minor* or approved program of study (at least 6 credits must be world language courses). See department for specific curriculum sheets with course information.
10	Electives
120.5	Total credits

*A second major or minor must be approved by the department offering the program of study. See university guidelines for structuring and declaring a second major and/or minor. Credit hours not applied toward a formal second major or minor must be used in a coherent program approved by the Department of Art and Design. Approval for these 30 credits must be documented in writing following completion of 75 credits and before completion of 100 credits toward the B.A. degree.

Curriculum in Community and Regional Planning

The Department of Community and Regional Planning administers the 129 credit undergraduate program leading to the Bachelor of Science. The curriculum is designed to prepare students to enter the profession of planning ready to work in a variety of professional settings. Students have the opportunity to work with their faculty advisers to define their own areas of interest, which may include a minor.

Consideration for admission into the Community and Regional Planning professional program takes place either through review of the performance in the College of Design's first year CORE design program, or through transfer from another curricula or accredited institution. If applying through the CORE program, admission is based upon a student's cumulative GPA for all courses earned during the first year, portfolio work submitted upon completion of the CORE courses, and an essay submission. In either case, predictors of success in the program include the quality of prior work and interest in the field. Community and Regional Planning emphasizes responsibility and citizenship, writing and analytical ability, and critical thinking. Students entering the CRP professional program from outsidethe College of Design should provide a similar portfolioof their work for evaluation.

Cr.	Degree Requirements
12.5	Communications Engl 150, 250, 309 or 314; Lib 160; Sp Cm 212
9	Humanities
7	Mathematics Stat 101; Math
6	Natural sciences
18	Social sciences Econ 101 or 102; Pol S 215; Soc 134; options
11.5	Design core Dsn S 102; Dsn S 115; Dsn S 131; Dsn S 183
28	Community and Regional Planning Core C R P 253, 272, 274, 332, 383, 391, 432, 492, 494, 498
12	Core Planning Electives — choose 4 from: 416 Urban Design and Practice 417 Urban Revitalization 425 Growth Management 429 International Planning 435 Planning in Small Town 442 Site Development

445 Transportation Policy Planning
451 Introduction to Geographic Information Systems
455 Community Economic Development
481 Regional and State Planning
484 Sustainable Communities
491 Environmental Law and Planning
C E 350 Introduction to Transportation Planning

11 Other Planning and Planning Related Courses
14 General Electives
129 Total credits

Curriculum in Graphic Design

Administered by the Department of Art and Design and leading to a 123.5 credit undergraduate Bachelor of Fine Arts in Graphic Design including a 29.5 credit pre-professional program (the college core).

Consideration for admission into the graphic design is based on department resources; GPA earned in the College Core courses and the freshman year; as well as porfolio, all of which are submitted at the end of the freshman year.

On admission to the program, the faculty strongly recommend the purchase of a laptop computer and software. Specifications for the laptop computer and software are available at www.design.iastate.edu under the "Students" link.

Transfer students with studio credits from other programs, colleges, and universities must present for departmental review a portfolio of work done in those courses in order to have the credits apply toward studio requirements. Students are required to present this portfolio upon admission and prior to registration for classes. Arrangements for this process must be made with department advisers.

Cr.	Degree Requirements
39.5	General education
6	Biological and physical sciences and mathematics Select from Astro, Biol, Bot, Chem, Com S, Geol, Gen, Math, Mteor, Stat, Phys.
9.5	Communications
6	Engl 150 and 250
3	Select from CmDis 286, ComSt 101, 102, Sp Cm 212
0.5	Lib 160
6	Humanities Select from all courses in Af Am, Am In, Cl St, Dance, Engl, WLC, Hist, Music, Phil, Relig, T C, Thtre. Select from W S 336, 340, 345, 422
6	Social sciences Select from all courses in Anthr, Econ, Pol S, Psych, Soc, Am In, Env S, HD FS, JI MC. (all courses except 315, 342,342L, 343L). Select from W S 201, 302, 321, 323, 327, 346, 350, 385, 386, 401.
12	Selected from the above areas and/or from Advrt (all courses except 436) CmDis, Fin, Mgmt, Mkt, Sp Cm. Six credits must be at the 300 level or above.
11	Design Core (4 cr); Dsn S 131 (4 cr); Dsn S 183 (3 cr)
21	General Design Education
6	History of Art I, II, Art H 280, 281
3	Drawing, Art 230
6	Select a history course from ArtGr 388, Arch, Art H, Dsn S, or L A.
6	Studio Options: Select from ArtIS, ArtID, LA, Arch or other approved studio course.
46	Graphic design
3	Design Through Photography ArtIS 229 or ArtIS 227 Graphic Design Studio I and II—ArtGr 270, 271
4	Graphic Technology I and II—ArtGr 275, 276
1	Theories and Principles of Graphic Design—ArtGr 291
1	Graphic Design Internship Seminar—ArtGr 377
6	Graphic Design Studio III and IV—ArtGr 370, 371
3	Graphic Design History/Theory/ Criticism I, ArtGr 387
2	Graphic Design Materials and Processes—ArtGr 372
3	Graphic Design Studio V—ArtGr 470
3	Graphic Design Professional Presentation—ArtGr 482
3	Graphic Design Professional Practices—ArtGr 481
8	Select four 2-credit options from approved program list. One option will be taken with ArtGr 370, 371, 470, 482
3	Select from: Art and Design in Europe—Art 495G Graphic Design Internship—ArtGr 480
6	Electives
123.5	Total credits

Curriculum in Integrated Studio Arts—B.F.A.

Administered by the Department of Art and Design and leading to a 120.5 credit undergraduate Bachelor of Fine Arts in Integrated Studio Arts including a 29.5 credit pre-professional program (the college core).

Consideration for admission into the Integrated Studio Arts program is based upon departmental resources; GPA earned in the College Core courses and in the freshman year; as well as a portfolio, all of which are submitted at the end of the freshman year.

Transfer students with studio credits from other programs, colleges, and universities must present for department review a portfolio of work done in those courses in order to have the credits apply toward studio requirements. Students are required to present this portfolio upon admission and prior to registration for classes. Arrangements for this process must be made with department advisers.

On admission to the program, if the student wishes to pursue studies in digital media and or photography, the faculty strongly recommend the purchase of a laptop computer and software. Specifications for the laptop computer and software are available at www.design.iastate.edu under the "Students" link

Cr.	Degree Requirements
36.5	General education
6 min	Biological and physical sciences and mathematics Select from Astro 120, 150, Biol 101, 173, 211, 212, Bot 111, 265, Chem 160, 163, 163L, Com S 103, 107, Geol 100, 101, Gen 260, Math 104 or 150, 105, 140, 141, 151, Mteor 206, Phys 101, 106, Stat 101, 104, or any higher level course in these disciplines for which these courses are prerequisite
9.5 min.	Communications
6	Engl 150 and 250
3	Select from CmDis 286, ComSt 101, 102, Sp Cm 212
0.5	Lib 160
6 min.	Humanities Select from Af Am 201, 252, Am In 310, Cl St–all courses, Dance 270, 360, Engl 201, 230,231, 237, 335, 340, 346, 347, 348, 353, 354, 360, 361, 362, 363, 364, 373, 374, 375, 376, 377, 378, 379, 384, 389, WLC 101, 102, 110, 201, 202, 301, 302, Hist—all courses, Music 102, 302, 304, 383, 384, 472, Phil—all courses, Relig— all courses, T C 354, 355, Thtre 106, 110, 252, 465, 466, W S 336, 340, 345, 377, 422
6 min.	Social sciences Select from Anthr 201, 202, 306, Econ 101, 102, Pol S 215, 230, 241, 251, Psych 101, 230, Soc 130 or 134, or any higher level course in these disciplines for which these courses are prerequisite, or select from Am In 210, Env S 201, 223, HD FS 102, 239, 276, 283, 349, 367, 370, 373, 377, 378, 380, 395, JI MC 101, 205, 320, 453, 474, 476, W S 201, 301, 321, 323, 327, 346, 350, 385, 386, 401
9 min.	Selected from the above areas and/or from CmDis 275, 286, ComSt 101, 102, 214, 310, 311, 314, 317, 318, Engl 205, 219, 220, 302, 303, 304, 305, 306, 309, 310, 314, 315, 316, Fin 351, 357, Mgmt 370, Mkt 340, Sp Cm 212, 305, 312, 321, 322, 323, 325, 327. Six credits must be at the 300 level or above
11	College of Design Core Dsn S 102 (4 cr); Dsn S 131 (4 cr); Dsn S 183 (3 cr)
30	ISA Core
2	ArtIS 200 Studio Introduction (students must take all sections ArtIS 205, 207, 209, 211)
3	ArtIS 208 Color Studio
3	Art 230 Drawing II
6	Art H 280 and 281 Art History I & II
3	Art IS 310 Sources of Visual Design
24	ISA Concentration Select eight (8) courses from two and three dimensional ArtIS studio offerings (ArtIS 200, 300 and 400 levels). Students will be assigned an adviser who will assist them in developing their studio concentration

plan.

9	Art History Select from 300 level or above courses
3	Professional Practice
2	ArtIS 399 BFA Professional Practice I
1	ArtIS 499 BFA Professional Practice II
10	Electives
120.5	Total credits

Curriculum in Interior Design

Administered by the Department of Art and Design and leading to a 127.5 credit undergraduate Bachelor of Fine Arts in Interior Design including a 29.5 credit pre-professional program (the college core).

Consideration for admission in the Interior Design program is based upon departmental resources; GPA earned in the College Core and the freshman year; as well as a portfolio, all of which are submitted at the end of the freshman year.

A 34 graduate credit program leading to the master of arts, for students planning to undertake professional or design research-orientated pursuits (NOTE: Applicants without a previous undergraduate degree in interior design may be required to complete up to 40 additional credits of deficiency work).

A 60 graduate credit post-professional graduate program leading to the degree master of fine arts.

For more complete graduate program descriptions see Graduate Study under Interior Design in the Courses and Programs section.

Consideration for admission into the undergraduate Interior Design curriculum requires completion of 29.5 credit freshman design core program, including the following courses: Dsn S 102, Dsn S 131, Dsn S 183, 6 credits of Social Science/Humanities, 6 credits of Math/Science, English 150 or 250 and Library 160. Admission is based on department resources and will be determined by a formal review at the end of the freshman foundation year.

Transfer students with studio credits from other programs, colleges, and universities must present for departmental review a portfolio of work done in those courses in order to have the credits apply toward studio requirements. Students are advised to present portfolio upon admission and prior to registration for classes. Arrangements for this process must be made with department advisers.

Cr.	Degree Requirements
36.5	General education total, including:
6	Biological and physical sciences and mathematics Math 104 or 105 or 140 or 150. Select from Astro 120, 150, Biol 111, 173, 211, 212, Bot 111, 265, Chem 160, 163, 163L, Com S 103, 107, Geol 100, 101, Gen 260, Math 104 or 150, 105, 140, 141, 151, Mteor 206, Phys 101, 106; Stat 101, 104 or any higher level course in these disciplines for which these courses are prerequisite
9.5	Communications Engl 150 and 250; Lib 160 Select from CmDis 286; ComSt 101, 102, Sp Cm 212
6	Humanities Select from Af Am 201, 252; Am In 310, Cl St – all courses, Dance 270, 360, Engl 201, 230, 231, 237, 335, 340, 346, 347, 348, 353, 354, 360, 361, 362, 363, 364, 373, 374, 375, 376, 377, 378, 379, 384, 389, WLC 101, 102, 110, 201, 202, 301, 302, Hist—all courses, Music 102, 302, 304, 383, 384, 472, Phil —all courses, Relig – all courses, T C 354, 355, Thtre 106, 110, 252, 465, 466, W S 336, 340, 345, 377, 422
6	Social sciences Select from Anthr 201, 202, 306; Econ 101, 102, Pol S 215, 230, 241, 251, Psych 101, 230, Soc 130 or 134, or any higher level course in these disciplines for which these courses are prerequisite, or select from Am In 210, Env S 201, 223, HD FS 102, 239, 276, 283, 349, 367, 370, 373, 377, 378, 380, 395, Jl MC 101, 205, 320, 453, 474, 476, W S 201, 301, 321, 323, 327, 346, 350, 385, 386, 401
9	Select from the above areas and/or CmDis 275, 286, ComSt 101, 102, 214, 310, 311, 314, 317, 318, Engl 205, 219, 220, 302, 303, 304, 305, 306, 309, 310, 314, 315, 316, Fin 361, 371, Mgmt 370, Mkt 340, Sp Cm 212, 305, 312, 321, 322, 323, 325, 327. Six credits must be at the 300 level or above.
11	Design Core Dsn S 102 (4 cr); Dsn S 131 (4 cr); Dsn S 183 (3 cr)
6	Select 2 history courses from Arch, Art H, Dsn S or LA
61	Interior Design Concentration, including:
2	Fundamentals of Interior Design—ArtID 250
2	Human Factors in Interior Design—ArtID 251
3	Interior Design History/Theory/Criticism I—ArtID 355
3	Interior Design History/Theory/Criticism II—ArtID 356
2	Graphic Communication for Interior Design I—ArtID 261
2	Graphic Communication for Interior Design II—-ArtID 262
2	Graphic Communication for Interior Design III—ArtID 263
4	Interior Design Studio I—ArtID 265
4	Interior Design Studio II—ArtID 267
4	Interior Design Studio III—ArtID 365
4	Interior Design Studio IV—ArtID 367
4	Interior Design Studio V—ArtID 465
4	Interior Design Studio VI—ArtID 467
3	Advanced Studies in Interior Design—ArtID 469
3	Interior Design Systems I: Materials—ArtID 350
3	Interior Design Systems II: Furniture & Millwork—ArtID 351
3	Interior Design Systems III: Lighting—ArtID 352
3	Interior Design Systems IV: Building Assemblies & Support—ArtID 353 Or
3	Materials and Assemblies I-Arch 240
1	Interior Design Internship Seminar—ArtID 360
3	Interior Design Internship—ArtID 460
2	Interior Design Professional Practices—ArtID 461
R	Sophomore Field Study—ArtID 259
R	Junior Field Study—ArtID 359
R	Senior Field Study—ArtID 459
6	Studio/Business Option Select 2 courses from Arch studio, ArtIS studio, or Mgmt/Mkt
3	Electives
128.5	Total credits

Curriculum in Landscape Architecture

The department offers graduate and undergraduate degree programs.

The undergraduate program consists of a five-year curriculum, requiring 149.5 credits, leading to the degree Bachelor of Landscape Architecture. These credits are distributed between a one-year pre-professional program of 29.5 credits and a four-year professional program of 120 credits.

Admission into the professional program depends upon available resources and is subject to the approval of a faculty committee at the completion of the pre-professional program. Applicants are reviewed on the basis of scholastic performance, a portfolio of original work, and a written essay.

The BLA from Iowa State University is an LAAB (Landscape Architectural Accreditation Board)-accredited professional degree program. In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for professional licensure. The LAAB is the sole entity recognized by the Council for Higher Education Accreditation to accredit U.S. first professional degree programs in landscape architecture at the Bachelor's and Master's levels.

The department also offers a 36 credit graduate program leading to the degree Master of Landscape Architecture. For more complete graduate program descriptions, see Graduate Study under Landscape Architecture in the Courses and Programs section.

Core Design Program

Cr.	Fall/Spring
4	Dsn S 102
4	Dsn S 131
3	Dsn S 183
6	Social Science/Humanities Electives
6	Math/Science Electives
6	English 150/250
0.5	Library 160
29.5	Required for professional program application
3	Additional electives recommended

Cr.	Fall second year
6	Landscape Interpretation and Representation—L A 201
3	Native Plants of the Midwest—LA 221
1	Developing Identity as Landscape Architect—LA 241
3	Cultural Landscape Studies—LA 272
3	Investigating Landscape Form, Process and Detail—LA 281
16	

Cr.	Spring second year
6	Site Planning and Design I—L A 202
3	The Social and Behavioral Landscape—L A 274
3	Introduced Plants of the Midwest—LA 222
3	Landscape Architecture History 1800-present—LA 371
3	Soils for Urban Use—Agron 156
18	

Cr.	Fall third year
6	Site Planning and Design II—L A 301
3	Shaping the Land—LA 381
3	Landscape Architecture History: Prehistory to 1800—LA 373
3	Landscape Change and Conservation—LA 465
3	Elective
18	

Cr.	Spring third year
6	Regional Landscape Design—L A 302
1	Contemporary Landscape Architecture—LA 341
3	LA Professional Elective
3	Social Science/Humanities Elective
3	Math 141 or Math 142/Science Elective
16	

Cr.	Fall fourth year
6	Urban Landscape Design—LA 402
2	Landscape Construction—LA 481
3	Social Science/Humanities
3	LA Professional Elective
3	Communication (300 level)
17	

Cr.	Spring fourth year
R	Landscape Architecture Professional Internship, Study Abroad, National Exchange—LA 451A, B, or C

Cr.	Fall fifth year
6	Community Landscape Design—LA 401
4	LA Professional Elective
3	Social Science/Humanities Elective (300 level)
3	Science/Math Elective
16	

Cr.	Spring fifth year
6	Interdisciplinary Design Studio (Dsn S 446), Advanced Landscape Architectural Design (LA 404), or Senior Thesis (LA 405
2	Professional Practice—LA 441
2	Advanced Landscape Construction—LA 482
6	Elective
16	
149.5	Total credits for BLA

College of Engineering

James E. Bernard, Interim Dean
Diane T. Rover, Associate Dean
Balaji Narasimham, Associate Dean
Loren W. Zachary, Assistant Dean
www.engineering.iastate.edu/

Departments of the College

For information on undergraduate options refer to the following curriculum sections, and for graduate specializations or certificate programs, refer to the Courses and Programs section of the catalog.

Aerospace Engineering
Agricultural and Biosystems Engineering
Chemical and Biological Engineering
Civil, Construction and Environmental Engineering
Electrical and Computer Engineering
Industrial and Manufacturing Systems Engineering
Materials Science and Engineering
Mechanical Engineering

Aligning Education in Engineering with the University Mission

The mission of Iowa State University is to create, share, and apply knowledge to make Iowa and the world a better place. Students will become broadly educated, global citizens who are culturally informed, technologically adept, and ready to lead. The College of Engineering echoes this philosophy and emphasizes preparing its graduates to meet the challenges of the 21st century.

Engineering education seeks to develop a capacity for objective analysis, synthesis, and design to obtain a practical solution. The engineering programs at Iowa State University are designed to develop the professional competence of a diverse student body and, by breadth of study, to prepare students to solve the technical problems of society while considering the ethical, social, and economic implications of their work at state, national and global levels.

The focus of each curriculum is to strengthen students' critical thinking, creative abilities, and communication skills. Students in engineering will have the opportunity for interdisciplinary and experiential learning through learning communities, service learning, internships and cooperative education, as well as research, capstone, and study abroad experiences.

The problem-solving skills learned from an engineering education at Iowa State University also provide an excellent launching pad for careers not only in engineering, but also medicine, law, business, and many other fields.

Each program is guided by the criteria developed by ABET, a non-governmental organization of peer reviewers which assures the quality of post secondary engineering education. The outcomes and objectives of the accredited engineering programs can be found in the Courses and Programs section of the catalog.

Registration as a professional engineer, which is granted by each individual state, is required for many types of positions. The professional curricula in engineering at Iowa State University are designed to prepare a graduate for subsequent registration in all states.

Seniors in accredited curricula of the College of Engineering are encouraged to take the Fundamentals of Engineering Examination toward professional registration during their final academic year. Seniors in engineering curricula who have obtained at least 6 semester credits in surveying may take the Fundamentals Examination for professional registration as land surveyors.

Concurrent Graduate/ Undergraduate Programs

Several engineering programs offer the opportunity for well-qualified undergraduate juniors and seniors to pursue a graduate degree in their program while finishing the undergraduate requirements. The programs offering concurrent undergraduate/graduate degrees are: agricultural engineering, civil engineering, computer engineering, electrical engineering, industrial engineering, mechanical engineering, and materials engineering.

Programs offering concurrent bachelor of science/master of business administration degrees are: civil engineering, computer engineering, electrical engineering, industrial engineering and mechanical engineering. For more information, refer to the graduate study sections for each engineering program. Advanced work in engineering is offered in the post-graduate programs. See the Graduate College section of this catalog.

Joint Undergraduate Programs

A bachelor of science degree in software engineering is offered in the College of Engineering and the College of Liberal Arts and Sciences. This program is jointly administered by the Department of Electrical and Computer Engineering and the Department of Computer Science.

Accreditation

Ten curricula in the College of Engineering are accredited by ABET. Two newer curricula will pursue accreditation. Accreditation status is indicated in the Courses and Programs section for each engineering curricula. For more information on accreditation practices contact:

Engineering Accreditation Commission
ABET
111 Market Place, Suite 1050
Baltimore, MD 21202-4012
Phone: 410-347-7700
http://www.abet.org

Organization of Curricula

All curricula in engineering are designed as four-year programs. They are structured in two phases: a basic program and a professional program. The basic program consists primarily of subjects fundamental and common to all branches of engineering and includes chemistry, physics, mathematics, engineering computations, and English. The professional phase of a curriculum includes intensive study in a particular branch of engineering, as well as a continuation of supporting work in mathematics, basic sciences, humanities, and social sciences.

Students should complete the requirements of the basic program before proceeding to a professional program.

Preparation for the Engineering Curricula

In addition to the standard university admission requirements, the college also requires 2 years of a foreign language. Other high school credits particularly important to students wishing to study engineering include: 2 years of algebra, 1 year of geometry, and 1/2 year of trigonometry and 1/2 year of pre-calculus; 1 year each of chemistry, biology, and physics; 3 years of social science, and 4 years of English. See Index for specific admission requirements.

Placement in mathematics, English, and chemistry will generally be based on high school preparation and test scores. Advanced placement is possible for exceptionally well-prepared students. Students who are not adequately prepared may be encouraged or required to take additional preparatory coursework and should expect to spend more than the customary time to complete the engineering program. Any coursework which is preparatory or remedial in nature cannot be used to satisfy credit requirements for graduation in any of the engineering curricula.

Basic Program for Professional Engineering Curricula

The first year program is much the same for all professional curricula in the College of Engineering. Students normally enroll in the majority of the basic program courses during their first year. The basic program is a set of courses common to all engineering curricula. Since students may also begin curriculum designated requirements during their first year, they will want to select a curriculum as soon as possible. This will enable them to receive the bachelor's degree in a minimum time.

Entering undergraduates must demonstrate proficiency in trigonometry based on test scores, or by having transfer credits from a college trigonometry course, or by passing either Math 141 or 142 before enrolling in Math 166 or C E 160.

The Department of English may recommend placement in one or more sections of Engl 101 if the placement test administered to students whose first language is not English indicates a deficiency in reading or writing. Satisfactory completion of the recommended course(s) will be required of students in the College of Engineering.

Basic Program

Cr.	
8	Mathematics 165, 166
6	English 150, 250
4	Chemistry 167 or 177*
3	Engineering 160, Aer E 160, CE 160, Cpr E 185, E E 185, S E 185, or I E 148**
5	Physics 221
R	Engineering 101***
0.5	Library 160
26.5	Total credits

Students without a strong high school chemistry background may opt to take a two course sequence of Chem 155 (3 cr.) and Chem 165 (4 cr.) to meet the Chem 167 (4 cr.) requirement.

English 250 is normally taken in the second year. However, students who advance place into this course may be able to enroll during their first year. Credit for English 150 is earned upon successful completion of English 250. In addition to the basic program courses listed above, curriculum designated courses normally taken the first year of each engineering curricula are listed below.

Curriculum Designated Requirements

Aerospace Engineering—Aer E 160**, Aer E 161 (4 cr.), Aer E 192 (R), GenEd Electives (3 cr)

Agricultural Engineering—Chem 167L (1 cr.), A E 110 (1 cr.), Engr 170 (3 cr.), SSH Elective (3 cr.)

Biological Systems Engineering—Chem 167L (1 cr.), BSE 110 (1 cr.), Engr 170 (3 cr.), SSH Elective (3 cr.)

Chemical Engineering—Chem 177*, 177L (1 cr.), 178 (3 cr.), 178L (1 cr.), SSH Elective (3 cr.)

Civil Engineering—Chem 167L (1 cr.) or Chem 177L (1 cr.)*, C E 105 (1 cr.), C E 160**, C E 170 (2 cr.), C E 111 (3 cr.), SSH Elective (3 cr.)

Computer Engineering—Cpr E 185** (3 cr.), Com S 227 (4 cr.), Cpr E 166 (R cr.), Gen Ed Elective (3 cr.)

Construction Engineering—Con E 121 (1 cr.), 122 (1 cr.), Psychology Elective – Psych 101, 230, or 280 (3 cr.), Engr 170 (3 cr.), SSH Elective (3 cr.)

Electrical Engineering—E E 185** (3 cr.), Com S 207 (3 cr.) or 227 (4 cr.), E E 166 (R cr.), Gen Ed Elective (3 cr.)

Industrial Engineering—I E 101 (R cr.), I E 148** (3 cr.), SSH Elective (6 cr.)

Materials Engineering—Chem 177*, 177L (1 cr.), 178 (3 cr.), 178L (1 cr.), Engr 170 (3 cr.), Gen Ed Elective (3 cr.), (Physics 221 scheduled in sophomore year.)

Mechanical Engineering—Chem 167L (1 cr.), Engr 170 (3 cr.), M E 102 (R cr.), Gen Ed Elective (3 cr.)

Software Engineering— S E 185** (3 cr.), 166 (R cr.), Com S 227 (4 cr.), 228 (3 cr.)

The student's adviser may require or recommend courses in addition to those specified above if the preparation and progress of the student are such that additional courses are necessary or desirable.

*Students planning to enroll in C E[1], Ch E, or Mat E will find Chem 177 to be a better preparation for Chem 178. However, Chem 167 is accepted as a substitute for 177 for those students declaring one of these curricula after having completed 167. The Chem 155-165 sequence is an acceptable substitute for Chem 167.

**Recommended choices by program:

Aer E: Aer E 160 (3 cr.)
C E: C E 160 (3 cr.)
Cpr E: Cpr E 185 (3 cr.)
E E: E E 185 (3 cr.)
I E: I E 148 (3 cr.)
S E: S E 185 (3 cr.)

Credit hours for graduation will be given for any one of Aer E 160, C E 160, Engr 160, I E 148, Cpr E 185, E E 185, or S E 185 without increasing a curriculum's minimum number of credits required for graduation.

***Students enrolled in the joint software engineering degree program will take S E 101.

[1]Students in the general emphasis in C E have two chemistry/physics sequence options. The environmental emphasis requires Option 1.

Option 1—Chem 177, 177L, 178, 178L, and Phys 221.

Option 2—Chem 167, 167L; or Chem 177, 177L; and Phys 221 and 222. Students who opt for Phys 222 rather than Chem 178, 178L will increase the total number of credits required by 1.

Requirement for Entry into Professional Program

Students enrolled in the College of Engineering must satisfy both of the following requirements before enrolling in the professional courses (200-level and above) offered by departments in the Engineering College:

1. Completion of the basic program with a grade point average of 2.00 or better in the basic program courses.
2. A cumulative grade point average of 2.00 or better for all courses taken at Iowa State University.

The following are the only exceptions to this rule:

a. Students who have completed all of their coursework while enrolled in the College of Engineering, but have not met the two basic program requirements, may enroll for not more than two semesters in 200-level or above courses offered by departments in the College of Engineering.

b. Students transferring to the College of Engineering from another college or university, or from a program outside this college, who have not met the two basic program requirements may also enroll for not more than two semesters in 200-level or above courses offered by departments in the College of Engineering. However, they may be granted an additional semester upon review by the college.

c. Iowa State students not pursuing an engineering degree may generally take engineering courses without restrictions provided they meet the prerequisites and space is available.

d. Only the first two semesters of 200-level and above engineering courses, taken at ISU while a student is not enrolled in the College of Engineering, can be applied toward an engineering degree.

Requirement for Graduation

In order to graduate in a professional engineering curriculum, students must have a minimum GPA of 2.00 in a department-designated group of 200-level and above courses known as the Core. These courses will total no fewer than 24 nor more than 48 semester credits.

Engineering Minors

The College of Engineering offers three undergraduate minors which are open only to students in the College of Engineering. These are minors in bioengineering, nondestructive evaluation, and nuclear engineering. These minors must include at least nine credits which are beyond the total used to meet curriculum requirements.

The bioengineering minor is a 15 credit interdisciplinary program that complements a student's major discipline by providing additional insight into the interactions between various engineering disciplines and biological systems. The minor is administered by a supervisory faculty committee. For minor course requirements, refer to Bioengineering in Courses and Programs.

The nondestructive evaluation minor is a 16 credit minor open only to engineering students who have met the basic program requirements and are not on academic warning or probation. The minor is supervised by an interdisciplinary faculty committee. For minor course requirements, refer to Aerospace Engineering in Courses and Programs for minor course requirements.

The nuclear engineering minor is a 15 credit minor which enables engineering students to acquire a basic and fundamental knowledge of nuclear sciences and engineering. Courses are provided at Iowa State University and also through an inter-institutional distance education program offered through the Web by four of the Big 12 Engineering Consortium Schools. For minor course requirements, refer to Nuclear Engineering in *Courses and Programs*.

Minor for Non-Engineers

The College of Engineering also offers an undergraduate minor in engineering studies which is open only to students outside of the College of Engineering.

The engineering studies minor is a 21 credit interdepartmental minor. A student's minor program in engineering studies must include at least nine credits which are beyond the total used to meet minimum degree requirements. The minor is supervised by an interdepartmental faculty committee. Refer to Engineering Studies in Courses and Programs for minor course requirements.

Undergraduate Majors and Minors Outside the College of Engineering

In addition to the engineering degree program, students may earn majors or minors in other colleges of the university. A major or minor program must meet all requirements of the offering department or program and its college and contain credits beyond the requirements for a B.S. degree in engineering. A minimum of 15 additional credits is required for each major area of study and an additional 9 credits for each minor.

Advising System

The purpose of the advising system in the College of Engineering is to work constructively with students in developing their individual academic programs and to maintain close contact with students during their college careers.

The college offers an orientation program during the spring and summer for students planning to enter in the fall, and during the fall for students planning to enter in the spring. All entering students are encouraged to attend an orientation session. Placement assessments given during the orientation program help determine the student's level of achievement and enable the adviser to prepare an appropriate program for the student.

Special Programs

All engineering students are strongly encouraged to participate in either the cooperative education or internship programs. Students who are qualified to participate in the engineering honors program are also urged to do so. These programs are integrated into the professional engineering curricula and may require additional work. However, both these professional and academic programs offer opportunities that will enrich the standard academic experience. Engineering students are also encouraged to take advantage of study abroad opportunities available through the College of Engineering's International Programs Office.

a. Cooperative Education Program. The College of Engineering offers, through its curricula, a cooperative education program. Enrollment in the program allows students to gain practical experience in their career field while attending college. In general, students enrolled in the co-op program will require an additional year to complete curriculum requirements.

   These programs are arranged so that the student alternates academic work with employment periods. The student has the opportunity to assess career paths within her/his chosen curriculum and the employer evaluates the student's potential as a future full-time employee. Both domestic and international co-op programs are available.

   Cooperative education students pay no fees to the university during their work periods and do not receive credit hours for their work experience. Students register for a non-credit cooperative education course (298, 398, or 498) for each work period and are considered full time students while enrolled in these courses. For additional information contact your academic adviser and the Office of Engineering Career Services.

b. Internship Program. Internships are a mechanism by which a student may work full-time for one semester per academic year while maintaining her/his status as a full-time student.

   Internship students pay no fees to the university during their work periods and do not receive credit hours for their work experience. Students who register for the internship course (397) for a fall or spring semester work period or (396) for the summer term are considered to be full time students. For additional information contact your academic adviser and the Office of Engineering Career Services.

c. Honors Program. The College of Engineering participates in the University Honors Program (see Index). The honors program is designed for students with above average ability who wish to individualize their programs of study. For further details consult the chair of the Engineering College Honors Program Committee or your departmental honors program adviser.

d. Engineering International Programs. In a world where the sun never sets, engineers must be prepared to understand other cultures and other ways of doing business. Engineers must expand their exportable skills, language and cross-cultural skills.

   Engineering International Programs (EIP) has formed worldwide partnerships to create opportunities for students to work and study with leading universities in other countries and multinational corporations. With careful planning, students may earn credit in courses that fulfill their degree requirements. To learn more about work and study with leading universities in other countries and multinational corporations, visit the EIP home page at www.eng.iastate.edu/intl-progs/.

e. Engineering Leadership Program. Started in the Fall Semester of 2006, the Engineering Leadership Program (ELP) was developed to address the growing need for leaders trained in technology. Initial funding for the program was provided by 3M Company with additional funding from other corporate and private sources. Students selected into the ELP have opportunities to interface with engineers and company leadership of the donating companies. Mentored by a faculty and a peer mentor, each student receives individual direction and insight on academics, leadership opportunities, career paths and life skills. They are encouraged to develop their individual leadership styles and leadership competencies, while interacting with industry, government, faculty and student leaders. Incoming freshmen may apply the spring prior to their first fall semester at Iowa State University. Current Iowa State students may apply to be upper-level scholars each spring. Visit the ELP website at: http://www.eng.iastate.edu/leadership/ .

Curriculum in Aerospace Engineering

Leading to the degree bachelor of science.

Total credits required: 126.5. See also *Basic Program and Special Programs.*

International Perspectives[1]: 3 cr.
U.S. Diversity[1]: 3 cr.

Communication Proficiency and Library requirements: Engl 150 and Engl 250 with minimum grade of C ; Lib 160. Department approval. (See Basic Program for credit requirements.)

General Education Electives: 15.0 cr[2]
Complete 15 cr. including a series. A series of at least two courses must be taken to fulfill this requirement.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Aer E 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See Basic Program rule.

Math and Physical Science: 13 cr.
Math 265, 4 cr.; Math 267, 4 cr.; Phys 222, 5 cr.

Aerospace Engineering Core: 48 cr.
Aer E 243, 3 cr. and Aer E 243L 0.5 cr.; Aer E 261, 4 cr.; Aer E 311, 3 cr. and Aer E 311L, 0.5 cr.; Aer E 321, 3 cr.; Aer E 331, 3 cr.; Aer E 343, 3 cr. and Aer E 343L, 1 cr.; Aer E 351, 3 cr.; Aer E 355, 3 cr.; Aer E 411, 3 cr.; Aer E 421, 3 cr.; Aer E 361, 3 cr.; Aer E 461, 3 cr.; Aer E 462, 3 cr.; E M 324, 3 cr.; M E 330, 3 cr.

Other Remaining Courses: 24 cr.
E M 274, 3 cr.; E M 345, 3 cr.; Mat E 272, 2 cr.; Aer E 161, 4 cr. Complete 3 cr., from Aer E 412, 3 cr.; Aer E 422, 3 cr.; Aer E 423, 3 cr.; Aer E 426, 3 cr.; Aer E 432, 3 cr.; Aer E 442, 3 cr.; Aer E 446, 3 cr.; Aer E 451, 3 cr. or Aer E 464. Technical Electives, 3 cr. and Career Electives, 6 cr. selected from preceding Aer E list or departmental-approved 300-level or above courses relevant to technical and career areas.

Seminar/Co-op/Internships:
Aer E 192, R cr.; Aer E 291, R cr.; Aer E 292, R cr., Aer E 391, R cr., Aer E 392, R cr., Aer E 491, R, cr. and Aer E 492, R cr.

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also allowed by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4] 2.00 required including transfer courses.

Curriculum in Agricultural Engineering

Administered by the Department of Agricultural and Biosystems Engineering.

Leading to the degree bachelor of science.

Total credits required: 127.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]
U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with a minimum grade of C; Lib 160. (See *Basic Program* for credits.) Complete one course from AgEds 311, Engl 309, Engl 314 or Sp Cm 212.

Social Sciences and Humanities: 12 cr.[2]
Complete 3 cr. from international perspectives and 3 cr. from U.S. diversity university-approved list. Complete additional 6 cr. Social Sciences and Humanities courses.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Engr 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 9 cr.
Chem 167L, 1 cr. or Chem 177L, 1 cr.; Phys 222, 5 cr.; and Stat 305, 3 cr.

Ag Engineering Core: 24 cr.[4]
A E 216, 3 cr.; A E 316, 3 cr.; A E 363, 4 cr.; A E 415, 2 cr.; A E 416, 2 cr.; E M 274, 3 cr.; E M 324, 3 cr.; E M 327, 1 cr.; Math 266, 3 cr.

Other Remaining Courses: 16 cr.
A E 110, 1 cr.; A E 201, 1 cr.; A E 301, 1 cr.; A E 401, 1 cr.; A E 404, 3 cr.; Engr 170, 3 cr.; M E 330, 3 cr. Complete one course (3 cr.) from AgEds 311, Engl 309, Engl 314 or Sp Cm 212.

Select remaining courses from one of the following options:

Agricultural and Environmental Systems Engineering Option: 40 cr.
A E 271, 1 cr. or A E 272, 1 cr.; A E 431, 3 cr.; A E 431, 3 cr.; A E 472, 3 cr.; Biol 211, 3 cr.; C E 332, 3 cr.; C E 372, 4 cr.; E M 378, 3 cr. Complete one course (3 cr.) from A E 340, A E 478, or BSE 480. Complete 3 cr. from Biological and Natural Resource Sciences list.[2]

Power and Machinery Engineering Option: 40 cr.
A E 271, 1 cr. or A E 272, 1 cr.; A E 340, 3 cr.; A E 342, 3 cr.; A E 413, 3 cr.; Agron 154, 3 cr.; Biol 211, 3 cr.; E M 345, 3 cr.; E M 378, 3 cr.; M E 324, 4 cr.; M E 325, 3 cr.; Mat E 272, 2 cr. Complete one course (3 cr.) from A E 431, A E 469, A E 472 or 478, or A E 480. Complete six credits of electives.[2]

Co-op/Internships (Optional)

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See *Basic Program for Professional Engineering Curricula* for accepted substitutions for curriculum designated courses in the Basic Program.

[4] 2.00 required including transfer courses.

Curriculum in Biological Systems Engineering

Administered by the Department of Agricultural and Biosystems Engineering.

Leading to the degree bachelor of science.

Total credits required: 127.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with a minimum grade of C; Lib 160. (See *Basic Program* for credits.) Complete one course from AgEds 311, C E 203, Engl 309, or Sp Cm 212.

Social Sciences and Humanities: 12 cr. [2]
Complete 3 cr. from international perspectives and 3 cr. from U.S. diversity university-approved list. Complete additional 6 cr. Social Sciences and Humanities courses.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 , 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Engr 160, 3 cr.c; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule.)

Biological, Math and Physical Science: 20 cr.
Biol 212, 3 cr.; Chem 167L, 1 cr.; Math 267, 4 cr.; Phys 222, 5 cr.; and Micro 302, 3 cr., Micro 302L, 1 cr., Stat 305, 3 cr.

Biological Systems Engineering Core: 26 cr.[4]
A E 316, 3 cr.; A E 363, 4 cr.; A E 404, 3 cr.; BSE 201, 1 cr.; BSE 216, 3 cr.; BSE 301, 1 cr.; BSE 380, 3 cr.; BSE 401, 1 cr.; BSE 415, 2 cr.; BSE 416, 2 cr.; BSE 480, 3 cr.

Other Remaining Courses: 23 cr.
BSE 110, 1 cr.; Ch E 356, 3 cr.; Ch E 357, 3 cr.; Engr 170, 3 cr.; E M 274, 3 cr.; E M 324, 3 cr.; E M 327, 1 cr.; M E 330, 3 cr. Complete one course (3 cr.) from AgEds 311, C E 203, Engl 309, or Sp Cm 212.

Complete remaining courses from one of the following options:

Biorenewable Resources Engineering Option: 20 cr.
A E 388, 3 cr. BSE 403, 3 cr.; Chem 331, 3 cr.; Chem 331L, 2 cr.; Chem 332, 3 cr. Complete 6 credits for option electives.[2]

Bioenvironmental Engineering Option: 20 cr.
A E 431, 3 cr. C E 326, 3 cr.; Chem 211, 2 cr.; Chem 211L, 2 cr.; Chem 231, 3 cr.; Chem 231L, 1 cr. Complete 3 cr. from A E 436, C E 421, C E 428, or EnSci 381. Complete 3 credits for remaining option elective. [2]

Food Engineering Option: 20 cr.
AE 451, 3 cr.; BSE 469, 3 cr.; Chem 231, 3 cr.; FSHN 311, 4 cr.; FSHN 420, 3 cr.; FSHN 471, 3 cr. Select 1 credit to complete option elective.

Pre-Professional and Pre-Graduate Option: 19-20 cr.
Chem 331, 3 cr.; Chem 331L, 1 cr.; Chem 332, 3 cr.; Chem 332L, 1 cr. Complete 3 credits from A E 406 or BSE 403. Complete 8 to 9 credits for remaining option electives. [2]

Co-op/Internships (Optional)

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4] 2.00 GPA required including transfer courses.

Curriculum in Chemical Engineering

Administered by the Department of Chemical and Biological Engineering

Leading to the degree bachelor of science.

Total credits required: 125.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]
U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250; Lib 160. (See Basic Program for credit requirements.) Complete one course from Engl 309, 3 cr.; Engl 314, 3cr.; or JL MC 347, 3 cr.

Social Sciences and Humanities: 15 cr.
Complete a total of 15 cr. with at least 6 cr. but not more than 9 cr. from the same department.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Engr 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See Basic Program rule.)

Math and Physical Science: 30 cr.
Math 265, 4 cr.; Math 267, 4 cr.; Phys 222, 5 cr.; Chem 167L, 1 cr. or Chem 177L, 1 cr.; Chem 178, 3 cr.; Chem 178L, 1 cr.; Chem 325, 3 cr.; Chem 331, 3 cr.; Chem 332, 3 cr.; BBMB 301, 3 cr.

Chemical Engineering Core: 33 cr.[4]
Ch E 210, 3 cr.; Ch E 302, 1 cr.; Ch E 310, 3 cr.; Ch E 325, 2 cr.; Ch E 356, 3 cr.; Ch E 357, 3 cr.; Ch E 358, 3 cr.; Ch E 381, 3 cr.; Ch E 382, 3 cr.; Ch E 421, 3 cr.; Ch E 426, 2 cr.; Ch E 430, 4 cr.

Other Remaining Courses: 21 cr.
Complete one course from Engl 309, 3 cr.; Engl 314 3 cr. or JL MC 347, 3 cr.
Complete 3 cr. from Chemistry Electives list.[2]
Complete 3 cr. from Statistical Electives list.[2]
Complete 3 cr. from Chemical Engineering

Electives list.[2] Complete 3 cr. from any 300+ level course in engineering.[2] Complete 6 cr. from Professional Electives list.[2]

Biological Engineering Option
The standard Chemical Engineering program may be modified to meet the option requirements for Biological Engineering:

Math and Physical Science – BBMB 404 or Biol 313, 3 cr., may be substituted for BBMB 301 from list above.

Chemical Engineering Core – Replace Ch E 426, 2 cr. with Ch E 427, 2 cr. in required Core.

Other Remaining Courses:
Chemistry Electives, 3 cr. - BBMB 405 (prerequisite 404), BBMB 420 (prerequisite 301), or Biol 314.
Chemical Engineering Electives, 3 cr. – Ch E 415, Ch E 440, Ch E 542 or Ch E 562.
Engineering Electives, 3 cr. – A E 373, A E 480, BRT 501, C E 421, or MSE 580.
Professional Electives, 6 cr. – Ch E 415, Ch E 440, Ch E 542, Ch E 562, or Ch E 490; and one course from 300-level, or above, life sciences (not BBMB 301), 300- or above level course in Chem, FS HN or BBMB.

Co-op/Internships: Optional

[1]These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program.
U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2]Choose from department approved list.

[3]See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4]2.00 required including transfer courses.

Curriculum in Civil Engineering (General)

Administered by the Department of Civil, Construction and Environmental Engineering.

Leading to the degree bachelor of science.

Total credits required: 131.5* See also *Basic Program and Special Programs.*

International Perspectives: 3 cr.[1]
U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with minimum grade of C); Lib 160. (See Basic Program for credit requirements.)

Social Sciences and Humanities: 12 cr.[2]
Complete 12 cr. with 6 cr. at 200-level or above.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; C E 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See Basic Program rule.)

Math and Physical Science: 17 cr. (18 cr.)*
Chem 177L, 1 cr.; Chem 178, 3 cr. and Chem 178L, 1 cr., or Phys 222 5 cr.; Geol 201, 3 cr.; Math 266, 3 cr. Complete 3 cr. Statistics Electives[2]. Complete 3 cr. Numerical Analysis Electives[2].

C E Engineering Core: 30 cr.[4]
E M 274, 3 cr.; E M 324, 3 cr.; E M 345, 3 cr.; E M 378, 3 cr. C E 305, 3 cr.; C E 326, 3 cr.; C E 332, 3 cr.; C E 355, 2 cr.; C E 360, 3 cr.; and C E 372, 4 cr.

Other Remaining Courses: 45 cr.
C E 105, 1 cr.; C E 111, 3 cr.; C E 170, 2 cr.; C E 205, 3 cr.; C E 306, 3 cr.; C E 333, 3 cr.; C E 334, 3 cr.; C E 382, 3 cr.; C E 453, 4 cr.; C E 485, 2 cr.; C E 486, 3 cr.; E M 327, 1 cr.; Sp Cm 212, 3 cr. Complete 11 cr. Engineering Topics Electives.[2]

Seminar/Co-op/Internships: R cr.
C E 403, R. cr.

Co-op/Internship optional.

[1]These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program.
U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2]Choose from department approved list.

[3]See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4]2.00 required including transfer courses.

* Note: Students who opt for Phys 222 rather than Chem 178, 178L will complete 18 cr. here which will increase the total number of credits required by 1.

Curriculum in Civil Engineering with Environmental Option

Administered by the Department of Civil, Construction and Environmental Engineering.

Leading to the degree bachelor of science.

Total credits required: 130.5. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement: Engl 150 and Engl 250 with minimum grade of C); Lib 160. (See Basic Program for credit requirements.)

Social Sciences and Humanities: 12 cr.[2]
Complete 12 cr. with 6 cr. at 200-level or above.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; C E 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 26 cr.
Chem 177L, 1 cr.; Chem 178, 3 cr. and Chem 178L, 1 cr., Biol 173 or 211, 3 cr.; Chem 231, 3 cr., and Chem 231L, 1 cr.; Geol 201, 3 cr.; Math 266, 3 cr.; Micro 201, 2 cr. Complete 3 cr. Statistics Electives[2]. Complete 3 cr. Numerical Analysis Electives[2].

C E/Env Engineering Core: 27 cr.[4]
E M 274, 3 cr.; E M 324, 3 cr.; E M 378, 3 cr.; C E 305, 3 cr.; C E 326, 3 cr.; C E 332, 3 cr.; C E 355, 2 cr.; C E 360, 3 cr.; and C E 372, 4 cr.

Other Remaining Courses: 39 cr.
C E 105, 1 cr.; C E 111, 3 cr.; C E 170, 2 cr.; C E 205, 3 cr.; C E 306, 3 cr.; C E 334, 3 cr.; C E 382, 3 cr.; C E 420, 3 cr.; C E 421, 3 cr.; C E 428, 3 cr.; C E 485, 2 cr.; C E 486, 3 cr.; E M 327, 1 cr.; Sp Cm 212, 3 cr. Complete 3 cr. Engineering Topics Electives.[2]

Seminar/Co-op/Internships: R cr.
C E 403, R. cr.

Co-op/Internship optional.

[1]These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program.
U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2]Choose from department approved list.

[3]See *Basic Program for Professional Engineering Curricula* for accepted substitutions for curriculum designated courses in the Basic Program.

[4]2.00 required including transfer courses.

Curriculum in Computer Engineering

Administered by the Department of Electrical and Computer Engineering.

Leading to the degree bachelor of science.

Total credits required: 126.5 See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement: Engl 150 and Engl 250 with minimum grade of C; Lib 160. (See *Basic Program* for credit requirements.) Engl 314 or Engl 309 with a minimum grade of C.

General Education Electives: 15 cr.[2]
Complete minimum of 6 cr. from Approved General Education Component at 300 or higher level. Complete additional 9 cr. from Approved General Education Component.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Cpr E 185, 3 cr.c; Lib 160, 0.5 cr.; Math 165, 4 cr. (minimum grade of C-) and Math 166, 4 cr. (minimum grade of C-); and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 20 cr.
Com S 227, 4 cr. (minimum grade of C-) and Com S 228, 3 cr. (minimum grade of C-). Math 265, 4 cr.; Math 267, 4 cr.; and Phys 222, 5 cr.

Computer Engineering Core: 33 cr.[4]
Cpr E 281, 4 cr.; Cpr E 288, 4 cr.; Cpr E 308, 4 cr.; Cpr E 310, 3 cr.; Cpr E 381, 4 cr.; Com S 309, 3 cr.; Com S 311, 3 cr.; E E 201, 4 cr.; and E E 230, 4 cr.

Other Remaining Courses: 32 cr.
Cpr E 491, 3 cr. and Cpr E 492, 2 cr. Engl 314, 3 cr. or Engl 309, 3 cr. with a minimum grade of C.
Complete 3 cr. of Computer Science courses, 6 cr. of Computer Engineering, 9 cr. of Technical Electives, and 3 cr. of Electrical Engineering courses.b Stat 330, 3 cr.

Seminar/Co-op/Internships:
Cpr E 166, R cr. Cpr E 294, R cr., Cpr E 394, R cr. and Cpr E 494, R cr.

Co-op or internship is optional.

Outcomes Assessment - Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses.

Transfer Credit Requirements
The degree program must include a minimum of 30 credits at the 300-level or above in professional and technical courses earned at ISU in order to receive a B.S. in computer engineering. These 30 credits must include Cpr E 491. Senior Design Project I and Professionalism, Cpr E 492 Senior Design Project II, and credits in the core professional curriculum and/or in technical electives. The Electrical and Computer Engineering Department requires a grade of C or better for any transfer credit course that is applied to the degree program.

[1]These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass, but are used to meet the general education electives.

[2]Choose from department approved lists.

[3]See *Basic Program for Professional Engineering Curricula* for accepted substitutions for curriculum designated courses in the *Basic Program*.

[4]2.00 required including transfer courses.

Note: International perspectives and U.S. diversity courses are used to meet the general education electives.

Curriculum in Construction Engineering

Administered by the Department of Civil, Construction, and Environmental Engineering.

Leading to the degree bachelor of science.

Total credits required: Building Option –123.5, Heavy Option – 123.5, Electrical – 126.5, Mechanical – 125.5 cr.

See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirements: Engl 150 and Engl 250 with minimum grade of C; Lib 160. (See *Basic Program* for credit requirements.) Business Communication Elective: one course from Engl 302, Engl 309 or Engl 314 with a minimum grade of C.

Social Sciences and Humanities: 12 cr.
Complete one of Psych 101, Psych 230, Psych 250, or Psych 280. Complete either Econ 101 or Econ 102. Complete 3 cr. from international perspectives and 3 cr. from U.S. diversity approved list.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; C E 160, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 11 cr. (B, H); 12 cr. (E, M).
Stat 105, 3 cr.; Math 266, 3 cr. (B, H); Math 267, 4 cr. (E, M); Phys 222, 5 cr.

Construction Engineering Core: 24 cr. (B, H, E); 25 cr. (M)[4].
E M 274, 3 cr.; E M 324, 3 cr.; Con E 421, 3 cr.; E M 378, 3 cr.; C E 332, 3 cr.; (See options for remaining option Core courses.)

Additional Required Courses: 35 cr. (B, H), 36 cr. (E, M)
Con E 121, 1 cr.; Con E 122, 1 cr.; C E 170,| 2 cr.; C E 111, 3 cr.; Acct. 284, 3 cr.; Con E 221, 4 cr.; Con E 241, 3 cr.; Con E 251, 1 cr. Complete one 3 cr. Law Elective.[2].; Con E 441, 3 cr.; Con E 487, 2 cr. and Con E 488, 3 cr.; Complete one 3 cr. Business Communication Elective from Engl 302, 309, or 314[2]. Complete one course from Math or Stat Elective, 3 cr. (B, H); 4 cr. (E, M)[2]

Select remaining courses from one of the following options:

Building Option:
Remaining Core courses (9 cr.)
C E 360, 3 cr.; Con E 322, 3 cr.; Con E 340, 3 cr.
Remaining option courses – 15 cr.
C E 333, 3 cr.; C E 334, 3 cr.; C E 383, 1 cr.; Con E 352, 3 cr.; Con E 353, 2 cr.; E M 327, 1 cr.; Complete 2 cr. from Engineering Topics Electives.[2]

Heavy Option:
Remaining Core courses (9 cr.)
C E 360, 3 cr.; Con E 322, 3 cr.; and Con E 340, 3 cr.
Remaining option courses – 15 cr.
C E 333, 3 cr.; C E 334, 3 cr.; C E 382, 3 cr.; E M 327, 1 cr. Complete 5 cr. of Engineering Topics Electives[2].

Electrical Option:
Remaining Core courses (9 cr.)
M E 231, 3 cr.; E E 303, 3 cr. and E E 456, 3 cr.
Remaining option courses – 16 cr.
Con E 352, 3 cr.; Con E 353, 2 cr.; E E 201, 4 cr. E E 230, 4 cr. and E E 457, 3 cr.

Mechanical Option:
Remaining Core courses (10 cr.)
M E 231, 3 cr., M E 436, 4 cr., and M E 441, 3 cr.
Remaining option courses – 14 cr.
Con E 352, 3 cr.; Con E 353, 2 cr; E E 442, 2 cr. and E E 448, 2 cr.; M E 442, 3 cr.
Complete 2 cr. of Engineering Topics Electives.

Co-op/Internships - Optional

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See *Basic Program for Professional Engineering Curricula* for accepted substitutions for curriculum designated courses in the *Basic Program*.

[4] 2.00 required including transfer courses

Curriculum in Electrical Engineering

Administered by the Department of Electrical and Computer Engineering.

Leading to the degree bachelor of science.

Total credits required: 126.5 See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement: Engl 150 and Engl 250 with minimum grade of C; Lib 160. (See *Basic Program* for credit requirements.) Engl 314 or Engl 309 with a minimum grade of C.

General Education Electives: 15 cr.[2]
Complete minimum of 6 cr. from Approved General Education Component at 300 or higher level. Complete additional 9 cr. from Approved General Education Component.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; E E 185, 3 cr.c; Lib 160, 0.5 cr.; Math 165, 4 cr. (minimum grade of C-) and Math 166, 4 cr. (minimum grade of C-); and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 16 cr.
Com S 207, 3 cr. or Com S 227, 4 cr. (minimum grade of C-), Math 265, 4 cr.; Math 267, 4 cr.; and Phys 222, 5 cr.

Electrical Engineering Core: 37 cr.[4]
Cpr E 281, 4 cr.; Cpr E 288, 4 cr.; E E 201, 4 cr.; E E 230, 4 cr.;E E 224, 4 cr.; E E 303, 3 cr.; E E 311, 4 cr.; E E 322, 3 cr.; E E 330, 4 cr. or E E 331, 4 cr.; and E E 332, 3 cr.

Other Remaining Courses: 32 cr.
E E 491, 3 cr. and E E 492, 2 cr. Engl 309, 3 cr. or Engl 314, 3 cr. with a minimum grade of C.
I E 305, 3 cr.
Complete one 3 cr. course from Math Electives list.[2]
Complete 12 cr. from EE/Cpr E Technical Elective list including one approved sequence.[2]
Complete 6 additional credits from Math Electives list, EE/Cpr E Technical Elective list and/or non-EE/CprE Electives list.[2]

Seminar/Co-op/Internships:
E E 166, R cr. E E 294, R cr., E E 394, R cr. and E E 494, R cr. Co-op or internship is optional.

Outcomes Assessment - Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses.

Transfer Credit Requirements
The degree program must include a minimum of 30 credits at the 300-level or above in professional and technical courses earned at ISU in order to receive a B.S. in electrical engineering. These 30 credits must include E E 491 Senior Design Project I and Professionalism, E E 492 Senior Design Project II, and credits in the core professional curriculum and/or in technical electives. The Electrical and Computer Engineering Department requires a grade of C or better for any transfer credit course that is applied to the degree program.

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved lists.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4] 2.00 required including transfer courses.

Note: International perspectives and U.S. diversity courses are used to meet the general education electives.

Curriculum in Industrial Engineering

Administered by the Department of Industrial and Manufacturing Systems Engineering.

Leading to the degree bachelor of science.

Total credits required: 120.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirements:
Engl 150 and Engl 250 with minimum grade of C; Lib 160.

Remaining Communication courses: 6 cr.
Engl 314, 3 cr.; Sp Cm 212, 3 cr.

Social Sciences and Humanities: 12 cr.[2]
Six of twelve credits must be from 200-level or above courses. Six credits must be sequential or related courses.

Basic Program: 26.5 cr.[4]
Chem 167, 4 cr.[3]; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements), Engr 101, R cr.; I E 148, 3 cr.[3], Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 17 cr.
Math 265, 4 cr.; Math 267, 4 cr.; Phys 222, 5 cr.; Stat 231, 4 cr.

Industrial Engineering Core: 31 cr.
I E 248, 3 cr.; I E 271, 3 cr.; I E 305, 3 cr.; I E 312, 3 cr.; I E 413, 4 cr., I E 341, 3 cr.; I E 348, 3 cr.; I E 361, 3 cr.; I E 441, 3 cr.; I E 448, 3 cr.

Other Remaining Courses: 28 cr.
Mat E 272, 2 cr.; E M 274, 3 cr.; E E 442, 2 cr.; M E 330, 3 cr.; Focus Electives , 6 cr.[2]; Management Electives, 6 cr.[2]; and Engineering Topic Electives, 6 cr.[2]

Seminar/Co-op/Internships:

I E 101, R cr. Optional co-op/internship courses.

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also allowed by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

[4] 2.00 required including transfer courses.

Curriculum in Materials Engineering

Administered by the Department of Materials Science and Engineering.

Leading to the degree bachelor of science.

Total credits required: 127.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with minimum grade of C; Lib 160. (See *Basic Program* for credit requirements.) Complete one course from Engl 302, 309, 314 or JL MC 347 with a minimum grade of C.

General Education Electives: 15 cr.
Complete 12 cr. from approved list with a minimum of 6 cr. but no more than 9 cr. from one designator, and a maximum of 9 cr. of 100-level courses[2] . Complete one course from Engl 302, 309, 314 or JL MC 347.[4]

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Engr 160, 3 cr.c; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See Basic Program rule.)

Math and Physical Science 18 cr.
Complete Chem 177L, 1 cr.; Chem 178, 3 cr. and Chem 178L, 1 cr.; Math 265, 4 cr.; Math 267, 4 cr.; and Phys 222, 5 cr.

Materials Engineering Core: 32 cr.[4]
Mat E 201, R cr.; Mat E 214, 3 cr.; Mat E 215, 3 cr.; Mat E 215L, 1 cr.; Mat E 216, 4 cr.; Mat E 311, 3 cr.; Mat E 314, 3 cr.; Mat E 316, 3 cr.; Mat E 317, 3 cr.; Mat E 413, 3 cr., Mat E 414, 3 cr., Mat E 418, 3 cr.

Other Courses: 12 cr.
Engr 170, 3 cr.; E M 274, 3 cr.; E M 324, 3 cr.; Complete 3 cr. from non-remedial courses.

Seminar/Co-op/Internships
Co-op and internships are optional.

Option Requirements: 18 cr.
Students must choose two from the four areas of specialization: ceramic, electronic, metallic and polymeric materials. In lieu of the second specialty from the four listed, a student may propose an individually designed, materials related technical specialty to meet specific career goals. Students must have a 3.00 gpa and a B+ in Mat E 215. Students may learn other requirements and procedures for applying in the Undergraduate Handbook or by speaking with their adviser. The options below meet that expectation by using the following specialization courses:

Ceramic Materials: 321, 322, 425
Electronic Materials: 334, 332, 433
Metallic Materials: 342, 443, 444
Polymeric Materials: 351, 453, 454

Technical Electives: 6 cr.
Complete 6 cr. technical electives from approved departments.[2]

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the *Basic Program*.

[4] 2.00 required including transfer courses.

Note: A Mat E student may take up to 9 credit hours from General Education and free electives on a P/NP basis, except for courses used to meet the diversity and international perspectives requirement. S/F courses (different from P/NP) will be considered for these requirements on a course-by-course basis.

Curriculum in Mechanical Engineering

Leading to the degree bachelor of science.

Total credits required: 128.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with minimum grade of C); Lib 160. (See Basic Program for credit requirements.)

Remaining Communication Courses: 3 cr.
Engl 314, 3 cr.

General Education Electives: 15 cr.
Econ 101, 3 cr. or Econ 102, 3 cr.
Complete 3 additional credits of Social Science Electives.[2]
Complete 6 cr. of Humanities Electives.[2]
Complete 3 additional General Education credits.[2]

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; Engr 160, 3 cr.c; Lib 160, 0.5 cr.; Math 165, 4 cr. and Math 166, 4 cr.; and Phys 221, 5 cr. (See *Basic Program* rule)

Math and Physical Science: 20 cr.
Engr 170, 3 cr.; Chem 167L, 1 cr. or Chem 177L, 1 cr.; Math 265, 4 cr.; Math 267, 4 cr. or Math 266, 3 cr. with Math 268, 1 cr.; Phys 222, 5 cr.; Stat 305, 3 cr.

Mechanical Engineering Core: 46 cr.[4]
E M 274, 3 cr.; E M 324, 3 cr.; E M 345, 3 cr.; E E 442, 2 cr.; E E 448, 2 cr.; M E 270, 3 cr.; M E 231, 3 cr; M E 324, 4 cr.; M E 325, 3 cr.; M E 332, 3 cr.; M E 335, 4 cr.; M E 370, 3 cr.; M E 421, 4 cr.; M E 436, 4 cr.; Mat E 272, 2 cr.

Other Remaining Courses: 18 cr.
Complete one course from M E 415, 3 cr.; M E 442, 3 cr. or M E 486, 3 cr. Complete 15 cr. Technical Electives.[2]

Seminar/Co-op/Internships:
M E 102, R cr.; M E 202, R cr. Co-op/Internship Optional

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved list.

[3] See *Basic Program* for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the *Basic Program*.

[4] 2.00 GPA average required including transfer courses.

Transfer Credit Requirements - The Mechanical Engineering Department requires a grade of a C or better for any transfer credit course that is applied to the degree program. The degree program must include a minimum of 15 credits taken from courses offered through the Mechanical Engineering Department at Iowa State University. Of these 15 credits, three must be from one of the senior capstone design courses. The remaining 12 credits may be from the core curriculum program (if a student is deficient in these courses) or from 400-level ME technical electives. No more than 3 credits of ME 490 (independent study) shall be applied to meet the 12 credit requirement.

Curriculum in Software Engineering

Administered by the Department of Electrical and Computer Engineering and the Department of Computer Science in the College of Liberal Arts and Sciences.

Leading to the degree bachelor of science.

Total credits required: 124.5 cr. See also *Basic Program* and *Special Programs*.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:
Engl 150 and Engl 250 with minimum grade of C; Lib 160. (See *Basic Program* for credit requirements.) Engl 314 with a minimum grade of C.

General Education Electives: 15 cr.[2]
Complete 6 cr. from Arts and Humanities list, 3 cr. of Social Sciences, and an additional 6 cr. from either Arts and Humanities or Social Sciences lists.

Basic Program: 26.5 cr.[4]
Complete with 2.00 GPA including transfer courses: Chem 167 or Chem 177, 4 cr.; Engl 150, 3 cr. and Engl 250, 3 cr. (see above for grade requirements); Engr 101, R cr.; S E 185, 3 cr.[3]; Lib 160, 0.5 cr.; Math 165, 4 cr. (minimum grade of C-) and Math 166, 4 cr. (minimum grade of C-); and Phys 221, 5 cr. (See *Basic Program* rule.)

Math and Physical Science: 11 cr.
Com S 227, 4 cr. (minimum grade of C-) and Com S 228, 3 cr. (minimum grade of C-). Math 267, 4 cr.

Software Engineering Core: 31 cr.[4]
Cpr E 281, 4 cr.; Cpr E 288, 4 cr. or Com S 229, 3 cr.; Cpr E 308, 4 cr. or Com S 352, 3 cr.; Com S 309, 3 cr.; Com S 311, 3 cr.; Com S 330, 3 cr. or Cpr E 310, 3 cr.; ComS 363, 3 cr. S E 319, 3 cr.; S E 329, 3 cr. and S E 339, 3 cr.

Other Remaining Courses: 41 cr.
S E 491, 3 cr. and S E 492, 2 cr. Engl 314, 3 cr. with a minimum grade of C. Complete either Econ 101, 3 cr., Econ 102, 3 cr. or I E 305, 3 cr. Sp Cm 212, 3 cr. Stat 330, 3 cr.
Complete 3 cr. from Math Electives list.[2]
Complete 6 cr. from Software Engineering course list. [2]
Complete 3 cr. from Technical Electives list.[2]
Complete 12 cr. from list of Supplementary Electives.[2]

Note: Excess credits from CprE 288 and/or Cpr E 308 may be applied to meet Supplementary Elective credit requirement.

Seminar/Co-op/Internships
S E 166 or Com S 203. Co-op or internship is optional.

Transfer Credit Requirements
The degree program must include a minimum of 30 credits at the 300-level or above in professional and technical courses earned at ISU in order to receive a B.S. in software engineering. These 30 credits must include S E 491 Senior Design Project I and Professionalism, S E 492 Senior Design Project II, and credits in the core professional curriculum and/or in technical electives. The software engineering degree program requires a grade of C or better for any transfer credit course that is applied to the degree program.

[1] These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

[2] Choose from department approved lists.

[3] See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

d 2.00 required including transfer courses.

Note: International perspectives and U.S. diversity courses are used to meet the general education electives.

College of Human Sciences

Pamela White, Interim Dean
Carla Peterson, Associate Dean
www.hs.iastate.edu/

Departments of the College

Apparel, Educational Studies, and Hospitality Management

Curriculum and Instruction

Educational Leadership and Policy Studies

Food Science and Human Nutrition

Kinesiology

Human Development and Family Studies

The College of Human Sciences provides an integrative approach to improving the quality of life for individuals, families, schools and communities by linking discovery, science, creativity, and practice; applying the knowledge of learning in all endeavors; and developing leaders for roles in research, education, business and industry, and health and human services.

The College of Human Sciences (CHS) was founded in 2005 and is the newest college on the ISU campus. The college fosters innovative synergies in teaching and research, and in many ways is reinventing how human potential can be enhanced. Members of the College of Human Sciences community strive to improve the quality of people's lives - helping them learn better, live longer, and lead lives that are more productive and fulfilling.

Recommended High School Preparation

Recommended preparation for students entering most departments of the College of Human Sciences should include 4 years of English (including speech) with emphasis in composition and communication skills; 3 years each of mathematics and natural sciences, and at least 2 years of social science and/or humanities. In addition, students interested in Elementary Education or Early Childhood Education are advised to complete three or more years of high school study in one foreign language.

Information for Prospective Students

Each student in the College of Human Sciences works closely with an academic adviser who is associated with the curriculum in which the student is majoring. In some majors, freshmen are advised by a general college adviser. After the freshmen year, these students are assigned an adviser in the department of the chosen curriculum. Advisers assist students in developing academic programs and in adjusting to university life. They also provide information and guidance about career choices. Advisers attempt to adjust each student's schedule of course work in accordance with the student's interests and capabilities.

The college offers a number of orientation sessions during the summer for students planning to enter in the fall. Incoming students are encouraged to attend an orientation session so that academic assessments can be made and appropriate classes may be scheduled for the following term.

Open Option Status

The College of Human Sciences offers an open option for entering students who have not selected a specific area of study. An orientation course helps students explore the opportunities available. Program planning information can be obtained from general college advisers.

Planned Transfer Programs

By careful planning, students may begin their education at another college, then transfer their courses to a curriculum within the College of Human Sciences with maximum efficiency in meeting the degree requirements. The college works closely with community colleges in Iowa and surrounding states to facilitate a transfer to Iowa State University. For more information, call 1-800-522-0683 or visit the College of Human Sciences Student Services.

Families Extension

Students may prepare for a career in the Cooperative Extension Service by enrolling in a curriculum in the College of Human Sciences that provides them with a broad subject matter base for conducting educational programs for families. Advice on choice of courses should be sought from the Family and Consumer Sciences Education and Studies program, the associate dean and director of Iowa State University Extension to Families programs, the director of Iowa State University Extension to Youth and 4-H programs, or the Extension Human Resources office.

Undergraduate Core Curriculum

Graduates of the College of Human Sciences will demonstrate professional and personal competencies in concepts fundamental to the College's mission. These core concepts serve as a unifying focus for students in the College. Competencies will be assessed by designated outcomes in courses within each major in the College. For information on the specific core competencies for particular majors contact the departmental office administering the program.

General Education

Students in the College of Human Sciences are required to complete a program in general education which is integrated with their professional training and extends through the undergraduate curriculum.

The general education program emphasizes intellectual growth and personal development as contrasted with specific career preparation.

The program aims to stimulate a desire for learning and intellectual endeavor, develop understanding and appreciation for the physical and cultural world, encourage independent thinking and analysis, increase competence in all aspects of communication, and create an understanding of individuals as social, psychological, and physical beings.

The student is expected to complete studies in three groups in general education. Areas represented below are not departmental titles. In some cases, courses relating to a given area may be found in several different departments. Credits listed are minimum requirements.

Minimum Group Requirements in the College of Human Sciences

9.5 cr.

I. Communication Skills: English 150, 250; Library 160; and 3 credits in oral communication

9 cr.

II. Biological and physical sciences and mathematical disciplines: at least 3 credits in mathematical disciplines

15 cr.

III. Social sciences and humanities: at least 6 credits in social sciences and at least 6 credits in humanities

Accreditation and Licensure

The following program-specific accreditation/licensure/registrations have been attained by departments within the college:

Department of Apparel, Educational Studies, and Hospitality Management:
Family and Consumer Sciences Education Teacher Licensure Program is licensed by the Iowa Department of Education and the Iowa Board of Educational Examiners.

Hotel, Restaurant, and Institution Management: is accredited by the Accreditation Commission for Programs in Hospitality Administration, the accrediting agency of the International Council on Hotel, Restaurant, and Institutional Education.

Production focus of the Apparel Merchandising, Design, and Production major is endorsed by the American Apparel and Footwear Association.

Department of Food Science and Human Nutrition:
Food Science and Industry and Food Science and Technology curricula are approved by the Institute of Food Technologists. The Dietetics Internship Program and the Didactic Program in Dietetics are accredited by the Commission on Accreditation/Approval for Dietetics Education of The American Dietetic Association, 216 W. Jackson Blvd., Chicago, IL 60606-6995, 312/899-4876.

Department of Kinesiology:
The Athletic Training Option is accredited by the Commission on Accreditation of Athletic Training Education.

Department of Human Development and Family Studies:
The Child Development Laboratory School is accredited by the National Association for the Education of Young Children (NAEYC) Academy for Early Childhood Programs and licensed by the Iowa Department of Human Services.

Teacher Education and Licensure

All students who are recommended by Iowa State University for teacher licensure must meet the requirements of the University Teacher Education Program and be recommended by the CHS Associate Dean for Teacher Education.

Each student will be enrolled in the department in which he or she plans to major and must meet the graduation requirements of that department and the college in which it is located.

For details concerning the professional teacher education requirements and the areas of specialization requirements, see Teacher Education, Courses and Programs.

Majors

For more information about a major, see: 1) the curriculum descriptions in this section of the catalog; 2) the department catalog section under *Courses and Programs;* and 3) department websites.

Apparel Merchandising, Design, and Production—Options: Merchandising; Design; Production—Administered by the Department of Apparel, Educational Studies and Hospitality Management

Child, Adult, and Family Services—Options: Child Programs; Youth Programs; and Adult/Family Programs — Administered by the Department of Human Development and Family Studies

Culinary Science- Administered by the Department of Food Science and Human Nutrition

Dietetics—Administered by the Department of Food Science and Human Nutrition

Early Childhood Education—Administered jointly by the Department of Curriculum and Instruction and the Department of Human Development and Family Studies

Elementary Education—Administered by the Department of Curriculum and Instruction

Family and Consumer Sciences Education and Studies—Options: Communications; Professional Studies; Teacher Licensure—Administered by the Department of Apparel, Educational Studies and Hospitality Management

Family Finance, Housing, and Policy—Administered by the Department of Human Development and Family Studies

Food Science—Options: Consumer Food Science; Food Science and Industry; Food Science and Technology—Administered by the Department of Food Science and Human Nutrition

Kinesiology—Options: Athletic Training; Community and Public Health; Exercise Science; General Studies; Health/Fitness Management; and Physical Education Licensure —Administered by the Department of Kinesiology

Hotel, Restaurant, and Institution Management—Administered by the Department of Apparel, Educational Studies and Hospitality Management

Nutritional Science—Administered by the Department of Food Science and Human Nutrition

Secondary Education—The College of Human Sciences provides secondary education licensure programs in conjunction with subject matter areas, or majors, offered by various departments across the university campus. These subject matter areas include agriculture, biology, chemistry, earth sciences, English, foreign languages, general sciences, health, family and consumer sciences education, mathematics, music, physical science, physics, and social studies. See *Index, Teacher Education*.

Minors

Minors are available to all Iowa State students. Minors consist of at least 15 credits including 6 credits taken at Iowa State University in courses numbered 300 or above. A student may not apply the same course to two different minors. The minor must include 9 credits that are not used to meet any other department, college or university requirement. Minors are available in the following areas:

Apparel Merchandising, Design, and Production

Athletic Coaching

Child, Adult, and Family Services

Dance

Educational Services in Family and Consumer Sciences

Family Finance, Housing, and Policy

Food Safety (interdepartmental minor)

Gerontology (interdisciplinary minor)

Hotel, Restaurant, and Institution Management

Nutrition (two minors: one for non FSHN majors and one for department majors)

See *Index* for minor requirements for specific departments and programs.

International Studies (secondary major only)

Sport and Culture

The International Studies Program is an interdisciplinary program which may be taken only as a second major. Students pursuing a second major in international studies must complete the International Studies Program as described in this catalog (see *Index, International Studies)*.

Double Majors

Students may elect a second major from the departments and program areas listed above, or from a major field offered for the bachelor's degree in another college of the university. Double majors may be prohibited between majors as determined by the appropriate curriculum committees.

The major departments must approve the degree program, and if those majors involve two colleges, both deans must approve. Such programs must fulfill the general education requirements of the college of the primary major. If one major leads to the B.A. degree and the other to the B.S. degree, the degree awarded will be the one offered by the department of the primary major. If the primary major may lead to either a B.A. or a B.S., a student may choose to receive either degree. In this case, the student must satisfy the requirements of each major and of the degree that is chosen for the primary major.

Students with a primary major in another college who wish to take a second major in the College of Human Sciences are required to meet all requirements for the major, including the CHS core, and prerequisite and supporting courses.

Two Bachelor's Degrees

Any degree offered by the College of Human Sciences may be earned together with a degree in this or any other college of the university. For the requirements for two degrees, see *Index, Two Bachelor's Degrees*.

International and Cross Cultural Programs

International experience opportunities are available and encouraged through the College of Human Sciences to broaden international and cross-cultural perspectives. Scholarships and other forms of financial assistance are available which provide partial support for students studying abroad. The College has established programs with a variety of colleges and universities around the world including Glasgow Caledonian University, Glasgow, Scotland; University of Otago, Dunedin, New Zealand; the International College of Hospitality Administration, Brig, Switzerland; the London College of Fashion, London, England; and Paris American Academy, Paris, France. Students also have an opportunity to participate in group study abroad programs to Europe, Africa, Central and South America, and Asia.

Other opportunities may be developed through consultation with the college director of international experiences and the student's adviser; for example, students have acquired internships and studied in such countries as Kenya, Rwanda, Spain, Puerto Rico, Ireland, Guatemala, Switzerland, England, Australia, Germany, and France. Faculty members bring diversity and global perspectives to instruction and research through their work in India, South Korea, Central and South America, Pakistan, Africa, and Europe.

Honors Program

High achieving students, with a grade point average of above 3.35, are invited to apply to the Honors Program. Honors students are encouraged to develop a creative program of study expanding their interests while meeting individual educational objectives. Students in the Honors Program also participate in University Honors Seminars, Honors Courses and complete an honors project. For further information, contact the College Honors Committee or academic adviser. Also see Index, Honors Program.

Dietetics Internship (DI)

This post-baccalaureate program, administered by the Department of Food Science and Human Nutrition, is accredited by the American Dietetic Association (ADA). The purpose of the program is to enable those who meet the academic requirements of the ADA to obtain at least 900 hours of practice supervised by registered dietitians in medical nutrition therapy, community nutrition, and foodservice management to meet ADA performance requirements for entry level dietitians.

Students who satisfactorily complete the DI will be eligible to take the national registration examination administered by the Commission on Dietetic Registration.

Preparation for Graduate Study

Students considering graduate studies should gain background knowledge in basic subjects related to their area of interest. Undergraduate mathematics, statistics, and research methods courses are useful as preparation for advanced study in graduate school. Upon completion of graduate programs, students are qualified for leadership positions in public and private institutions and for teaching, research, and extension positions in colleges and universities.

Graduate Curricula

The College of Human Sciences offers programs leading to the degrees of master of science, master of education, and doctor of philosophy. Graduate study in the College of Human Sciences is conducted through the Graduate College. Details are found in the Graduate College section of this catalog, (www.grad-college.iastate.edu) and on department websites.

Curriculum in Apparel Merchandising, Design, and Production

Administered by the Textiles and Clothing Program. Leading to the degree bachelor of science. **Total credits required: 123** including a minimum of 18 credits in AMDP at Iowa State University for the degree.

The major in apparel merchandising, design, and production provides a broad based program of study with flexibility in creating program options. Courses are required in general education, and textiles and clothing core. To complete the program, a student combines structured clusters of courses to form primary and secondary program options.

A minor in apparel merchandising, design, and production is available; the requirements appear under *Textiles and Clothing, Courses and Programs.*

Cr.	Degree Requirements
9.5	**Communications Skills**
6.5	Engl 150, 250; Lib 160
3	Select from ComSt 214, 218; Sp Cm 212
9-14	**Biological and Physical Sciences and Mathematical Disciplines**
3-4	Mathematics (Math 150 recommended for Merchandising and Production Options)
3-5	Select from natural sciences (including FS HN 167)
4-5	Stat 101 or 104, or 226
9-10	**Social sciences**
6	Econ 101
3	T C 165
3	Select from the Human Sciences list (including T C 362)
9	**Humanities**
3	T C 257, 354, 356 or AESHM 342.
3	Select from Human Sciences approved list, foreign language requirement
3	One history/art history course. Creative Design: Art H required.

Professional courses

25	**Textiles and clothing core:** AESHM 111, 275, 311; TC 131, 204, 210, 231, 245, 372
3-6	T C 470
2-3	TC 380 or TC 381 (if TC 470 is not out of home state)

Primary options

Select one professional option from the following three choices

13	**Design Professional Courses** T C 221, 225, 278, 321
15	**Merchandising Professional Courses**
12	T C 376, 377, 475; Acct 284;
3	Mkt 340 or T C 340
15	**Production and Sourcing Management Professional Courses**
12	T C 221, 305, 331, 496
3	Acct 284

Additional Requirements for a Primary Option

24	**Design**
R	T C 301
9	T C 325, 326, 495
3	Select one: T C 354 or 356
12	Select from T C 257, 305, 340, 354, 356, 362, 377, 404; 415, 431 AESHM 471, 474; Thtre 255; Any Art History, Art Integrated Studio or Design Studies
24	**Technical Design**
R	T C 301
12	T C 305, 325, 415, 431
6	Select two courses from T C 354, 356, 362, 496
6	Select two courses from: Acct 284; I E 408; OSCM 320; T C 340, 404
24	**Product Development**
15	T C 305, 431, 467, 496; Acct 284
3	Select one: Mkt 340, T C 340
6	Select two: T C 376, 377, 404, 415 475; AESHM 474; I E 408
14-16	**Merchandising Option**
8-10	Select three: AESHM 271, 287, 340, 471, 474, 477; T C 467, 496; ADVRT 230; Mgmt 370, 371; Mkt 340*, 410, 446, 448
3	Select one: T C 354, 356, 362, 467
3	Select one: T C 221, 305, 331, 404
12	**Production/Sourcing Management Option**
6	Select two: I E 408; LSCM 360; OSCM 320; Stat 495; AESHM 340*, 404; TSM 310
3	Select one: T C 354, 356, 362, 467
3	Select one: T C 362, 381 or Study Abroad

Secondary options

For Merchandising and Production/Apparel Engineering select a second cluster from the secondary option areas.

9-10	**Business/Entrepreneurship**
9-12	Select three courses from AESHM 287, 474; Acct 215, 285; Econ 355; Fin 301; LSCM 360; Mgmt 310, 313, 370; Mkt 340; MIS 330; OSCM 320
9	**Communications/Publication**
9	Select three: ComSt 214; Engl 302, 303, 309, 313, 314; Jl MC 310, 321, 341, 342; Sp Cm 212; any Art Graphic Design
9	**Consumer Behavior/Marketing**
3	T C 467
3	Select from T C 499; AESHM 340; Advrt 230; Jl MC 205, 220; Mkt 410, 442, 444, 446, 447, 448, 451, 493
9	**History/Museum Studies**
3	T C 257
6	Select two courses from T C 354, 356, 362, 404, 467, 499; Any History; Any Art History; any Anthropology
9	**Human Resource Management**
9	Select three courses from AESHM 287; T C 438, 467, 499; ComSt 214, 218, 310, 314, 317; Mgmt 370, 371; Psych 450; Soc 380; Sp Cm 212
9	**International Trade**
3	T C 362
6-8	One foreign language or 6 credits from T C 381, AESHM 421; Anthr 323, 325, 326, 418; IntSt 120/220, 235; Mgmt 414; Mkt 448; TSC 341
9	**Public Relations/Event Management**
3	Select three: T C 287, 499; AESHM 471; Advrt 230, 301, 334, 424, 434; Jl MC 205, 220, 321; Mkt 410, 447
	Electives Select courses to broaden or complement the options (see adviser).
123	**Total credits**

* If Merchandising primary option, may need to select another course from approved list.

Curriculum in Child, Adult, and Family Services

Administered by the Department of Human Development and Family Studies. Leading to the degree bachelor of science. **Total credits required: 125.**

The child, adult, and family services curriculum, with options in child programs, youth programs, adult/family programs, leads to employment opportunities in the helping professions working with children, adults, and families in a variety of public and private human service agencies and organizations.

A minor in child, adult, and family services is available; the requirements appear under *Human Development and Family Studies, Courses and Programs.*

The following requirements are for the child programs, youth programs, adult/family programs:

Degree Requirements

12.5	Communications and Library
9.5	Engl 150, 250; Lib 160; Sp Cm 212
3	Select from Engl 302, 309, 314
10-11	Natural Sciences and Mathematical Disciplines*
3-4	Select from: Stat 101, Math 104, 105, 140, 142, 150, 165
4	Com S 103
	Select 3 credits from Biology courses
9	Social Sciences
	Select from CHS list of approved social sciences
9	Humanities
	Select from CHS list of approved humanities
2	HD FS Orientation
	HD FS 110
17	Human Development and Family Studies Core: HD FS 102, 269, 449, 491
11	Child, Adult, and Family Services Core: HD FS 218, 367, 395, and 445 or 486
24	Programs Option
	See option lists
31.5-32.5	Electives
125.0	Total credits

U.S. Diversity and International Perspectives Requirement: Students fulfill the U.S. Diversity and International Perspectives Requirement by choosing three credits of coursework from each of the university-approved lists.

Program Options

24	Child Programs: HD FS 220, 221, 240, 344, 349; H S 105; C I 250 Select 3 credits from: HD FS 239, 283, 360, 270, 380, 479
24	Youth Programs: HD FS 226, 227, 270, 276, 349, 479 Select 3 credits from: C I 250, HD FS 360, Psych 436 and Select 3 credits from: HD FS 239, 283, 373, 380
24	Adult/Family Programs: HD FS 270, 276, 349, 377, 479, and 360 or 463 Select 6 credits from: HD FS 239, 283, 341, 373, and 380

Curriculum in Culinary Science

Administered by the Department of Food Science and Human Nutrition

Cr.	Degree Requirements*
9.5	Communications/Library Engl 150, 250; Sp Cm 212 or ComSt 214; Lib 160
6-7	Mathematical sciences Math 140, 142, 160, 165, or 181 Stat 101 or 104
9	Physical sciences Chem 163;163L; 231, 231L
12-13	Biological sciences BBMB 301; Biol 211, 212; Micro 201 or 302; and Micro 201L or 302L
15	Humanities/Social sciences Econ 101; FS HN 342; 6 credits Humanities courses; 3 additional credits Humanities or Social Sciences
44	Food science and human nutrition FS HN 101, 104, 110, 167, 203, 214, 265, 311, 314, 403, 405, 406, 411, 412, 420, 480, 491B, 491D
3	Animal science An S 270
22	Hotel, restaurant institutional management HRI 233, 333, 340, 380, 380L, 383, 487 and AESHM 474
0-2	Electives
122.5	Total credits

*Additional requirement: Students must fulfill international perspectives, U.S. diversity, and ethics requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Curriculum in Diet and Exercise B.S./M.S.

Administered by the Departments of Food Science and Human Nutrition, and Kinesiology

Courses included have been approved as meeting the academic requirements of the American Dietetic Association in preparation for admission to dietetic internship programs. There is a $30 fee for a statement of verification of completion of the approved program. Courses also are included to meet the ACSM requirements for certification at the level of Health Fitness Instructor.

Cr.	Degree Requirements*
9.5	Interpersonal and public communication skills Engl 150, 250; Lib 160; Sp Cm 212
38-41	Mathematical, physical, and life sciences Math 140, 142, 160, 165, or 181; Stat 101, 104, or 226; Chem 163 and 163L or 177, 177L, and 178; 231;231L; Phys 106 or 111; BBMB 301; Biol 211, 212; 255; 255L; 256; 256L; Micro 201
12	Humanities and social science select 3 credits from approved humanities course list; select 3 credits from approved Ethics course list (if ethics course selected is not on the humanities list, 3 additional credits of humanities must be taken.); Psych 101, 230
20-22	Diet and exercise Kin 252-253, or FS HN 110; Kin 258; FS HN 167, 214, 265, 360;
41	Diet and exercise H S 380; Kin 220, 259, 345, 358, 462; FS HN 403. 411, 463, 466; NutrS 561; HRI 380, 380L, 392 Kin 355, 360, 366, or 372
123.5	Total credits

*Additional requirement: Students must fulfill international perspectives, U.S. diversity, and ethics requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Graduate Program

Cr.	Degree Requirements
39-40	Graduate level coursework FS HN 581; NutrS 501, 561, 562, 564; Kin 501, 505, 551, 558; Kin 699 or NutrS 699A; Stat 401; Kin 550, 570, or NutrS 502. Additional requirement: FS HN 490C for students in the FSHN Department.

Curriculum in Dietetics

Administered by the Department of Food Science and Human Nutrition.

The student is prepared for admission to dietetic internship programs and other professional experience programs approved/accredited by The American Dietetic Association. Courses included have been approved as meeting the academic requirements of The American Dietetic Association. There is a $30 fee for a statement of verification of completion of the approved program.

Cr.	Degree Requirements*
9.5	Communications Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212
6-7	Mathematical sciences 3 credits Math 140, 142, 160, 165 or 181; Stat 101 or 104
12	Physical sciences Chem 163 and 163L or 177, 177L, and 178; 231; 231L;
20-22	Biological sciences BBMB 301 or Biol 314; Biol 211, 212, 212L, 255, 255L; 300-level physiology course (BIOL 306 or 335) Micro 201 and 201L
15	Humanities/Social sciences 6 crs. Humanities course; FS HN 342; Psych 101; 3 crs. Humanities or social science list
41	Food science and human nutrition FS HN 110, 167, 203, 214, 265, 340, 360, 361, 362, 403, 411, 461, 463, 464, 466, 480
11	Management HRI 380, 380L, 391, 392
0-6	Electives
120.5	Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Curriculum in Early Childhood Education

The curriculum in early childhood education is planned for students preparing to teach young children and work with their families. This program leads to careers in working with young children who are typically developing and those with special needs from birth through age eight. Graduates in this curriculum may teach in early childhood (preschool and primary) classrooms and home based programs, with emphasis on inclusive services; graduates may be employed by either public or private agencies or schools. This curriculum has been approved by the Iowa Department of Education and meets the requirements for the early childhood education unified teacher license, which permits individuals to teach general and special education for children from birth through age eight. The program is administered jointly by the Departments of Human Development and Family Studies and Curriculum and Instruction.

Students in early childhood education must make application to and be accepted into the teacher education program prior to enrolling in advanced courses. All early childhood students, including those seeking a double major, must meet general education requirements for teacher licensure. Iowa State University is in compliance with the Iowa Department of Education's mandate for a performance based system of teacher training. Following this same type of system, the state of Iowa has developed and implemented a competency system to evaluate the performance of all teachers. A detailed list of the eleven Teacher Education Standards along with other information about the University Teacher Education Program, can be found at www.teacher.hs.iastate.edu/, the teacher education website.

Foreign Language Requirement
Early childhood education majors must satisfy a graduation requirement equivalent to the first year of university-level study in one foreign language (normally, completion of a two-semester sequence in any one foreign language). The requirement may be met by completion of three or more years of high school study in one foreign language.

Students who have completed three or more years of French, German, or Spanish in high school may not receive graded credit for 101-102 in those languages; test-out credit (T credit) may be obtained by passing an appropriate examination or by completing an advanced sequence (200-level or higher) in that language. If these students choose to take 101-102 on a remedial basis, they will be graded S-F.

Degree Requirements
125.5 total semester credits required

- 9.5 Communications and Library
  Engl 150, 250; Lib 160,select 3 credits from Communications

Options

- 9 Natural Sciences and Mathematics
  Math 195, Select 3 credits from physical sciences, Select 3 credits from biological sciences
- 9 Social Sciences*
- 3 Select from American government or American history
- 6 Select from CHS approved list
- 9 Humanities*
  Select from CHS approved list. Must meet Foreign Language Requirement.
- 2 Health, Dance, Physical Education, Safety
  H S 105
- 9 Human Development and Family Studies: HD FS 102, 220, 221
- 2 Orientation
  HD FS 110, HD FS 208
- 15 Professional Education Core:
  C I 201, 204, 250, 332, 406
- 21 Preprimary Inclusive: HD FS 240, 340, 343, 345, 455, 456
- 21-24 Primary Inclusive: C I 245, 268, 377, 433 or 443, 438 or 448, 439 or 449, 468F, 468G, 468I; Sp Ed 355, 368, 455
- 16 Student teaching: Sp Ed 415 and HD FS 417B OR C I 416A and HD FS 417C
- 0-3 Electives

Communication Options
Select 3 credits from: ComSt 102, 218, 317, Sp Cm 212, 312, 313, 322, 327

Physical Sciences Options
Select 3 credits from: Astro 120, 150, Chem 160, 163, 164, Geol 100, 102, LAS 111, Mteor 206, Phys 101, 106

Biological Sciences Options
Select 3 credits from: Biol 101, 173, 155, 211, 211L, 255, 255L, 258, Ent 211

U.S. Diversity and International Perspectives Requirement: Students in Early Childhood Education fulfill the U.S. Diversity and International Perspectives Requirements by choosing three credits of coursework from each of the university-approved lists.

*Refer to departmental curriculum sheet, available from adviser, for specific course requirements.

Curriculum in Elementary Education

The curriculum in elementary education is planned for students preparing to teach in grades kindergarten through six. For additional information, see Index*, Elementary Education*.

Teaching endorsements in areas closely related to elementary education, including a special education endorsement in Instructional Strategist I: Mild/Moderate K-8, are available for elementary education majors. See Teacher Education, Courses and Programs, for information about specific endorsements.

Additional teaching endorsements, available at the graduate level to individuals who hold a valid Iowa teaching license, include the following: K-6 foreign language, reading, special education (Instructional Strategist I: Mild/Moderate K-8; Instructional Strategist I: Mild/Moderate 5-12; and Instructional Strategist II: Behavior Disorders/Learning Disabilities, ages 5-21).

Communication Proficiency
In order to meet graduation requirements, all students must have a C (2.0) or better for each of Engl 150 and Engl 250.

U.S. Diversity and International Perspectives
In order to meet graduation requirements, all students must complete 3 credits of course work in U.S. Diversity and 3 credits in International Perspectives. See department for approved lists of courses.

Foreign Language Requirement
Elementary education majors must satisfy a graduation requirement equivalent to the first year of university-level study in one foreign language (normally, completion of a two-semester sequence in any one foreign language). The requirement may be met by completion of three or more years of high school study in one foreign language.

Students who have completed three or more years of French, German, or Spanish in high school may not receive graded credit for 101-102 in those languages; test-out credit (T credit) may be obtained by passing an appropriate examination or by completing an advanced sequence (200-level or higher) in that language. If these students choose to take 101-102 on a remedial basis, they will be graded S-F. Certification in American Sign Language is recognized by the University and satisfies the foreign language requirement for the curriculum in Elementary Education.

Total credits required: 128.5.

Cr.

- 46.5 General Education*
- 9.5 Communication skills
  Engl 150 (3), 250 (3); Lib 160 (0.5); Select from ComSt 102 (3), 218 (3), 317 (3), Sp Cm 212 (3), 312 (3), 313 (3), 322 (3), 327 (3)
- 9 Social sciences
  HD FS 102 or Psych 230 (3), American history/American government (3), options (3)
- 9 Humanities
  Select 9 credits from department approved list
- 1 Health, dance, kinesiology, safety options (1)
- 9 Mathematics
  Math 195 (3), 196 (3); Select from 104 (3), 105 (3), 140 (3), 142 (3), 160 (3), 165 (4), 180 (3), 297 (3).
- 9 Biological/Physical Sciences
  Biological sciences (3) select from Anthr 202 (3); Biol 101 (3), 173 (3), 211 (3); Biol 202 (2), Biol 155 (3), 155L (2), 255 (3), 258 (3)
  Physical sciences (3) select from Astro 120 (3), 150 (3); Chem 160 (3), 163 (4), 164 (4); Geol 100 (3), 100L (1), 101 (3); Mteor 206 (3); Phys 101 (3), 106 (4)
- 18 Area of specialization
  (Requires at least 24 credits. Nine credits from an area specialization may be used to meet other requirements.)
- 67 Professional education
- 24 Required courses
  C I 201 (3), 204 (3), 245 (2), 268 (1), 332 (3), 406 (3); HD FS 226 (3), 240 (3) or Engl 396 (3), Sp Ed 250 (3)
- 21 Required methods

C I 377 (4), 468A (1), 378 (4), 468B (1), 448 (3), 468C (1), 449 (3), 468D (1), 443 (3)
6 Related Methods
Select from H S 275 (3); ArtEd 211 (3); Music 265 (3); Ex Sp 284 (3)
16 Student teaching
C I 416A (8) or 416D (8), 416B (8) or 416E (8), Sp Ed 416 (special education students only)
R Orientation (required)
First year—115; sophomore—215; transfer—315

*Refer to departmental curriculum sheet, available from adviser, for specific course requirements.

Curriculum in Family and Consumer Sciences Education and Studies

Administered by Apparel, Educational Studies and Hospitality Management. Leading to the degree bachelor of science. Total credits required: 125.5

This curriculum provides a broad-based program of study focusing on preparation for professional careers related to education or community leadership. Courses are required in general education and the College core. Students select one program option.

There are three choices for this curriculum. Option 1, teacher licensure, Option 2, communications, or Option 3, professional studies. In all options, students are prepared with a broad-based understanding of family and consumer sciences.

Option 1, teacher licensure, is designed for students seeking careers as family and consumer sciences educators in a variety of settings such as middle, junior, and senior high schools. With additional credits students may also be approved to teach in specific occupational areas: child care, fashion merchandising, and foodservice. Further information about licensure programs appears under Teacher Education.

Option 2, communications, is designed for students seeking careers emphasizing communication with diverse populations in extension, business, community agencies, community colleges, and youth and adult education programs in a global community.

Option 3, professional studies, is designed to provide students with the opportunity to pursue an individualized program which is planned with their academic advisers. Opportunities to participate in study abroad, internships, and field study build a solid base for work in a global community. Careers include working with diverse population in extension, business, community agencies, community colleges, and youth and adult education programs.

The program offers a minor in family and consumer sciences education; the requirements appear under Family and Consumer Sciences Education and Studies, Courses and Programs.

Cr. Degree Requirements

9.5 Communications and library
6 Engl 150, 250
3 Select from: ComSt 102, 214 218, Sp Cm 212, 312
0.5 Lib 160
9-10 Natural sciences and mathematical disciplines
3 Biol 101 or Biol 155
3-4 Select a course from the mathematical disciplines (Teacher licensure option must select a Math or Stat course and communications option must select Stat 101 or 104)
3 Select additional course in natural science. (Both teacher licensure option and communications option must complete high school chemistry or its equivalent. Teacher licensure must have a physical science course)
9 Social sciences
3 Econ 101
3 Soc 130 or 134
3 HD FS 102
9 Humanities
9 Courses from approved list (Teacher licensure must complete 3 cr. of American history or American government)
14 Family and Consumer Sciences Education and Studies core
AESHM 111, 206, 460
AESHM 311, 379, 421

Option 1: Teacher Licensure
75 Additional Professional Courses
30 FCEdS 214, 280L, 306, 318, 403, 413, 417A, 417B
6 FSHN 111, 167
12 HD FS 239; 276; 283, and 349;
3 Select from HD FS 341, 483, or 488
3 Select from HD FS 220, 221, 226 or FCEdS 223
3 T C Select one course from 121, 131, 165, 204, or 362
15 C I 201, 204, 333, 406, 415, 426
3 Sp Ed 450
125.5 Total Credits

Option 2: Communications
74-75 Additional Professional Courses
14 FCEdS 306, 415, 418A
3 FSHN 167
3 JL MC 305
6 HD FS 239; 283
3 AESHM 287
9 Select from: Engl 302, 309, 313, or 314
3 Sp Cm 312
6 Jl MC Select from 205, 220, 341, 462, 476, or 477
6 Jl MC 342 and 342L
3 Select from Anthr 417, AESHM 342, T C 362, or Phil 340
12 Select from AESHM, FCEdS, FS HN, HD FS, HRI, H S, or T C (At least 6 credits should be 300 level or above)
6-7 Electives
121 Total Credits

Option 3: Professional Studies
74 Additional Professional Courses
6-11 FCEdS 415, 418B
3 HD FS 283
3 HD FS Select from 239, 341, 483, or 488
3 AESHM 474 or Mgmt 310
3 FSHN 167
3 Select from: Anthr 417; AESHM 342, T C 362; Phil 340
6 Select from Engl 302, 309, 313, 314; Jl MC 205; Sp Cm 312
16-21 Select from AESHM, FCEdS, FS HN, HD FS, HRI, H S, or T C (At least 6 credits should be 300 level or above)
14 Select from Natural Sciences, Social Sciences, Humanities, Art and Design
12 Electives
121 Total Credits

Occupational teaching areas available:
Child care: HD FS 220, 221, 340, 343, 445

Fashion merchandising: T C 131, 165, 375, 376, 377, Com S 103

Foodservice: Biol 101, Micro 201 or HRI 233, 333, 380, 380L, 438

Curriculum in Family Finance, Housing, and Policy

Administered by the Department of Human Development and Family Studies. Leading to the degree bachelor of science.

Total credits required: 121.5

The family finance, housing, and policy curriculum prepares students for professional work related to financial and housing resource management and policy analysis. The program focuses on financial resource management, housing services and administration, and family policy issues pertinent to children, adults, and families. Graduates of the program are prepared for employment within the public and private sector as financial counselors and planners, insurance agents, loan officers, mortgage originators, government housing authority administrators, housing advocates, housing planners, real-estate agents, non-profit agency administrators, policy analysts and lobbyists, property managers, and consumer credit and financial aid counselors. Family finance, housing, and policy majors also are prepared to enter graduate programs in family policy and family financial planning.

Learning outcomes are identified for graduates with a degree in family finance, housing, and policy. Students are able to: demonstrate competency in consumer science and their chosen field of emphasis; demonstrate proficiency in interpersonal communication and in working with diverse groups to solve multidisciplinary problems; effectively prepare and deliver information to family finance, housing, and policy professionals as well as to the general public; critically evaluate information and accurately interpret and use research; understand the complexity of issues facing professionals in the field, including ethical, cultural and environmental elements.

A minor in family finance, housing and policy is available; the requirements appear under Human Development and Family Studies, Courses and Programs.

Degree Requirements
121.5 total semester credits required

12.5	Communications and Library Engl 150, 250, Sp Cm 212, Lib 160 Select from Engl 302, 309, 314
10	Natural Sciences and Mathematical Disciplines*
4	Stat 101
3	Select from Computer Science
3	Select from Math, Stat, or natural sciences
9	Social Sciences Econ 101, Soc 134, Select from Anthr, Econ, Pol S, Psych, or Soc
9	Humanities Select from approved College of Human Sciences list
2	HD FS Orientation HD FS 110
20	Human Development and Family Studies Core: HD FS 102, 269, 449, 491, Select 3 credits HD FS from outside of major
20	Family Finance, Housing, and Policy Core: HD FS 239, 270, 283, 341, 395, 489, 489L, 416
15	Family Finance, Housing, and Policy Emphasis: Select from Acct 284, HD FS 360, 380, 378, 463, 483, 488
24	Electives

Courses from Accounting, Architecture, Art, and Design, Community and Regional Planning, Economics, Family and Consumer Sciences Education, Finance, Gerontology, Interior Design, Journalism, Management, Marketing, Political Science, Psychology, and Sociology are suggested.

Curriculum in Food Science

Administered by the Department of Food Science and Human Nutrition.

Option 1. Food Science and Technology

Cr.	Degree Requirements*
12.5	Communications/Library Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212; TSM 115
11-12	Mathematical Sciences Math 165 and 166, or 181 and 182; Stat 101 or 104
23	Physical Sciences Chem 177, 177L, 178, 331, 331L, 332; Phys 111, 112
13	Biological sciences BBMB 301; Biol 211, 212; Micro 302, 302L
15	Humanities/Social Sciences 6 credits Humanities courses; 3 credits Social Sciences courses; FS HN 342; additional 3 credits Humanities or Social Sciences courses
44	Food science and human nutrition FS HN 101, 110, 167, 203, 311, 351, 403, 405, 406, 410, 411, 412, 420, 421, 471, 472, 480
0-2	Electives
120.5	Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Option 2. Food Science and Industry

Cr.	Degree Requirements*
15.5	Communication/Library Engl 150, 250; Lib 160; Jl MC 305, or 220, or 347; Sp Cm 212 or ComSt 214; TSM 115
7-8	Mathematical Sciences Math 160, 165, or 181; Stat 101 or 104
16	Physical Sciences Chem 163 and 163L or 177, 177L and 178; 231; 231L; Phys 106
12-13	Biological Sciences BBMB 301; Biol 211, 212; Micro 201 or 302; Micro 201L or 302L
15	Humanities/Social Sciences Econ 101; FS HN 342; select 6 credits of humanities courses; select 3 additional credits of humanities or social science courses
6	Business Select 6 credits from Acct 215, 284, 285; Econ 301, 320; Mgmt 310, 370, 371, 414, 472; MIS 330; Mkt 340, 447, 448
44	Food science and human nutrition FS HN 101, 110, 167, 203, 311, 351, 403, 405, 406, 410, 411, 412, 420, 421, 471, 472, 480
0-5	Electives
120.5	Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Option 3. Consumer Food Science

Cr.	Degree Requirements*
21.5	Communications/Library Engl 150, 250; Jl MC 305 or 220; select 6 cr. from Jl MC 347, Engl 205, 302, 309, 313, or 314; Sp Cm 212 or ComSt 214; Lib 160; TSM 115
6-7	Mathematical sciences Math 140, 142, 160, 165, or 181
16	Physical sciences Chem 163 and 163L or 177, 177L and 178; 231, 231L; Phys 106
12-13	Biological sciences BBMB 301; Biol 211, 212; Micro 201 or 302; and Micro 201L or 302L
15	Humanities/Social sciences Econ 101; FS HN 342; 6 credits humanties courses; 3 additional credits humanties or social sciences
41	Food science and human nutrition FS HN 101, 110, 167, 203, 214, 265, 311, 403, 405, 406, 411, 412, 420, 471, 480
6	Business Mkt 340 or 447
0-3	Electives
120.5	Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Concurrent B.S. and M.S. Program:
Well qualified students in Food Science who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both a bachelor of science in Food Science and a master of science degree in Food Science and Technology. For more information, refer to www.fshn.hs.iastate.edu

Curriculum in Kinesiology and Health

The curriculum in Kinesiology and Health is designed for students preparing to enter professional areas related to the health, exercise or sport science fields. Students majoring in Kinesiology & Health may select one of six options: 1) Athletic Training, 2) Community and Public Health. 3) Exercise Science, 4) General Studies, 5) Health/Fitness Management, and 6) Physical Education Licensure.

Minors in dance, athletic coaching, and sport and culture are available; the requirements appear under Kinesiology, Courses and Programs.

A major in Performing Arts with a dance emphasis is available; the requirements appear under *Curriculum in Performing Arts in Theatre.*

Communication Proficiency
In order to meet graduation requirements, all students must earn an average of C (2.0) or better in Engl 150 and 250, with neither grade being lower than a C-. Students not meeting this condition must earn a C or better in an advanced writing course (select from Engl 220, 302, 309, or 314).

U.S. Diversity and International Perspectives

In order to meet graduation requirements, all students must complete 3 credits of course work in U.S. Diversity and 3 credits in International Perspectives. See university approved list.

Total credits required: 124 (46 credits in courses numbered 300 or above).

Cr.	
42	General Education
9	Physical and Life Sciences Basic Human Physiology and Anatomy
8	Biol 255, 255L, 256, and 256L
3	Introduction to Human Nutrition—FS HN 167
6	Mathematics and Computer Sciences
2-3	Mathematics/Statistics—select from Math 104, 140, 141, 142, 150, 165 OR Stat 101, 104, 226
3-4	Computer Science choice
9	Social Sciences
6	Humanities
12.5	Communication Skills
6	Freshman Composition—Engl 150, 250

3 Fundamentals of Public Speaking—Sp Cm 212
0.5 Library instruction—Lib 160
3 Business Communication—Engl 302, 314, or Sp Cm 312
17 **Core requirements: (Each course used to meet the Core require ments must be completed with a grade of C- or better.)**
Basic Core
3 Personal and Consumer Health—H S 110
3 Fields and Disciplines in Kinesiology—Kin 252, 253, 254 (required of fresh men only)
2 Concepts of Physical Fitness—Ex Sp 258
Advanced Core
(H S 110, , Kin 252. 253, and 258 should be completed prior to enrollment in the advanced core courses; students must have completed three of these courses with at least one from each sub-discipline; some courses have unique prerequisites which can be taken as part of General Education coursework)

Biological Basis of Physical Activity and Health Promotion
3 Biomechanics - Kin 355
3 Physiology of Exercise—Kin 358
3 Human Diseases—H S 350

Behavioral Basis of Physical Activity and Health Promotion
3 Sociology of Sport and Physical Activity—Kin 360
3 Sport Psychology—Kin 365
OR
Exercise Psychology—Kin 366
3 Motor Control and Learning Across the Lifespan—Kin 372
3 Consumer and Public Health—H S 310

Option 1. Athletic Training

The CAATE accredited athletic training option prepares students for the NATABOC certification examination or for graduate work in athletic training. Admission to the athletic training option is competitive and based on available department resources and will be determined on the basis of grades and other performance factors. Technical standards can be found on the athletic training website. Details are available from the Kinesiology Advising Office or the Athletic Training Education Program.

3 Basic Athletic Training for Athletic Trainers—Kin 222
1 Athletic Training Clinical Practicum—Kin 221, Kin 223
1 Introduction to Taping, Bracing, and Equipment Fitting - Kin 240
3 Evaluation of Athletic Injuries I—Kin 224
1 Athletic Training Clinical Practicum—Kin 225
3 Evaluation of Athletic Injuries II—Kin 226
1 Athletic Training Clinical Practicum—Kin 227
3 Therapeutic Modalities for Athletic Trainers—Kin 323
1 Athletic Training Clinical Practicum—Kin 324
3 Rehabilitation of Athletic Injuries—Kin 326
1 Athletic Training Practicum—Kin 327
3 Organization and Administration of Athletic Training—Kin 425
3 Medical Concerns for the Athletic Trainer—Kin 450
3 Legal Aspects of Sport—Kin 445
4 Principles of Fitness Assessment and Exercise Prescription—Kin 458
R Review of Athletic Training Competencies—Kin 489
2 Instructor's First Aid and CPR—H S 305
4 General Chemistry—Chem 163
1 Laboratory in General Chemistry—Chem 163L
4 Physics 106 or 111
3 Drug Education—H S 215

Elective to equal 124 total credits

The following courses are required; they can be taken as part of the General Education requirements:

3-5 Statistics—Stat 101, 104, 226
2-3 Mathematics—select from Math 140, 141, 142, 150, 165

The following six courses must also be taken; three can fulfill the Advanced Core requirement: Kin 355, 358, 360, 365, 372 and H S 350.

Option 2. Community and Public Health

This option emphasizes health promotion and disease prevention and prepares students for professional involvement in community health agencies which incorporate health services and the educational process. Students will be prepared for employment in state and public health agencies, volunteer health agencies, hospitals (patient education), and industry (health and wellness programs). Graduates are eligible to take the National Certified Health Education Specialist (CHES) exam which recognizes qualified specialists in the diversified field of health education.

2 First Aid and Emergency Care—H S 105
3 Drug Education—H S 215
3 Worksite Health Promotion—H S 380
R Search Strategies for Field Experiences and Employment—H S 385
3 Administration of School Health—H S 390
3 Community Health Program Development—H S 430
2 General Microbiology—Micro 201
1 Intro Micro Lab—Micro 201L
3 Human Sexuality—HD FS 276
3 Aging and the Family—HD FS 377
3 Principles of Accident Prevention—TSM 270
5 General Chemistry with lab—Chem 163 and 163L
4 Principles of Biology with lab—Biol 211 and 211L
3 Principles of Marketing—Mkt 340
3 Principles of Public Relations—Jl MC 220 or Publicity Methods—Jl MC 205
3 Principles of Microeconomics—Econ 101
3-4 Select from Engl 309, Engl 313, HD FS 395, HD FS 449 or Jl MC 342/342L
10-16 Directed Field Experience—H S 485

Electives to equal 124 total credits

The following courses must also be taken. They can fulfill either General Education or Core requirements for the Kinesiology & Health major:

3 Statistics—Stat 101, 104, 226
3 Psych 230 or HD FS 102 (under Social Science choice)

The following three courses must also be taken; they will fulfill the Advanced Core requirement; H S 310, 350 and Kin 366.

Option 3. Exercise Science

The Exercise Science option is designed for students interested in an interdisciplinary approach to the science of human movement. By combining exercise science with another area of study to support an individualized program, this option is suitable for students interested in graduate study or who are preparing for advanced study leading to careers in medicine, physical therapy, or other allied health programs.

R Search Strategies for Field Experience and Employment—Ex Sp 385
6 Two 300-400 level Ex Sp courses
26 Meet the requirements of a specialization area in a related field

Electives to equal 124 total credits
A statistics course and one of Math 140, 141, 142, or 165 must be selected in the General Education requirements.

The following six courses must also be taken; three can fulfill the Advanced Core requirement: Kin 355, 358, 360, 365 or 366, 372 and H S 350.

Option 4. General Studies

The general studies option is provided for students interested in an interdisciplinary approach to the study of human movement. In this option kinesiology is combined with a concentration in another area of study to support an individualized program, such as community sport and recreation, dance, and other sport, exercise, or health related fields. Programs of study must be approved by the undergraduate program coordinator.

R Kin 385
6 Additional credits in 300-400 Kin courses
26 Credits in related areas of study (must be approved by Curriculum Coordinator)
8-12 Internship in Sport and Exercise Science—Kin 485

Electives to equal 124 credits

The following courses must also be taken. They can fulfill the General Education requirements:

2-3 Mathematics—Select from Math 140, 141, 142, 150, 165
3-5 Statistics—select from Stat 101, 104, 226

4 Physics—Physics 106 or 111

The following five courses must also be taken: three can fulfill the Advanced Core requirement: Kin 355, 358, 360, 365, 372.

Option 5. Health/Fitness Management

This option prepares students for careers in the physical fitness/health field. It is designed for those who wish to prepare for professional roles as exercise specialists or program directors in corporate fitness programs, health clubs, cardiac rehabilitation programs, or other public and private agencies providing physical fitness activities.

2 Basic Athletic Training—Kin 220

2 Leadership Techniques for Fitness Programs—Kin 259
3 Management of Health-Fitness Programs and Facilities—Kin 345
3 Worksite Health Promotion—H S 380
R Search Strategies for Field Experiences and Employment—Kin 385
4 Principles of Fitness Assessment and Exercise Prescription—Kin 458
1 Internship in Exercise Leadership —Kin 459
3 Medical Aspects of Exercise—Kin 462
8-16 Internship in Sport and Exercise Science—Kin 485A
3 Principles of Organization and Management—Mgmt 370
3 Principles of Macroeconomics—Econ 101
4 Phys 106 or 111

Electives to equal 124 credits
The following courses are required: they can be taken as part of the General Education requirements:

2-3 Mathematics - select from Math 140, 141, 142, 150, 165
3-5 Statistics - select from Stat 101, 104, 226

The following five courses must also be taken: three can fulfill the Advanced Core requirement: Kin 355, 358, 366, 372 and H S 350.

Option 6. Physical Education Licensure

This option is designed for students seeking a license to teach physical education K-12. Students interested in preparing to coach must earn additional credits in: Kin 220 and 315. Note: when making general education course selections, teacher licensure students must choose C I 201, Psych 230, a natural science and a U.S. history or political science course.

Professional education requirements

3 Foundations of American Education—C I 204
R Senior Seminar—C I 415
3 Multicultural Gender Fair Education—C I 406
8 Supervised Student Teaching in Physical Education in the Secondary School—Kin 417
8 Supervised Student Teaching in Physical Education in the Elementary School—Kin 418

Physical education professional theory

2 Leadership Techniques for Fitness Programs—Kin 259
3 Elementary and Pre-school Movement Education—Kin 312
0.5-1 Directed Field Experience in Elementary School Physical Education—Kin 280
0.5-1 Directed Field Experience in Physical Education—Kin 281
3 Teaching Physical Education—Kin 375
3 Adapted Physical Education—Kin 395
3 Measurment in Physical Education—Kin 471
3 Physical Education Curriculum Design and Program Organization—Kin 475

Physical education professional activity and related courses

2 First Aid and Emergency Care—H S 105
1 Aquatics—Kin 230
1 Tumbling and Gymnastics Skills—Kin 231
1 Fundamentals of Self-defense—Kin 237
1 Fundamentals of Outdoor and Adventure Activities—Kin 238
1 Team Sport - Kin 232 or 233
1 Individual Sport—Kin 235 or 236
2 Dance—Dance 211

Electives to equal 124 total credits
The following course must also be taken. It can fulfill the General Education requirement:

4 Physics 106 or 111

The following five courses must also be taken; three can fulfill the Advanced Core requirement: Kin 355, 358, 360, 365 or 366, and 372.

Curriculum in Hotel, Restaurant, and Institution Management

Administered by the Hotel, Restaurant, and Institution Management Program. Leading to the degree bachelor of science. **Total credits required: 123.5**

The curriculum in Hotel, Restaurant and Institution Management develops students as leaders for the hospitality professions.

Cr. Degree Requirements
9.5 Communications and library
Engl 150, 250; Lib 160; Sp Cm 212
13 Natural sciences and mathematical disciplines
Math 104 or 150; Stat 101; and 6 credits of natural sciences
9 Social sciences
Econ 101; HD FS 102; select 3 credits from psychology or sociology
9 Humanities
AESHM 342 and courses from approved list.
37 Hotel, Restaurant, and Institution Management core
AESHM 287; HRI 101, 193, 233, 315, 333, 352, 380, 380L, 393 or 491, 433, 438,455
13-15 Hotel, Restaurant, and Institution Management electives
Select from AESHM 271, 471, 474, 477; HRI 189, 260, 289, 383, 437, 439, 452, 487
13 Supporting courses
Acct 284, AESHM 111, 311
FS HN 111*, 167*
18-20 Electives
123.5 Total credits

*A student who has not had high school chemistry is required to take Chem 160.
**A student who has not had high school biology is required to take Biol 101.

Curriculum in Nutritional Science

Administered by the Department of Food Science and Human Nutrition.

Cr. Degree Requirements*
12.5 Communications/Library
Engl 150, 250; Lib 160; ComSt 214 or Sp Cm 212; Engl 314
7-12 Mathematical sciences
Math 160, 165-166, or 181-182 Calculus (2 semesters recommended); Stat 101 or 104
24 Physical sciences
Chem 177, 177L, 178, 331, 331L, 332, 332L; Phys 111, 112
26-27 Biological sciences
Biol 211, 211L, 212, 212L, 313, 314, 255, 255L, 335; Micro 201 or 302; Micro 201L or 302L
15 Humanities/Social sciences
FS HN 342; select 6 crs. of humanities courses; select 3 crs. of social science courses; select 3 additional crs. of humanities or social sciences courses
34-35 Food science and human nutrition
FS HN 110, 167, 203, 214 or 311, 265, 360, 361, 362, 461, 480, 492; select at least 9 additional credits from FS HN 403, 412, 419 or 519, 463, 464, 466, 490C 499,
0-2 Electives
120.5 Total credits

*Additional degree requirements: Students must fulfill international perspectives and U.S. diversity requirements by selecting coursework from approved lists. These courses may be used to fulfill other area requirements.

Concurrent B.S. and M.S. Program:
Well qualified students in Nuritional Science who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both a bachelor of science in Nutritional Science and a master of science degree in Nutritional Sciences. For more information, refer to www.fshn.hs.iastate.edu

College of Liberal Arts and Sciences

Michael B. Whiteford, Dean
Zora D. Zimmerman, Associate Dean
David J. Oliver, Associate Dean
Dawn Bratsch-Prince, Associate Dean
Ruth W. Swenson, Associate Dean Emerita
www.las.iastate.edu/

Departments of the College

Air Force Aerospace Studies
Anthropology
Biochemistry, Biophysics, and Molecular Biology
Chemistry
Computer Science
Ecology, Evolution, and Organismal Biology
Economics
English
Genetics, Development, and Cellular Biology
Geological and Atmospheric Sciences
Greenlee School of Journalism and Communication
History
Mathematics
Military Science (Army Reserve Officers' Training Corps)
Music
Naval Science
Philosophy and Religious Studies
Physics and Astronomy
Political Science
Psychology
Sociology
Statistics
World Languages and Cultures

The College of Liberal Arts and Sciences is the academic home, the foundation, for many essential learning disciplines. The college provides students with all the components of a modern liberal education. Students may choose to study in various fields of the physical, biological, and social sciences; in mathematical disciplines; in methods and systems of communication; and in the arts and humanities.

Learning and Teaching Mission

The primary mission of the college is to promote learning in all its dimensions by providing the student with ample opportunities to acquire the requisite knowledge, abilities, and skills to succeed in the world beyond the university. Throughout coursework within the major and in general education, students will develop skills in reasoning, analysis, and communication; achieve an understanding of the intellectual, historical, and artistic foundations of culture; and work to strengthen their abilities to interact with people, cultures, and the environment in an ethical and sensitive manner. To achieve these learning goals, the college asks students to acquire depth in learning within disciplines of their own choosing, and to acquire breadth through general education courses and electives.

The Curriculum

A baccalaureate degree in liberal arts and sciences is the end result of a curriculum that connects and integrates study in a major with general education. Requirements for a degree are deliberately flexible. Students select programs of study suited to a variety of interests and goals. Students having academic interests not fully met by a departmental major may also pursue a major offered by one of the college's interdepartmental programs or may apply for an undergraduate major in interdisciplinary studies (See *Index, Cross-Disciplinary Studies, Courses and Programs*). The college participates in the University Honors Program; thus, students with exceptional academic promise can develop unique and challenging programs of study.

The college has three curricula: a curriculum in Liberal Arts and Sciences, leading to the bachelor of arts or the bachelor of science degree; a curriculum in music, leading to the bachelor of music degree; and a curriculum in liberal studies, leading to the bachelor of liberal studies degree.

High School Preparation/ Admission Requirements

Students entering the college are required to present evidence of the following high school preparation:

4 years of English (Typically this preparation includes courses in British, American, and world literature in which critical reading and writing skills are emphasized and courses in speech and composition, including at least one senior-level writing course.)

3 years of social studies (Typically such preparation includes two semesters of world history, two semesters of American history, and a semester of American government. Electives can be chosen from areas such as economics, sociology, or psychology.)

2 years of a single world language (Three years or more of a single world language are strongly recommended for students who wish to continue their work in that language. A minimum of three years of a single world language is required to fulfill the world language graduation requirement in the College of Liberal Arts and Sciences.)

3 years of mathematics (Such preparation shall include two semesters of beginning algebra, two semesters of geometry, and two semesters of intermediate algebra. A fourth year of study involving analytic geometry, trigonometry, linear algebra, and/or calculus is strongly recommended for students who will major in mathematical or scientific disciplines.)

3 years of science (At least two years of such preparation shall be chosen from biology, chemistry, and physics.)

Recommended but not required as a condition of admission to the College of Liberal Arts and Sciences is one semester of computer experience. (Such a course should stress problem-solving with computers and should not substitute for courses in mathematics. In schools where computer use is an integral part of most courses, separate instruction in computers is not necessary.)

Students who transfer from another college or university with at least 24 credits of satisfactory coursework may be exempt from most of these requirements. Students who do not meet the requirements listed here may be admitted with a limited number of deficiencies. Contact the college office for further information about resolving these deficiencies.

Transfer Students

To graduate from the College of Liberal Arts and Sciences, a transfer student must complete the general requirements of the college as well as those of the university. Students planning to transfer to Iowa State University for the purpose of enrolling in the College of Liberal Arts and Sciences are advised to contact the college office for information concerning degree program requirements. Prospective transfer students are urged to learn about the academic programs that are of interest to them well before arriving on campus so that pretransfer courses are appropriate to the planned major and transferable toward graduation from ISU. Additional information concerning transfer credit evaluation may be obtained through the Office of Admissions as well as the department in which a student is interested.

A transfer student in the College of Liberal Arts and Sciences may choose to graduate under the catalog in effect at the time of his or her graduation or under one of the two immediately preceding catalogs, provided that it covers the period of his or her enrollment either at Iowa State or any other accredited school. Full requirements of the chosen catalog must be met except that adjustments will be made in instances where courses are no longer available or where programs have been changed. A transfer student is responsible for reviewing his/her transfer credit evaluation with the academic adviser during the first semester of enrollment.

University Requirements

The university requirements for the bachelor's degree, including statements of academic standards, learning goals, the university residence requirement, the Communication proficiency requirement, U.S. diversity and international perspectives requirement, and the library requirement, appear in the Colleges and Curricula portion at the beginning of this catalog.

Curriculum in Liberal Arts and Sciences

To obtain a bachelor's degree from the College of Liberal Arts and Sciences, curriculum in liberal arts and sciences, an undergraduate student must earn a minimum of 120 semester credits including a minimum of 32 semester credits earned in residence at Iowa State University. In addition, the student must meet general education, communication proficiency, library proficiency, world language, and advanced credit requirements, as well as the requirements of a major. Courses taken on a pass/not pass basis may be counted toward the required total of 120 credits, and may be used to meet the advanced credit requirement, if appropriate, but may not be used to satisfy any other graduation requirement. No more than 9 credits of 490 (Independent Study) courses in a single discipline may be counted toward graduation.

General Education

Requirements and Learning Goals

The central importance of a general education is reflected in the learning goals of each of four disciplinary areas. Whereas the courses in a major are designed to develop mastery of a specific field or discipline, courses in general education are designed to establish a strong, intellectual foundation for all specializations. Students earn the minimum credits listed in each of the four general education areas in courses not required by the department of the first major listed on the degree program. Interdisciplinary courses may be used to satisfy requirements in any area for which they have been approved, but a student may not apply the same course to more than one area.

Credit by Examination Program

Individual departments may use CLEP Subject Tests for testout of specific courses. Students in the College of Liberal Arts and Sciences may use CLEP General Test credits as free electives but not toward any of the general education area requirements.

World Language Requirement

The faculty of the College of Liberal Arts and Sciences believes that undergraduate students should acquire elementary practical experience in a second language, should be introduced to the theoretical study of language structure, and should begin to develop an understanding of a second culture through study of that culture's language.

As a means of achieving this objective, a student must satisfy a graduation requirement equivalent to the first year of university-level study in one world language (normally, completion of a two-semester sequence in any one world language). Students who have completed three or more years of high-school world language study are deemed to have completed the LAS World Language Requirement. These students may not enroll in or receive credit for 101 or 102 in those languages; test-out credit may be obtained by passing an appropriate examination or by completing an advanced sequence (200-level or higher) in that language. 101 or 102 may not be taken on a remedial basis.

Students who have completed more than one year but less than three years of high-school world language study may not enroll in 101 in the same language. These students may enroll in either a 102 course in that language, or in the case of Spanish, Span 97. Before enrolling in either Span 97 or a 102 language course, students are advised to take the on-line placement test available at www.language.iastate.edu. Span 97 is designed for students who need additional remedial work in the language at the first-year level (101-102) and are not planning to continue their language study at the second-year 201-202 level. Students who complete Span 97 with a passing grade will have fulfilled the LAS World Language Requirement. Students who have completed Span 97 and wish to pursue further study in Spanish at the 201-202 level may enroll in 102.

Students who have completed more than one year but less than three years of high-school world language study may satisfy the World Language Requirement by (a) passing the exam for credit at the 102 level, (b) receiving a passing grade in a 102 world language course, or (c) receiving a passing grade in a world language course at the 200-level or higher. For more information see *Department of World Languages and Cultures*. (Courses taught in English do not satisfy the World Language Requirement). Iowa State University accepts a record of academic performance in American Sign Language or certification of proficiency in American Sign Language as fulfillment of entrance or graduation requirements in world language for a baccalaureate degree.

Questions about the World Language Requirement and how to meet it should be directed to the Department of World Languages and Cultures. Credits applied toward the World Language Requirement cannot be used to satisfy the general education requirements, but students who have fulfilled the World Language Requirement may apply additional courses in world languages toward the appropriate general education areas. Majors in any world language are deemed to have fulfilled the college World Language Requirement. International students for whom English is a second language may satisfy the World Language Requirement by completion of Engl 150 and 250 at ISU with an average grade of C- or better. See *World Languages and Cultures* for additional information on international students.

Advanced Communication Skills

The continued development of communication skills following the sophomore year is the responsibility of the student's major department. The department promotes this development by adopting measures to certify the writing proficiency of its own majors. Certification occurs upon satisfactory completion of a designated course in which writing is evaluated and is a significant component. This designated course may be be either a course required in the student's program or an advanced writing course offered by the Department of English (e.g., Engl 302, 305, or 314).

General Education Areas

The central importance of a general education is reflected in the learning goals of each of three disciplinary areas. Whereas the courses in a major are designed to develop mastery of a specific field or discipline, courses in general education are designed to establish a strong, intellectual foundation for all specializations. The general education areas with their minimum credit requirements for the College of Liberal Arts and Sciences are:

Arts and Humanities—(Minimum 12 credits). The student should develop an understanding of human cultural heritage and history, and an appreciation of reasoning and the aesthetic value of human creativity.

Natural Sciences and Mathematical Disciplines—(Minimum 11 credits, including 3 in the mathematical disciplines and 8 in the natural sciences). The student should experience science as a rational search for understanding the structure and behavior of the natural world, and should appreciate mathematics as a valuable tool of the sciences and as an intrinsically important way of thinking.

Social Sciences—(Minimum 9 credits). The student should develop an appreciation of the principal methods of studying human behavior and an understanding of the structure and functioning of institutuions.

Because students fulfill, in part, the learning goals of the area of their first major by taking courses in their programs of study, the minimum number of general education credits required in the area of the first major is reduced from that listed above by 3 credits. Students in Liberal Studies or Interdisciplinary Studies majors must complete the minimum requirements in all three areas. The list of majors falling within each area is available from the Office of the Dean, College of Liberal Arts and Sciences, and is posted on the web site of the College of Liberal Arts and Sciences.

Courses from the department of the first major may not be applied to general education requirements. Courses cross-listed with a course in the student's first major may be used to satisfy either major requirements or general education requirements, but may not be used more than once. Interdisciplinary courses may be used to satisfy requirements in any area for which they have been approved, but a student may not apply the same course more than once.

Lists of approved courses are available on the web, from academic advisers or from the Office of the Dean, College of Liberal Arts and Sciences.

Advanced Credit Requirements

To obtain a baccalaureate degree from the College of Liberal Arts and Sciences, curriculum in liberal arts and sciences, a student must earn at least 45 credits at the 300 level or above taken at a four-year college. All such credits, including courses taken on a pass/not pass basis, may be used to meet this requirement.

The major must contain at least 8 credits in courses taken at Iowa State University that are numbered 300 or above and in which the student's grade is C or higher. In addition, the average grade of all courses in the major (those courses listed under major on the degree audit) must be 2.0 or higher. Courses from the department of the first major listed on the degree program may not be counted in the general education areas.

The Major

Students must show they have achieved depth in a specialized area by completing successfully the requirements and learning goals of a major. A major is comprised of 24 to 48 credits in a specific discipline as determined by the faculty. Tracks within a major must have a common 24 credit core. Some courses outside the major discipline may also be required as supporting work for the major. (See Index for page reference to individual department and program requirements.)

The major must contain at least 8 credits in courses taken at Iowa State University that are numbered 300 or above and in which the student's grade is C or higher. In addition, the average grade of all courses in the major (those courses listed under major on the degree audit) must be 2.0 or higher. Courses in the first major listed on the degree program may not be counted in the general education groups.

Courses meeting the requirement of additional majors may be counted in the general education groups. When choosing an additional major, students must confirm that the additional major is allowable (see list under "*Double Majors*").

The major is chosen from the following list, which also indicates the degree(s) offered in the respective majors.

Advertising, B.A.
Anthropology, B.A., B.S.
Biochemistry, B.S.
Bioinformatics and Computational Biology, B.S.
Biological/Pre-Medical Illustration, B.A.
Biology, B.S.
Biophysics, B.S.
Chemistry, B.A., B.S.
Communication Studies, B.A.
Computer Science, B.S.
Earth Science, B.A., B.S.
Economics, B.S.
English, B.A., B.S.
Environmental Science, B.S.
    Environmental Studies (may be taken as a second major with the degree to be determined by the first major)
Genetics, B.S.
Geology, B.S.
History, B.A., B.S.
Interdisciplinary Studies, B.A., B.S.
    International Studies (may be taken as a second major with the degree to be determined by the first major)
Journalism and Mass Communication, B.A., B.S.
Linguistics, B.A.
Mathematics, B.S.
Meteorology, B.S.
Music, B.A., B. Mus.
Performing Arts, B.A.
Philosophy, B.A.
Physics, B.S.
Political Science, B.A.
Psychology, B.A., B.S.
Religious Studies, B.A.
Sociology, B.A., B.S.
Software Engineering, B.S.
Speech Communication, B.A.
Statistics, B.S.
Technical Communication, B.S.
Women's Studies, B.A., B.S.
World Languages and Cultures, B.A.

The major in interdisciplinary studies (B.A., B.S.) is available for undergraduate students who have unique interdisciplinary educational goals. Such a major is designed by the faculty and the student and is approved only when the educational goals cannot be met by a reasonable combination of existing majors, minors, and electives. (See Index, *Interdisciplinary Studies*.)

A curriculum in liberal studies leading to a bachelor of liberal studies degree (B.L.S.) is also available. (See Index, *Liberal Studies*.)

The LAS College offers certificate programs available for students seeking documentation of additional study in specialized academic topics. At present, certificates are available in Latin American Studies and in Community Leadership and Public Service. Information about the specific course requirements in these certificate programs may be found in their respective entries in the Courses and Programs section of this catalog.

Double Majors

Students may elect a second major from the departments and program areas listed above, or from a major field offered for the bachelor's degree in another college of the university. Double majors between the following are not allowed: Chemistry with Biochemistry and Agricultural Biochemistry; Biology with Animal Ecology, Agricultural Biochemistry, Biochemistry, Genetics, and Microbiology.

The major departments must then approve the degree program, and if those majors involve two colleges, both deans must approve. Such programs must fulfill the general education requirements of the college of the primary major. If one major leads to the B.A. degree and the other to the B.S. degree, the degree awarded will be the one offered by the department of the primary major.

If the primary major may lead to either a B.A. or a B.S., a student may choose to receive either degree. In all cases, the student must satisfy the requirements of each major and of the degree that is chosen for the primary major. Students with a primary major in another college who wish to take a second major in the College of Liberal Arts and Sciences are not required to meet the Liberal Arts and Sciences General Education and World Language Requirements.

A student may earn two degrees in the Liberal Arts and Sciences curriculum with two appropriate majors and at least 30 additional credits. Either the B.A. or the B.S. in this curriculum may be earned with the Bachelor of Music. A major in Liberal Arts and Sciences may not be added to a Bachelor of Liberal Studies or a Bachelor of Music degree. Any degree offered by this college may be earned together with a degree with a major in any other college of the university. For the requirements for two degrees, see Index, *Bachelor's Degree Requirements.*

Minor

A minor, which is optional, must consist of at least 15 credits, with at least 6 credits in courses numbered 300 and above taken at ISU with a grade of C or higher. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement. (See Index, *Minors*.)

The following minors are offered by the college of Liberal Arts and Sciences:

Advertising
African American Studies
American Indian Studies
Anthropology
Astronomy
Biochemistry
Biological Illustration
Biology
Chemistry
Chinese Studies
Classical Studies
Communication Studies
Computer Science
Criminal Justice Studies
Economics
Emerging Global Disease
English
Entrepreneurial Studies
Environmental Science
Environmental Studies
French
Genetics
Geology
German
Gerontology
History
International Studies
Journalism and Mass Communication
Latin
Linguistics
Mathematics
Meteorology
Military Studies (Army Reserve Officers' Training Corps)
Music
Music Technology
Performing Arts
Philosophy
Physics
Political Science
Psychology
Religious Studies
Russian Studies
Sociology
Spanish
Speech Communication
Statistics
Technical Communication
Technology and Social Change
Women's Studies

Courses applied toward the general education groups may be used to meet the requirements of a minor. (For restrictions, see *Index, Minors*.)

If a student declares a minor and completes the requirements specified by the offering department/program, the minor will be recorded on the transcript.

Electives

Students will take additional courses, freely elected, sufficient to accumulate a total of 120 credits. These additional courses together with the general education courses may be used to meet the requirements of a minor or of another major, provided that they are taken on a graded basis.

Planning the Program of Study

Careful, comprehensive planning is important for meeting graduation requirements and taking advantage of the resources offered by the university. Each student is encouraged to work with his or her academic adviser in developing a four year plan as soon as possible after declaration of the major. A degree audit listing all completed courses and those remaining to be taken for fulfillment of the degree requirements in the student's chosen major is provided to the student and the adviser each semester. The student should review the audit each semester and consult with the adviser when changes are required. Any changes to the audit must be approved by the academic adviser and by the dean's office. It is essential that the audit be reviewed and updated in a timely fashion in order to avoid delay in the student's graduation.

During the first year, students should meet proficiency requirements in English and in library. They should also make progress toward meeting the general education requirements, a large part of which should be completed by the end of the second year. The third and fourth years should emphasize completion of the major (and minor, if elected) and of general education requirements, and should give the student an opportunity to take electives.

Academic Advising Learning Outcomes

Through their experience with academic advising, students will:

Develop an understanding of the structure, application, and goals of a liberal arts education in relation to their academic development.

Be able to formulate appropriate questions, seek information, and evaluate and apply academic advice.

Know the requirements, policies and protocol of the university, college, and department as they relate to their educational experience.

Understand how degree programs can be enhanced by study and experiences tailored to their intellectual and personal goals.

Be able to identify and utilize university resources effectively to

- Satisfy degree requirements
- Plan programs of study, including selection of appropriate courses and registration
- Discover how interests, skills and goals connect to fields of study and careers
- Link curricular and co-curricular activities
- Research and prepare for advanced study and/or careers

Share responsibility for a mentor-mentee relationship between advisee and adviser.

The Open Option

Many students entering Iowa State University are not ready to declare a major. They want time to become familiar with the academic opportunities that the university offers and to determine the best match between their academic interests and abilities. These students enter Iowa State University as Open Option majors.

The Open Option experience is designed to help students explore majors and careers, become acquainted with the entire university, and make successful adjustments to the academic expectations of Iowa State. Open Option students are assigned academic advisers in the Liberal Arts and Sciences Student Academic Services Office. These advisers help students with academic and career development.

During the first year, an orientation class introduces them to all of the colleges and majors on campus. A career development class in the second semester guides students in selecting a major and career that match their academic and personal goals. Open Option majors also have the opportunity to be members of a learning community with other Open Option students.

Aided by their adviser, Open Option students select courses that allow them to sample their academic interests before committing to a specific university major. Open Option students are encouraged to declare this major by the end of the first year. In addition, students who may have started in a specific field and have discovered it is not meeting their needs may transfer into Open Option for a semester or two while they decide on a new major.

Honors Program

For information on the Honors Program in the College of Liberal Arts and Sciences, see Index*, Liberal Arts and Sciences, Cross-Disciplinary Programs, Honors Program.*

Reserve Officers' Training Corps Programs (ROTC)

The College of Liberal Arts and Sciences also offers students the opportunity to combine their academic programs with ROTC programs in the Military Science (Army), Naval Science, and Air Force Aerospace Studies).

Teacher Licensure

Teaching licenses are issued by the Iowa Board of Educational Examiners. The Recommending Officer for the ISU University Teacher Education Program submits each candidate file after that candidate is determined to be eligible for licensure. Teaching licenses are issued for a specific teaching level, e.g., K-6 or 7-12. A subject area endorsement is listed on the candidate's license. The licensee may have multiple subject area endorsements listed.

Students in the College of Liberal Arts and Sciences who complete the approved licensure program in music education (BM degree with Vocal K-12 option or Instrumental K-12 option) may apply for a teaching license that allows them to teach music in grades K-12. Students who plan to teach in secondary schools (grades 7-12) may qualify for a license by completing an approved licensure program in one of the following LAS majors:

Biology
Chemistry
Earth Science
English
French
German
History
Spanish (Latin & Russian endorsements)
Mathematics
Physics

Students may also add these additional endorsements to their primary license:

English as a Second Language
General Science
Physical Science
Social Studies
Speech Communication

For further information, see *Index, Teacher Education*.

Preprofessional Programs

Students in the College of Liberal Arts and Sciences may participate in preprofessional programs in human health-related fields, law, and theology by taking the courses required for admission to professional schools. Students may enter the college with the designation Premed, Prelaw, or Preprofessional Health Programs. Most will earn a bachelor's degree by choosing a major and meeting the requirements for the major while taking the preprofessional courses.

Others will spend one to three years as students in the college before transferring to a professional school to which they have applied and been accepted. For further information, see *Index, Preprofessional Study.*

Experiential Learning (Internship/Co-op Program)

The Experiential Learning (Internship/Co-op) Program assists students in gaining career-related experience while going to school. Internships/Co-ops provide students with the opportunity to gain specific skills, apply academic knowledge in practical situations, pretest their career choice, earn a salary, and establish a network of professional contacts.

Most internships are full-time and last for a semester or a summer, but a part-time experience is possible. Students wishing to receive academic credit for their internship must make arrangements with a faculty member in their major department. In contrast, co-op students work full-time on an extended basis (work two semesters) or on an alternating basis (work, school, work, etc.) during any semester (fall, spring, summer).

It may take students participating in the Experiential Learning (Internship/Co-op) Program an additional semester or more to complete their academic curriculum requirements. For additional information, contact Business/Liberal Arts and Sciences Career Services.

Curriculum for Bachelor of Music

The Department of Music offers a Bachelor of Music degree (B.Mus.) as well as a Bachelor of Arts degree in music. For information about both degrees, see Music, Courses and Programs.

In order to receive teacher certification in music, students must earn the bachelor of music degree.

Candidates for the bachelor of music will complete the following requirements.

Cr.	
38.5-46.5	General education
47	Music core
31-52.5	Music option

(Students must select one of the following options: music education [vocal or instrumental], performance [voice, piano, organ, string instruments, wind or percussion instrument], or composition.)

Curriculum for Bachelor of Liberal Studies

The LAS College administers a bachelors degree program in Liberal Studies. This degree, the bachelor of liberal studies (B.L.S.), was established by the three Iowa Regent universities to meet the needs of Iowans who want to earn a college degree but whose circumstances present obstacles to completing a traditional on-campus degree program. The B.L.S. is a general studies degree in the liberal arts. There is no traditional major. Instead, students take coursework in three areas of distribution. These areas may be focused in a single discipline or diversified over several disciplines. With the assistance of a B.L.S. adviser, students can structure a program that meets their individual educational, vocational or personal goals.

For specific degree requirements, see Liberal Studies, Courses and Programs.

Curriculum for Software Engineering

A bachelor of science degree in software engineering is jointly administered by the Department of Electrical and Computer Engineering (College of Engineering) and the Department of Computer Science (College of Liberal Arts and Sciences). The program is aimed at creating high-quality software in a systematic, controlled, and efficient manner. The specific objective of the program is to educate students on principles, processes, techniques, and tools for producing, analyzing, specifying, designing and evolving software. A broader objective is to cultivate among students intellectual curiosity, problem solving skills, good learning habits, effective communication skills, leadership, and teamwork.

This interdepartmental program enables students to take a range of Software Engineering courses, as well as elective courses from both Computer Science and Computer Engineering as part of their degree program.

For specific degree requirements, see Software Engineering, Courses and Programs.

College of Veterinary Medicine

John U. Thomson, Dean
Donald D. Draper, Associate Dean for Academic and Student Affairs
Donald L. Reynolds, Associate Dean for Research and Graduate Studies
Eldon Uhlenhopp, Interim Associate Dean for Outreach and Operations

vetmed.iastate.edu/

Departments of the College

Biomedical Sciences
Veterinary Clinical Sciences
Veterinary Diagnostic and Production Animal Medicine
Veterinary Microbiology and Preventive Medicine
Veterinary Pathology

Other units of the college include the Veterinary Teaching Hospital, Veterinary Diagnostic Laboratory, Veterinary Medical Research Institute, Veterinary Education and Technology Services and Office of Curricular and Student Assessment. The college participates in interdisciplinary graduate programs in genetics; molecular, cellular and developmental biology; toxicology; immunobiology; and neuroscience.

Objectives of the Curriculum

The instructional objective of the College of Veterinary Medicine is to enable students to assume vital roles in society as productive health care providers and biomedical scientists. Such an education provides students with general learning, communication, and problem solving abilities; veterinary medical practice and research skills; and professional and ethical values.

The curriculum incorporates basic biomedical and clinical principles, clinical decision making skills, and exceptional clinical experience in small animal medicine and surgery, equine medicine and surgery, food animal medicine and surgery, and production animal medicine. Companion animal medicine and surgery are provided within the regionally recognized referral hospital through the community practice unit and equine field services. The college is located in one of the most intensive livestock producing areas in the United States. Because of this, students engage in extensive food supply veterinary medicine experiences and numerous diagnostic cases.

The professional curriculum is a four-year course of study leading to the doctor of veterinary medicine degree. Each of the first three years of the curriculum consists of two semesters while the fourth year has three semesters. Students are admitted into the professional curriculum after completing a minimum of 60 semester credits of required undergraduate coursework.

A strong and reputable basic science education during the first two years of the professional curriculum prepares veterinary students for a wide range of clinical experience during the last two years of the educational program. Fourth year students may choose to enhance their education by earning clinical elective credits at approved government agencies, research laboratories, veterinary practices and other university hospitals. Outstanding research programs in infectious diseases, food safety, neuroscience, immunoparasitology, evidence-based medicine, and many other areas provide opportunities for qualified students to participate in research.

Concurrent D.V.M./M.S., DVM/Ph.D., D.V.M./M.P.H. programs are available for qualified students who wish to obtain both veterinary and graduate degrees. Students must have a bachelor's degree or a minimum of 128 semester credits in undergraduate and professional curricula in order to participate in the concurrent DVM/graduate degree program. Admission to the concurrent degree program is subject to the approval of the deans of the College of Veterinary Medicine and the Graduate College.

The college is an important recruiting center for employers seeking veterinarians for private practice; industry; educational institutions; international agencies; federal, state and local governments; the armed forces; departments of public health; zoological gardens; and other related fields of professional activity. Graduates are highly sought after and typically have multiple employment offers upon graduation. Career services and an online job board are available for students.

Pre-veterinary Medicine Preparation

Admission Requirements

The College of Veterinary Medicine seeks students with diverse backgrounds and encourages students to enroll in baccalaureate programs in the college of their choice.

Undergraduate students are strongly encouraged to complete a bachelor's degree before applying to the College of Veterinary Medicine. Because veterinarians have varied career options, when deciding on an undergraduate major, the student should consider the area of veterinary medicine which interests them. For example, those who desire a career in clinical practice may wish to pursue a degree in biological science, animal science, agricultural economics, business, social science or humanities. Students with an interest in zoo or wildlife veterinary medicine may want to look at animal ecology, environmental studies or zoology. Future researchers may wish to consider genetics, molecular biology, microbiology, or biochemistry. Students who desire a career in public health (USDA, FDA, etc) or government (legislative/policy) may find benefits in any of the biological sciences or in political science. A degree in education may be valuable to those who envision themselves as educators in a College of Veterinary Medicine. These examples are only suggestions and are but a few of the many possibilities.

For the most current information regarding applications and admission to the College of Veterinary Medicine, please refer to the College web site at www.vetmed.iastate.edu/.

Applicants for admission to the College of Veterinary Medicine must have attended an accredited college or university, have completed 40 semester credits prior to the deadline for filing an application for admission, and have completed 60 semester credits prior to the end of the spring term of the year in which the applicant seeks to be admitted to the College of Veterinary Medicine.

All science requirements should be fulfilled by the time of application or scheduled for completion by the **end of the fall term in which the applicant applies.** However, if necessary, the applicant may complete up to two required science courses during the spring term prior to matriculation.

Any required science courses taken the spring term prior to matriculation requires a grade of B (3.00) or better to fulfill the requirement. Remaining non-science required courses must be completed by the end of spring term prior to matriculation with a grade of C (2.00) or better. Required courses may not be taken during the summer prior to entering the program.

Credits earned must include the following Iowa State semester course offerings or their equivalents:

English Composition One year of composition or writing emphasis courses. May include business or technical writing.

Engl 150, 250, 302, 309, or 314 6 cr.

Oral Communications May include public speaking, interpersonal communication, group or organizational communication or speaking emphasis courses.

Sp Cm 212, 223, or 312 or ComSt 214 or Ag Ed 311 3 cr.

General Chemistry with Laboratory*
One year series for biological science majors with one semester lab.

Chem 177-177L, 178 7 cr.

Organic Chemistry with Laboratory*
One year series with one semester lab.

Chem 331, 331L, 332 7 cr.

Biochemistry*
One semester (no lab required)
BBMB 301 3 cr.

General Physics with Laboratory*
First semester of a two-semester series with lab. Must include mechanics, fluids, heat and thermodynamics, vibrations, waves and sound.
Phys 111 4 cr.

General Biology with Laboratory*
Two semester series with lab each semester. A Bachelor's degree in Biology fulfills this requirement.
Biol 211, 211L, 212, 212L 8 cr.

Genetics *	
Must include Mendelian and molecular genetics.	
Biol 313 or Gen 320	3 cr.
Mammalian Anatomy or Physiology*	
Human anatomy or physiology will also fulfill this requirement (no lab required).	
An S 214, BMS 329, Biol 155, or Biol 255 or Biol 335)	3 cr.
Humanities or Social Sciences	8 cr.
Electives	8 cr.
Total Credits Required	60 cr.

* science requirement

Credits in the previously specified courses will normally be earned on the traditional four-letter grading system with A as the highest grade and D as the lowest passing grade. All required courses must be completed with a grade of C (2.0) or better. It is generally expected that required courses have been completed within the past eight (8) years. AP or CLEP credits must be documented by original scores submitted to the University and MUST meet the University's minimum requirement in the appropriate subject area. CLEP credits may be accepted only for arts, humanities and social sciences. Credits in the preceding specified courses will not be accepted if earned under the pass-not pass grading system or similar options.

Application and Admission

Applicants must apply using the Veterinary Medical College Application Service (VMCAS). The VMCAS application may be found online at the VMCAS website (www.aavmc.org under VMCAS). Those applying through VMCAS also need to complete the ISU Supplementary Application found at the College of Veterinary Medicine website. The deadline for filing the VMCAS application, evaluations and transcripts is October 1. The supplemental application, and processing fee are due to the College of Veterinary Medicine postmarked by October 15.

Any student wishing to use international coursework (including study abroad) to fulfill a preveterinary requirement must provide a transcript from the foreign institution.

A list of courses in progress at the time of submission and/or scheduled for completion by the end of spring term should accompany the supplemental application. Undergraduate college credits must average at least 2.50 on a 4.00 marking system for the application to be accepted. The preceding scholastic requirements are minimum and do not assure admission even though these requirements have been fulfilled.

Admission to the College of Veterinary Medicine is on a competitive and selective basis. Undergraduate GPA, Graduate Record Exam (GRE) general test score (The GRE must be taken prior to October 15 of the year the applicant applies and the scores must be received by October 31.), animal and veterinary experience, essays, recommendations and personal development (leadership, citizenship, etc.) are given consideration in the selection of candidates. An interview will be required for those applying to enter Fall 2008 and later.

Approximately one-half of the positions available are reserved for residents of Iowa. The College of Veterinary Medicine has implemented a Cooperative Program in Veterinary Medicine with the University of Nebraska-Lincoln for Nebraska residents and contracts with the states of North Dakota, South Dakota and New Jersey. A number of positions are also available to residents of other states. A few highly qualified international students may be accepted and are considered in the non-resident/non-contract applicant pool. Consideration is given equally to all applicants without regard to race, color, national origin, gender, religion, disability, or age, political beliefs, or marital or familial status.

For further information on these programs and contracts, please visit the College of Veterinary Medicine at www.vetmed.iastate.edu and click on Admissions.

Curriculum in Veterinary Medicine

Graduation Requirements

To be awarded the degree doctor of veterinary medicine, candidates must have passed all required courses in the curriculum in veterinary medicine, have earned at least 4 elective credits on a graded basis of A, B, C, D while enrolled in the College of Veterinary Medicine, and have at least a 2.0 grade-point average in the veterinary medicine curriculum.

Required Courses in the Professional Program

BBMB 420—Physiological Chemistry
BMS 330—Principles of Morphology I
BMS 331—Principles of Morphology II
BMS 333—Biomedical Sciences I
BMS 334—Biomedical Sciences II
BMS 337—Neurobiology
BMS/VCS 339—Clinical Foundations I
BMS 345—Case Study I
BMS 346—Case Study II
BMS 354—General Pharmacology
BMS 443—Pharmacology and Therapeutics
VCS 311—Veterinarian in Society I
VCS 312—Veterinarian in Society II
VCS 313—Veterinarian in Society III
VCS 314—Veterinarian in Society IV
VCS 315—Veterinarian in Society V
VCS 385—Seminar
VCS 391—Clinical Imaging
VCS 393—Principles of Surgery
VCS 394—Principles of Surgery Lab
VCS 395—Small Animal Surgery
VCS 398—Anesthesiology
VCS 399—Ophthalmology
VCS 436—Small Animal Internal Medicine
VCS/VDPAM 440—Introduction to Clinics
VCS 444—Small Animal Medicine
VCS 445—Equine Medicine
VCS 448—Diagnostic Imaging and Radiobiology
VCS 449—Junior Surgery Laboratory
VCS/VDPAM 450—Disturbances of Reproduction
VDPAM/V PTH 426—Veterinary Toxicology
VDPAM 445—Clinical Medicine
V MPM 378—Case Study IV
V MPM 380—Veterinary Immunology
V MPM 386—Veterinary Microbiology
V MPM 387—Veterinary Virology
V MPM 388—Public Health and the role of the Veterinary Profession
V MPM 437—Infectious Diseases and Preventive Medicine
V PTH 342—Anatomic Pathology I
V PTH 372—Anatomic Pathology II
V PTH 376—Veterinary Parasitology
V PTH 377—Case Study III
V PTH 409—Introduction to Veterinary Cytology and Laboratory Techniques
V PTH 425—Clinical Pathology

Fourth Year

The fourth year of the veterinary medical curriculum is designed to be flexible yet provide a broad based clinical education involving all domestic species of animals. All students participate in rotations that are considered fundamental to any species orientation that the student might choose. In addition, students can participate in rotations focused on small animals, horses, or food animals. Students may obtain clinical elective credits by repeating on-campus rotations or participating in approved off-campus preceptorships at government, private or public agencies; other universities; or private veterinary practices.

Students may choose from the following list of clinical rotations.

Anesthesiology
Beef Production Medicine
Cardiology
CDC Epidemiology
Clinical Microbiology
Clinical Pathology
Community Practice
Dairy Production Medicine
Dermatology
Diagnostic Laboratory
Equine Field Services
Equine Medicine
Equine Surgery
Farrier
Food Animal Medicine and Surgery
Food Supply Field Services
Intensive Care/Emergency Medicine
Necropsy
Neurology
Oncology
Ophthalmology
Orthopedic Surgery
Public Health Laboratory
Radiology
Small Animal Medicine
Small Ruminant Production Medicine
Soft Tissue Surgery
Swine Production Medicine
Theriogenology

Reinstatement

Any student who voluntarily withdraws from the College of Veterinary Medicine or who is dismissed from the College of Veterinary Medicine, after having successfully completed one or more semesters forfeits his/her standing and must make written application for reinstatement to this college a minimum of 60 days prior to the opening of the semester for which they seek to re-enter. Any student who voluntarily withdraws from the College of Veterinary Medicine prior to completion of one semester must re-apply for admission to the college in the general applicant pool.

Graduate College

www.grad-college.iastate.edu/

David K. Holger, Dean
George A. Jackson, Assistant Dean
Carolyn Payne, Assistant Dean

The Graduate College and graduate faculty at Iowa State University are responsible for the quality of graduate education, for administering students' graduate programs, and for promoting research support from various governmental, industrial, and private agencies.

The graduate faculty in various programs handle admission and classification of graduate students, establish requirements for advanced degrees, and have charge of instruction and research at the graduate level. Graduate faculty members also teach graduate courses, serve on program of study (POS) committees, and direct work of master's and doctoral students. All graduate courses offered for major or nonmajor credit are taught by graduate faculty members or graduate lecturers.

Graduate study was offered soon after the university was founded, and the first graduate degree was conferred in 1877. Experimentation and research also started early, first in agriculture and shortly thereafter in home economics, engineering, science, and veterinary medicine. In 1913, the graduate faculty was organized formally and an executive graduate committee was appointed. In 1915, the graduate faculty held its first meeting, and in 1916, it granted the first doctor of philosophy degree.

Graduate education is vital to the quality of university teaching. The creative efforts of graduate faculty members and graduate students result in knowledge necessary to help society solve problems in educational, scientific, technological, and socio-economic areas. The Graduate College encourages educational exchange and contact with undergraduate areas of the university to promote improved teaching on both the undergraduate and graduate levels. A part of this exchange is accomplished by the publication of books and technical articles which are made possible by graduate research.

The degrees master of arts, master of science, and doctor of philosophy are research oriented. In many fields master's degrees are also awarded without a thesis, but a written report of independent study, called a creative component, is generally required. For those individuals interested in advanced study directed toward meeting vocational or professional objectives, the following degrees are offered: master of accounting, master of agriculture, master of architecture, master of arts in teaching, master of business administration, master of community and regional planning, master of education, master of engineering, master of family and consumer sciences, master of fine arts, master of landscape architecture, master of public administration, and the master of school mathematics.

The Graduate College Handbook lists policies and procedures of the Graduate College. It is available at the Graduate College's Web site: www.grad-college.iastate.edu/.

Admission

All degree-seeking graduate students must have graduated with a bachelor's or master's degree from a regionally accredited U.S. institution or from a recognized foreign institution where the requirements for the bachelor's degree or its equivalent are similar to those at ISU. Additionally, each applicant must be accepted at ISU by the major program, the Office of Admissions, and the Graduate College. For information concerning graduate study in a particular academic discipline, prospective students should correspond with the chair of the major program in which they wish to study.

Iowa State University has a shared application process, which means certain items are sent (electronically or in print form) to the Office of Admissions and other items are sent to the graduate program to which the prospective student is applying. Detailed instructions are available at https://www.applyweb.com/apply/isu/. Students are also encouraged to check the Program Requirements Web page on the Graduate College Web site at http://www.grad-college.iastate.edu/programs/APprograms.php for mailing instructions and deadlines for each program.

The nonrefundable application fee is $30 ($70 for international applicants). An electronic application is required to apply to ISU's graduate programs; the form and necessary instructions are available at https://www.applyweb.com/apply/isu/. The application fee is required of all applicants except those who have attended Iowa State as undergraduates, or those applying for admission in the nondegree admission status. Iowa State requires official academic records and statements of all degrees earned from all institutions attended since secondary school. Faxed, scanned, and notarized copies are not considered official. that each previous college or university attended provide official transcripts of grades and credits earned, and request that the institution from which the degree was granted provide a statement of the degree received and the applicant's quartile class rank, if available from the institution.

Many programs have very early application deadlines. For more details, check program deadlines at www.grad-college.iastate.edu/programs/APprograms.php.

Categories of Graduate Admission

An applicant pursuing an advanced degree must be recommended by the program in which he/she will be pursuing an advanced degree and must be approved by the Dean of the Graduate College.There are three admission categories for students who wish to pursue an advanced degree:

Full Admission status may be granted to an applicant who either has achieved a grade point average (GPA) of 3.0 or greater (on a 4.0 scale), or ranks in the upper one-half of his or her undergraduate class.

Provisional admission status may be granted to applicants who meet the requirements for full admission (listed above), but have academic or prerequisite deficiencies to remedy. Transfer from provisional admission to full admission status requires the completion of the graduate English requirement, completion of the coursework prescribed to remedy the background deficiencies with a grade average of B or better, and the written recommendation of the major professor and approval by the Dean of the Graduate College.

Restricted admission status may be granted to an applicant who does not satisfy the formal university requirements for full admission status and/or lacks undergraduate preparation in a field related to the graduate field of study. Restricted admission may also be granted to graduates of non-English-speaking foreign institutions, even if the student meets the university requirements for full admission status. Advancement from restricted to full admission status requires completion of 9 semester credits of graduate level course work as a graduate student with a cumulative grade average of B or better and satisfaction of the Graduate College English requirement. A recommendation is submitted in writing to the Graduate College by the major professor and must be approved by the Dean of the Graduate College.

Graduate Admission Without a Declared Major

Admission without a declared major is a category for graduates of regionally accredited institutions in the United States who do not intend to seek an advanced degree from Iowa State University. Such students usually include:

1. Those who intend to transfer graduate credit earned at Iowa State University to other institutions.
2. Those who intend to use graduate credits earned for professional certification.
3. Those who enroll for personal satisfaction.
4. Those who enroll occasionally in off-campus graduate courses.Students who wish to apply to Iowa State University without a declared major need to contact the Office of Admissions, 100 Enrollment Services Center (1-800-262-3810) for the nondegree application form for students in this category. The application form is also available at the web site at www.admissions.iastate.edu/nondegree/

Applications and schedules for students with an undeclared major are processed directly by the Office of Admissions and the Graduate College office; no program approvals are generally required. (Applications and schedules for students declaring a major require program evaluation and approval.)

A student without a declared major who subsequently seeks full, provisional, or restricted admission must apply to and be accepted by a graduate program and by the Graduate College for degree study. A new application, the application fee (unless the student attended Iowa State University as an undergraduate), and transcripts from all colleges attended are required.

For those students originally admitted to the Graduate College on a nondegree basis, no more than 9 semester hours of graduate credit earned under the nondegree option may be applied if the student later chooses to undertake a graduate degree program. The student's program of study committee will recommend to the Graduate College which courses (if any) taken on a nondegree basis may be included in the degree program.

Graduate Admission of International Students

An applicant who is a graduate of a recognized foreign institution is subject to the same criteria for admission as a graduate from an institution in the United States and may be recommended for the same admission categories described above except that of the nondegree option. International applicants for nondegree status may be considered for admission at the discretion of the Graduate College dean. Application and admission deadlines for international students can be obtained from the Admissions web site at www.admissions.iastate.edu/apply/.

International students are required to show evidence of financial support and to carry adequate health and accident insurance while in residence.

Admission Examinations

Graduate Record Examination. The Graduate Record Examination (GRE) is not a university-wide requirement for all applicants. However, many programs require or recommend submission of GRE scores; individual program statements at www.grad-college.iastate.edu/programs/APprograms.php should be consulted for this information.

English Requirements for Non-native Speakers

Applicants whose native language is not English and who have not earned a bachelor's or master's in a country where the only official language is English are required to submit Test of English as a Foreign Language (TOEFL) scores as part of the admission process. A minimum score of at least 79 on the TOEFL internet-based test or 550 on the paper-based test is required by the Graduate College. International students may also submit IELTS (International English Language Testing System) scores in lieu of the TOEFL. The ISU Graduate College minimum is 6.5. Because many programs require higher TOEFL and/or IELTS scores, applicants should check directly with the program to which they desire admission or browse the Graduate College Web site at www.grad-college.iastate.edu/programs/APprograms.php.

Graduate students whose native language is not English and who did not graduate from a U.S. institution must take an English Placement Test at the beginning of their first semester of enrollment. This test is administered by the Department of English. A student who does not pass this examination is assigned to one or more courses in the English 99 and 101 series. This course work must be completed during the first year of study . (There is a developmental course fee for the English 99 course.). Non-native English speaking ISU graduate students who meet or exceed the TOEFL scores (640 or above on the paper-based test or 105 on the internet-based test) are exempted from taking the Enlish Placement Test. (Self-enrollment in English 099 or 101 courses remains possible.

A graduate student whose native language is not English but did graduate from a U.S. institution, may bring to the Graduate College the "Request for the Graduate College to Approve the Graduate English Requirement for a Student Whose Native Language is NOT English" form, available from the Graduate College or on the Graduate College's Web site at www.grad-college.iastate.edu/forms/forms.html. Two conditions must be met: the student must have received a bachelor's, master's, or Ph.D degree from a U.S. college or university and the language of instruction at that college or university must have been in English.

New teaching assistants whose native language is not English are evaluated for their ability to communicate effectively in English before their assistantship assignments are made. Tests of oral proficiency and teaching skills (SPEAK and TEACH) are given before the beginning of each semester. Department offices have a schedule of SPEAK/TEACH testing dates, or browse the SPEAK/TEACH Web site. Registration for the test is held in 1116 Pearson Hall the day before the test is administered. TAs and faculty with questions about SPEAK/TEACH testing should call 515-294-1958 or 515-294-7996. A prospective teaching assistant who does not pass these tests is required to successfully complete course work and be retested. University Studies 180 is a series of communication courses designed to help new teaching assistants. Students focus upon pronunciation, listening, question-handling, teaching and lecturing skills, and analyze the culture of U.S. university life. Because enrollment is restricted, TAs cannot register for the courses online through AccessPlus. TAs must go to the SPEAK/TEACH Office, 1116 Pearson by the first or second day of classes to obtain permission to enter the course by completing a course add slip.

Graduate Appointments

Graduate assistantships, fellowships, and research grants have been established at Iowa State University to encourage graduate work and to promote research. Such appointments and research opportunities are available through the various departments of instruction and the research centers on campus.

Graduate assistantships, the most common form of graduate student support, are available in three categories: the research assistantship, the teaching assistantship, or the administrative assistantship. A half-time graduate assistantship (20 hours per week) permits the holder to enroll for a maximum of 12 semester credits. Recipients of these assistantships are assessed fees at full Iowa resident rates regardless of the number of credits for which they register. These students may also be eligible for tuition scholarship awards (50% of in-state tuition for most master's students and 100% of in-state tuition for most Ph.D. students and certain terminal masters students). Students who are graduates of a regionally accredited college or university in the United States or of a recognized institution in another country whose requirements for the bachelor's degree are substantially equivalent to those of Iowa State University, who are admitted in the full or provisional admissions status, and who present the requisite undergraduate or graduate preparation, may apply for these appointments.

Students registered on a restricted basis or those placed on academic probation are eligible for assistantship appointment only on a term by term basis but are not normally eligible for a graduate tuition scholarship. Students admitted without a declared major are not eligible for assistantship appointments. Further information may be obtained by writing to the appropriate graduate program.

The satisfactory completion of one appointment, plus satisfactory academic performance, will ordinarily make a student eligible for reappointment. After a period of three years of full time study for the master's degree or five years for the doctorate, the student will not normally be continued on assistantship support (shorter periods may be stipulated by the student's program or department).

Postdoctoral Study

Opportunities are provided for postdoctoral study through the extensive research programs of the university. Inquiries should be directed to the appropriate program, institute, or to the Dean of the Graduate College.

Graduate Study by Staff Members

Any full-time member of the research, instructional, or extension staff at the rank of instructor, research associate, or assistant scientist may carry up to six course credits per semester and three credits per summer session, subject to the approval of the head of the program or section, and provided it does not interfere with other duties. This privilege may be extended to members of the research, instructional, or extension staffs at the rank of assistant professor with approval of the college dean and the Dean of the Graduate College. Staff members at the rank of professor or associate professor cannot become candidates for graduate degrees from ISU.

Registration

Graduate students are encouraged to register for courses on the ISU web site (www.iastate.edu) via AccessPlus. Students who are unable or who choose not to register through this system may use a walk-through registration procedure. Students who do not register by the published deadline for initiation of a schedule through the AccessPlus systems must use the walk-through procedure. For complete information on registration, see the ISU Schedule of Classes or the Registration Web site at www.iastate.edu/~registrar/registration/.

Credit Limits

Registration is limited to a maximum of 15 credits per semester. Schedules for graduate assistants on one-half time appointments are limited to a maximum of 12 credits. For full-time staff members, the limit is 6 credits. (Different credit limits apply during the summer session; see the Graduate College Handbook at www.grad-college.iastate.edu/publications/homepage.html for more details.)

Interim Registration

Registration for special work between semesters and during certain vacation periods cannot exceed one credit for each week that the student is in residence. For more information, consult the Graduate College Handbook.

Distance Education

Iowa State offers many graduate degree and certificate programs off-campus. For a listing of the degree programs, registrations for courses, and more information about distance education, consult the Iowa State University Web site at http://www.distance.iastate.edu/programs/homepage.php.

Other information about graduate requirements is available in the Graduate College Handbook at http://www.grad-college.iastate.edu/publications/gchandbook/homepage.html.

Doctoral Post Prelim (formerly Continuous Registration)

Even when Ph.D. graduate students have completed course work and residency requirements, they are required to register and pay tuition and fees, whether or not university facilities and equipment are used or staff is consulted—either in person or in absentia.

After the preliminary oral examination is passed (with either full or conditional pass) and if university facilities, equipment, and staff time are used, the Ph.D. candidate must register for the appropriate number of credits in the major department or program and pay the appropriate graduate tuition and fees.

After the preliminary oral examination is passed (with either full or conditional pass) and if university facilities, equipment, and staff time are not used, the Ph.D. candidate may register for Gr St 680 (Doctoral Post Prelim Registration) and pay the Doctoral Post Prelim Registration fee.

The Ph.D. candidate must be aware that registration for Gr St 680 is allowed only after the Ph.D. candidate passes the preliminary oral examination; is required only in the fall and spring semesters, and not during the summer term; is not allowed after the completion of the final oral examination; and is not sufficient registration for the term the preliminary or final oral examination is taken; and does not defer student loans.

If students take the final examination during the interim between terms (including the first day of classes), registration can be for the term either before or after the examination is held.

Auditing

Audit registration means taking courses without receiving formal credit. Audit provisions are as follows: Instructors must approve ALL audits; students must register for audits by day 10 of the semester; changes to or from an audit must be made in the first 10 days of the semester; students are assessed tuition and fees as though they were taking the course for credit; and the course DOES NOT count in determining full-time student status.

Audited courses do not appear on the student's permanent record unless the "Request for Audit(s) to Appear on Transcript" form is completed and signed by the student, course instructor, and major professor. Copies of this form, which are available from the Graduate College or from the Graduate College's web site at www.grad-college.iastate.edu/forms/forms.html, must be filed with the Graduate College, 1137 Pearson Hall.

After the fifth class day, if a student changes a regular course to an audit, that course will appear on the student's permanent record as a drop. Audits are not acceptable as registration for loan deferments.

Graduate Courses Taken by Undergraduates

Certain graduate level courses listed in the ISU Catalog may be used in the program of study even though they were taken for graduate credit by the student as an undergraduate at Iowa State University.

The following conditions must be met:

1. The POS committee can request approval from the Dean of the Graduate College that up to nine hours of such credit be applied toward meeting advanced degree requirements (these courses must be clearly marked on the POS).
2. Credits earned in these courses must be in addition to those used to meet requirements for the bachelor's degree and must have grades of B or better.
3. The student must be classified as an undergraduate and not a nondegree undergraduate (credits taken as a nondegree undergraduate student are not allowed).
4. The Graduation Office (10A Enrollment Services Center) should be contacted to determine that the courses were not taken as Graduation Office (10A Enrollment Services Center) indicating that the courses were not taken as a nondegree undergraduate student, were not used toward fulfillment of the undergraduate degree program and were graded B or better.

Undergraduate Admission to Concurrent Graduate Degree Programs

Several programs provide opportunities for well qualified ISU juniors and seniors majoring in those curricula to apply for admission to both a bachelor's and master's degree.

The graduate degree will be awarded only at the same time as, or after, the undergraduate degree is conferred. For a complete listing of the concurrent degree programs, consult the table, "Concurrent Bachelor and Master Programs" in this section.

Students interested in a research career may apply for graduate research assistantships during their last two years of study. Students should contact the programs listed below about applying early in their undergraduate careers. Undergraduate students seeking admission to concurrent graduate degree programs in field other than these, plus any student with an interdepartmental major, must submit a written proposal for an individualized program, co-signed by their advisers, to the Graduate College for review and approval. For more information about the application process and transferring credits, consult the *Graduate College Handbook*.

Veterinary Medicine Students in Concurrent Graduate Degree Programs

Students may be concurrently enrolled in the professional curriculum leading to the D.V.M. degree and in a graduate program leading to the M.S. or Ph.D. degree after completion of 90 semester credits. The graduate program may be in the College of Veterinary Medicine or in another college.

Interested students must complete a graduate application, complete a "Concurrent Enrollment Request" form available in the Graduate College office or on the web site at www.grad-college.iastate.edu/forms/forms.html, submit both forms with appropriate transcripts and letters of recommendation to the Office of Admissions (100 Enrollment Services Center). (Copies of the application forms may be obtained at www.admissions.iastate.edu/apply/index.php.) State on the application that the application is for a concurrent degree program.

Signed approvals on the Graduate Admissions Evaluation form are required from the graduate program, the Dean of the College of Veterinary Medicine, and the Dean of the Graduate College. On admittance, the student receives an admission notification from the Office of Admissions. For more information see the *Graduate College Handbook*.

Graduate Students in Concurrent Undergraduate Programs

Graduate students interested in enrolling in a concurrent undergraduate program should contact the Office of Admissions (100 Enrollment Services Center) to obtain admission information (even if the student has been previously

admitted as an undergraduate). A "Concurrent Enrollment Request" form should be obtained from the Graduate College Web site at www.grad-college.iastate.edu/forms/forms.html and circulated for the appropriate approvals. The student must be formally admitted both as a graduate student and as an undergraduate student. Official enrollment and fee payment will be as a graduate student. Credits transferred from the graduate permanent record to the undergraduate permanent record are no longer available for use on a graduate program of study.

Courses Taken as a Nondegree Undergraduate Student

A person classified as a "nondegree undergraduate" student may not use courses taken under that status in a graduate degree program. A student who has received the baccalaureate degree must register as a graduate student if he/she is to receive graduate credit for courses.

Grading

Grades are the permanent official record of a student's academic performance. Iowa State uses A through F grading for most courses. S, P, and NP grades are given in some courses. The standard four-point scale is used to calculate a grade point average.

Grade Point Average (GPA)

All courses (even if they are undergraduate courses) taken as a graduate student will be calculated into the graduate GPA. The GPA is determined by dividing the number of grade points earned by the total number of ISU cumulative hours. The grade given when an incomplete (I) is resolved is figured into the cumulative grade point average, but not into a particular semester's average. Marks of I, S, P, NP, T, and X are not counted in the grade point average; a mark of F (even if taken S/F) is counted in the grade point average. Creative Component/Research (599 and 699) credits are not used in the calculation of the GPA. In the case of repeated courses, only the grade achieved the last time the course is taken is used in computing the grade point average. (However, grades in courses that are noted as repeatable courses in the catalog, such as certain repeatable seminars, will all be used in calculating the grade point average.)

Grading Research and Creative Component Credits

Creative Component/Research credits may be graded as A, B, C, D, I, S, or F. Plus and minus grades are optional. These credits are not calculated in a student's GPA.

Pass (P)/Not Pass (NP) Course Credit

Pass/Not Pass courses are those that a student, with the approval of the major professor, may take for personal enrichment, but not for satisfying prerequisites or deficiencies in the undergraduate background. P/NP marks may not be used in a POS, nor do P/NP marks contribute to the student's GPA. Full credit for P/NP courses is used in calculating tuition assessment and credit load limitations. For more information, see *the Graduate College Handbook*.

Satisfactory/Fail (S/F) Grading

S/F grading is not the same as P/NP grading. S/F grading is by instructor option; all students in a particular course receive S/F grading. P/NP grading is generally a student option. A P mark is equivalent to at least a D- grade whereas an S mark is equivalent to at least a B grade at the graduate level. No special registration procedures are required for S/F grading. An S mark in a course taken S/F is not counted in the grade point average, but an F mark in a course taken S/F is counted in the grade point average and is equivalent to an F in a regularly graded (A-F) course. No more than 20 percent of the total credits (excluding creative component, thesis or dissertation research) in the program of study may be earned on an S/F basis. S/F grading may be used only for approved courses offered as seminars, symposia, workshops, special topics, and research. Programs must submit requests for S/F grading to the Dean of the Graduate College. The Graduate College Curriculum and Catalog Committee reviews and approves or rejects all S/F courses.

Grievances about Grades

A graduate student who feels that a course grade has been unjustly assigned, and whose attempts to resolve the matter with the instructor have failed, may appeal through the grievance procedures described in the *Graduate College Handbook.*

Concurrent Bachelor and Master Programs

Bachelor's Degree	Bachelor's Major	Master's Degree	Master's Major
B. S.	Accounting	M.Acc.	Accounting
B.S.	Agricultural Biochemistry	M.S.	Biochemistry
B. S.	Agricultural Engineering	M.S.	Agricultural Engineering
B. S.	Animal Science	M.S.	Animal Breeding and Genetics
B. S.	Animal Science	M.S.	Nutritional Sciences
B. S.	Animal Science	M.S.	Meat Science
B. S.	Animal Science	M.S.	Animal Physiology
B. S.	Animal Science	M.S.	Animal Science
B. S.	Biochemistry	M.S.	Biochemistry
B. S.	Biophysics	M.S.	Biophysics
B. S.	Civil Engineering	M.S.	Civil Engineering
B.S.	Civil Engineering	M.B.A.	Business Administration
B. S.	Computer Engineering	M.S.	Computer Engineering
B. S.	Computer Engineering	M.B.A.	Business Administration
B. S.	Diet and Exercise	M.S.	Diet and Exercise
B. S.	Electrical Engineering	M.S.	Electrical Engineering
B. S.	Electrical Engineering	M.B.A.	Business Administration
B.S.	Family Finances, Housing and Policy	M.S.	Human Development and Family Studies
B. S.	Food Science	M.S.	Food Science and Technology
B.S.	Industrial Engineering	M.B.A.	Business Administration
B. S.	Industrial Engineering	M.S.	Industrial Engineering
B. S.	Materials Engineering	M.S.	Materials Science and Engineering
B.S.	Mechanical Engineering	M.B.A.	Business Administration
B.S.	Mechanical Engineering	M.S.	Mechanical Engineering
B. S.	Nutritional Science	M.S.	Nutritional Sciences
B. S.	Psychology	M.S.	Psychology

Concurrent Bachelor and Master Certificates

Bachelor's Degree	Bachelor's Major	Master's Certificate
B.S.	Computer Engineering	Information Assurance
B.S.	Family Finances, Housing and Policy	Family Financial Planning

Probation

If a graduate student does not maintain a cumulative 3.0 grade point average on all course work taken, exclusive of research credit, he or she may be placed on academic probation by the Dean of the Graduate College. Grades earned by graduate students in undergraduate courses are included in the calculation of the grade point average. Academic probation judgments are made on the basis of grades in course work only. New, first-term graduate students who fall below a 3.0 GPA at the end of their first semester will be given a one term grace period to bring their grades back to a 3.0 GPA. These students will receive a warning letter from the Graduate College.

While on academic probation a student will not be admitted to candidacy for a degree and if appointed to a graduate assistantship, the student will not receive a Graduate tuition scholarship unless approval is given by the student's academic college. If a student is to qualify for a tuition scholarship, he/she must be removed from probation by the tenth class day of the term.

To insure that registration does not take place without a review by the program, the Graduate College places a hold on future registrations by a student on probation. Before the student registers for each term, the program must review his or her record and recommend in writing if the Graduate College should permit further registration. Before graduation is approved, the student must complete all courses listed on the program of study with a minimum grade of C and have achieved a 3.0 GPA or greater.

Master's Degrees

General requirements for all master's degrees are as follows:

General Requirements

The Graduate College Handbook outlines the general requirements for completion of a graduate degree at ISU. Faculty in a major field have the responsibility for establishing educational objectives for their graduate program, including specific course requirements and research requirements appropriate to the master's programs in the major. These requirements may place additional responsibilities on the student, the major professor, or the student's program of study (POS) committee beyond those listed in the Graduate College Handbook as deemed appropriate to the goals of the major program.

Faculty and graduate students are active participants in the academic programs of Iowa State University. As active participants, they have a collective impact on the success of those programs and of the university in fulfilling its mission. Each graduate program is encouraged to implement a mechanism for responding to feedback from graduate students as a valuable resource for continuing improvement.

Appointment of the Student's Program of Study (POS) Committee

New graduate students at ISU may be assigned a temporary academic adviser by the major program in the first semester of the student's residence. This faculty member guides the student in selection of a field of study and in development of a graduate program of study until the major professor and POS committee are selected. After the POS committee has been selected, it guides and evaluates the student during the remainder of graduate study.

A master's POS committee consists of at least three members of the graduate faculty. It must include two members, including the major professor, from the major or program. The committee must include member(s) from different fields of emphasis so as to ensure diversity of perspectives. A term member of the graduate faculty may participate in the direction of a student's master's research as a co-major professor if a member of the graduate faculty serves as a co-major professor and jointly accepts responsibility for the direction of a program of study. For more information on duties and makeup of the committee as well as changes to the committee makeup, see the *Graduate College Handbook*.

Program of Study.The student and major professor develop the program of study with the consultation and approval of the POS committee. This agreement between the student and the Graduate College should be submitted as early as possible for approval. It is recommended that the committee be formed and the POS form submitted as early as the second semester of graduate study. In no case can the committee be formed later than the term before the final oral examination.

Residency. There is no on-campus residency requirement for the master's degree.

Credits. Unless otherwise noted, at least 30 credits of acceptable graduate work must be completed in all master's programs. At least 22 graduate credits must be earned from Iowa State University unless noted in the descriptions under "Specific Master's Degrees" in this catalog.

Transfer Credits. At the discretion of the POS committee, and with the approval of the program and the Graduate College, graduate credits earned as a graduate student at another institution or through a distance education program offered by another institution may be transferred if the grade was B or better. Such courses must have been acceptable toward an advanced degree at that institution and must have been taught by individuals having graduate faculty status at the institution. If a student wishes to transfer credits from graduate courses taken at or through another university as an undergraduate student, it is the student's responsibility to provide verification by letter from that institution that these graduate courses were not used to satisfy undergraduate requirements for a degree.

A transcript must accompany the POS in order to transfer credits. The POS committee may ask for other materials, such as a course outline or accreditation of the institution, to evaluate the course. Transfer courses not completed when the POS is submitted must be completed before the term in which the student graduates. A transcript must then be submitted for review and final approval.

Research credits earned at another institution are generally not transferred. In rare circumstances, the transfer of S or P marks may be accepted for research credits only. It is the responsibility of the POS committee to obtain a letter from the responsible faculty member at the other institution stating that research credits recommended for transfer with S or P marks are considered to be worthy of a B grade or better. Audits may be listed on the program of study, but do not carry credit.

Major. A major is an approved area of study leading to a graduate degree. The exact number of credits in a major is not prescribed.

Minor. Students may request a minor in any program approved to grant a graduate degree and in programs approved to offer only a minor. A student may not minor and major in the same field. Requirements for declared minors are determined by the minor program and the faculty member representing the minor field on the student's POS committee.

The minor subject area must be tested at the final oral examination and cannot be placed on the transcript after graduation unless it was approved on the program of study, listed on all examination reports, and recorded on the "Application for Graduation" form (diploma slip). A minor cannot be added to a degree that has already been received.

Department/Program Change.

Transferring from One Major/Program/Department to Another

Students who have been admitted to a graduate program and to the Graduate College may request to transfer at a later date to another department or program. Because graduate students are admitted to particular programs, transfers require the approval of both the receiving program and the Graduate College.

Students seeking transfer to another program or department should first discuss their wishes with the new program DOGE (Director of Graduate Education) to determine requirements and interest by the new program. When a student receives a favorable preliminary response from the new program, he or she should fill out the student portion of the form entitled "Request to Transfer from One/Major/Program/Department to Another" and submit this form to his or her current DOGE. The current DOGE will fill out the Current Program Information adding any comments he or she believes the new program should consider and forward the form to the proposed new program. This form is available from the department, the Graduate College, or the Graduate College web page.

The receiving program will generally give the student the same consideration and employ the same admissions standards that are used for original applications for admission and will expect the same application materials (transcripts, letters of recommendation, test scores, etc). During the process, the new and old programs and the Graduate College are authorized and encouraged to seek and disclose information related to the student's overall fitness for studies in the receiving program. Programs are authorized to inquire into the student's prior conduct at the university, both with the prior department and with the Dean of Students.

Upon departmental action (acceptance or denial), the request to transfer form must be sent to the Graduate College for approval. All parties

will receive a copy of the completed form from the Graduate College.

Students desiring to transfer from a degree-seeking status to a nondegree-seeking status need to fill out the "Request to Transfer from One Major/Program/Department to Non-degree" form and bring it to the Graduate College.

Students desiring to transfer from nondegree-seeking status to a degree-seeking status must be admitted by a program through the regular graduate admission process.

Curriculum Change from Active Graduate to Active Undergraduate Status

Individuals who are in good standing in the Graduate College and who wish to transfer to an undergraduate curriculum must contact the graduate classification officer (1137 Pearson Hall). The classification officer will consult with the student and determine the proper course of action.

Curriculum Change from Inactive Graduate to Active Undergraduate Status

Individuals who were admitted to the Graduate College more than one year previous and who do not have active graduate status but who wish to change their status from inactive graduate to active undergraduate, must follow the same procedures required of reentering undergraduate students and must begin the process by filing a completed "Undergraduate Reentry" form with the Office of the Registrar. When considering reinstatement, the undergraduate college may consider the student's overall fitness for continued studies including information about the student's conduct, employment and education since the student's last enrollment.

Individuals who do not have active graduate status and who first enrolled less than one year previous should first see the classification officer in the Graduate College.

Time Limits. It is expected that work for the master's degree shall be completed within five years. In special circumstances the student's POS committee may recommend that the Dean of the Graduate College extend these degree time limits. Cases in which the student leaves Iowa State during his or her graduate career and later returns are dealt with individually by the student's POS committee and the Graduate College. The inclusion in the student's program of study of course work that is beyond the time limits ("over-age" courses) must be justified by the POS committee in a statement accompanying the submission of the program of study.

Application for Graduation. Students planning to graduate must submit an "Application for Graduation" form (diploma slip) to the Graduate Office by the end of the first week of the semester (fall or spring) in which he/she expects to receive the degree, or by the last day of spring semester when wishing to graduate during summer.

Before submitting this form, a student must have submitted and had approved by the Graduate College a "Recommendation for Committee Appointment" form and a "Program of Study" form. Also the student must have been fully admitted to a program and have met the Graduate English requirement if he/she is a non-native English speaker. Graduation may be delayed if the "Application for Graduation" form filing deadline is not met. If it becomes apparent that a student cannot graduate during the indicated term, he/she should call the Graduate College (515-294-4531) and cancel the previously submitted "Application for Graduation" form. The student must then file a new form for the next planned term of graduation.

Thesis. A master's thesis is a scholarly composition that demonstrates the ability of the author to do independent and creative work. A thesis is required in all fields in which a master's degree is awarded, except where specific provision is made for a nonthesis degree program. A minimum of three research credits is required on every program of study for a thesis master's degree.

Responsibility for writing and editing of the thesis rests with the student, under the supervision of the major professor, and not with the Graduate College. The Graduate College does not permit joint authorship of theses. It is the responsibility of the major professor to supervise the preparation of preliminary and final drafts of the thesis to assure the highest level of quality when the student presents the thesis to the committee for final approval.

Copies of the thesis must be submitted to the members of the POS committee at least two weeks before the final oral examination.

All theses and dissertations will be submitted electronically after the final oral examination is held. Please browse the Graduate College's web site (http://www.grad-college.iastate.edu/thesis/homepage.html) for requirements, revised fees, and other pertinent information.

Shortly after the submission of the "Application for Graduation" form, a one-time, nonrefundable thesis fee is billed by the university accounting system. In addition, a graduation fee will be assessed by the Registrar's Office. This fee is nonrefundable if a student does not cancel his/her graduation by the Graduate College's cancellation deadline.

Creative Component. Most nonthesis students must present substantial evidence of individual accomplishment (e.g., a special report, capstone course, integrated field experience, annotated bibliography, research project, design, or other creative endeavor). A minimum of two credits of such independent work is required on those programs of study for a nonthesis master's degree. Some programs require more credits. (For more information, contact the individual program or consult the Specific Master's Degrees section in this catalog.) The element of creative independent study must be explicitly identified on the program of study. The format of the creative component is determined in cooperation with the POS committee. As with a thesis, a creative component should be submitted to members of the POS committee two weeks before the final oral examination. However, no final submission of a creative component is turned in to the Graduate College for review and approval.

Final Oral Examination. Most master's candidates must pass final oral examinations. The final oral examination must be held by the final examination deadline date for the semester in which the degree is granted. All coursework in the program of study must either be completed or in progress before the final examination can be scheduled. This examination is oral; it may also include a written component if specified by the student's (POS) committee.

Graduate students must register at Iowa State for the equivalent of two credits, or for the R-credit course GR ST 600 (Examination Only) if no course work is needed, during the semester in which the final examination is taken. (Graduate students who are not required to take a final oral examination should complete all required coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.) Taking only an R-credit course where the fee is not equivalent to the 2-credit minimum charge is not acceptable for the term of the final oral examination. If the examination is taken during the interim between terms (including the first day of classes), registration can be for either the term before or the term after the examination is held.

The candidate is responsible for initiating the "Request for Final Oral Examination" form, which must be submitted to the Graduate College at least three weeks before the examination. This form can be obtained only from the student's program/department. The entire POS committee must be convened for the final oral examination. For more information on the final oral examination, see *the Graduate College Handbook*.

Graduate Student Approval Slip for Graduation. Every candidate for an advanced degree is required to complete a "Graduate Student Approval Slip for Graduation" form. It is sent to the major professor or program to give to the student after the "Request for Final Examination" form is received and approved by the Graduate College. Signatures are required by the major program, the Graduate College Thesis specialist (for those completing a thesis), and the Graduate College. Final clearance of academic requirements will be made when current term grades have been submitted and evaluated by the Graduate College.

All incompletes from previous terms must be completed by the deadline for completion of the Graduate Student Approval Slip. An incomplete or non-report grade that a student receives for the term of graduation will result in removal from that term's graduation list. The student will need to complete a new Application for Graduation and Graduate Student Approval Slip for the new term of graduation. If a conditional pass was recommended at the final oral examination, the major professor and the committee members, if so specified, must notify the Graduate College in writing no later than the due date for the Graduate Student Approval Slip for the term of graduation that the conditions have been met.

Specific Master's Degrees

The number of credits in a major for a master's degree will vary according to the degrees listed below. General credit requirements for all master's degrees include: a minimum of 30 graduate credits is required for all master's programs at ISU; at least 22 graduate credits must be earned at ISU unless noted in descriptions; any transfer of graduate credits from another institution must be recommended in the program of study by the POS committee; and graduate credit earned as a graduate student will be approved for transfer only if a B grade or better was earned. A transcript must accompany the POS form.

Master of Arts or Master of Science—Thesis

At least 30 credits of acceptable graduate work must be completed, not less than 22 of which must be earned from ISU. Students are expected to research and write a thesis that demonstrates independent and creative work. A minimum of 3 semester credits is required for thesis research.

Master of Arts or Master of Science—Nonthesis

In certain programs a nonthesis degree program is offered. (For more information on requirements, contact the individual program or department.) This option requires the satisfactory completion of at least 30 graduate credit hours of acceptable work (not including research credit), not less than 22 credits of which must be earned from Iowa State University, and satisfactory completion of a comprehensive final oral examination. In addition, every nonthesis master's program must present substantial evidence of individual accomplishment (e.g., a special report, capstone course, integrated field experience, annotated bibliography, or other creative endeavor). A minimum of two semester hours of such independent work (referred to as the creative component) is required on every program of study for a nonthesis master's degree and is applied toward the credit-hour requirement. This element of creative independent study must be explicitly identified on the program of study. Detailed requirements may vary with fields. Reference should be made to the *Courses and Programs* section in this catalog.

Master of Accounting. The Department of Accounting offers a 30-credit Master of Accounting graduate degree. The program requires 15 credits of graduate accounting courses, at least 9 credits of non-accounting graduate electives, a communications course, an international course from an approved list, and an optional creative component. At least 22 graduate credits must be earned at ISU. The degree is appropriate for any student wanting to pursue a variety of accounting careers. Additionally, the program is designed to help interested candidates meet the 150-hour education requirement for the CPA certification in Iowa. Since no final oral examination is required in the above professional program and its options, students should complete all coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.

Master of Agriculture. The major in professional agriculture is an off-campus, nonthesis program leading to the master of agriculture degree. It is available to students wishing to pursue graduate study in agriculture without taking formal coursework on campus. The program is considered to be a terminal master's degree. Students are required to take a minimum of two courses in each of three disciplines and complete 28 semester credits of formal coursework and four credits of creative component experience, resulting in a total of 32 graduate credits of coursework. At least 22 graduate credits must be earned at ISU. Courses are delivered via video-tapes, interactive video, world-wide web, on-and off-campus classes and workshops. Specific courses offered in the program and the location of the off-campus classes may be obtained from the departmental course listings, off-campus course catalog, or by contacting the Professional Agriculture Coordinator, 201 Curtiss Hall.

Master of Architecture. The Department of Architecture offers three master programs: M Arch I, M Arch II and M S A S. M Arch I (100 credits) is a non-thesis accredited professional degree in architecture. Students with an undergraduate degree other than architecture enroll in a 100-credit, seven semester program. Students with a B.A. or B.S. in architecture or other affiliated design fields are considered for advanced standing based on a review of their academic record. Students with advanced standing typically enroll for four semesters. Since no final oral examination is required in the M Arch I program, students should complete all coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.

The M Arch II (30 credits) is a post-professional degree in architecture with a required graduate thesis. Students with a B Arch, M Arch I or equivalent professional degree in architecture or other affiliated design fields may apply for this degree.

The M S A S (30 credits) is an interdisciplinary research degree in architecture with a required graduate thesis. This degree is for students with bachelor degrees in various fields that are interested in conducting graduate-level research on the built environment. At least 22 graduate credits must be earned at ISU for all the above programs.

Since no final oral examination is required in the above professional program and its options, students should complete all coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.

The M.Arch. II (30-credit) option is for students with a B.A. or B.S. in a 4-year degree program in architecture or a M.Arch.I degree. These students must complete a thesis. At least 22 graduate credits must be earned at ISU for all the above options.

Master of Arts in Teaching. This is a degree leading to teacher licensure. A range of graduate credits are required depending on the program offering the degree. The student must also demonstrate an ability to perform independent study through the completion of a creative component or thesis. At least 22 graduate credit hours must be earned at ISU.

Master of Business Administration. The College of Business offers a 48 graduate credit-hour program leading to a nonthesis master of business administration degree.

At least 22 graduate credits must be earned at ISU. Students may select courses in the traditional business disciplines or choose areas of specialization in accounting, agribusiness, family finanical planning, information systems, international business, marketing, and supply chain management.

Since no final oral examination is required, M.B.A. students should complete all required coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.

Master of Community and Regional Planning. The master of community and regional planning degree requires a minimum of 48 graduate semester credit hours. At least 22 graduate credits must be earned at ISU. This degree is available as a thesis or nonthesis option.

Master of Education. For the master of education degree, a range of 30 to 40 graduate credits are required. At least 22 graduate credits must be earned at ISU. The student demonstrates an ability to perform independent study through the completion of a creative component or a field-based activity.

Master of Engineering. The academic standards and the general level of attainment are the same for the master of engineering and master of science degrees. Master of engineering programs are offered to meet the needs for professionally oriented programs on campus and for off-campus professionally oriented programs at locations with adequate library and laboratory facilities. An appropriate number of credit hours in design, laboratory work, computation, or independent study is required as evidence of individual accomplishment. Of the minimum 30 graduate credits requirement, 22 graduate credit hours must be earned at ISU. For those Master of Engineering programs that do not require a final oral examination, students should complete all coursework on the POS prior to or during the term of graduation. Any transfer credits must be completed the term before the graduation term and follow normal transfer rules.

Master of Family and Consumer Sciences. The College of Human Sciences offers two nonthesis options leading to the degree master of family and consumer sciences. Both options are designed to enhance the skills of those holding the bachelor's degree so that they may meet the requirements of their present jobs or progress in their careers. The comprehensive option can be followed on- or off-campus and requires 36 graduate credits covering a variety of family and consumer sciences subject matter. The specialization option requires 36 credits and is offered on-campus from the following departments and programs: Dietetics, Family Financial Planning, Foodservice and Lodging Management, Gerontology, Human Development and Family Studies, Nutritional Sciences, and Textiles and Clothing. At least 22 graduate

credits must be earned at ISU. Both options require a written and oral integrative final exam.

Master of Fine Arts. For this degree a minimum of 54-61 graduate credits is required, including the completion of a thesis-exhibition or a thesis. At least 22 graduate credits must be earned at ISU.

Master of Landscape Architecture. The master of landscape architecture degree requires a minimum of 36 graduate credits and the satisfactory completion of a thesis or a creative component. At least 22 graduate credits must be earned at ISU.

Master of Public Administration. This is a professional degree program designed to provide training necessary for an administrator in a public or quasi-public bureaucracy. The MPA degree requires 37 graduate credit hours, which includes (a) 12 credit hours in Core Competency, (b) 12 credit hours in one of the Concentration areas, (c) 4 credit hours in other required courses, (d) up to 7 credit hours of electives, (e) 3 credit hours of Creative Component (a Capstone Project) or a minimum of 3 credit hours of research (thesis). Pre-service students are encouraged to obtain an internship for 3 credit hours. At least 22 graduate credits must be earned at ISU.

Master of School Mathematics. This degree is designed primarily for in-service secondary mathematics teachers. Its prescribed program of study requires 33 graduate credits, two of which come from the writing of an approved creative component, 15 from courses offered for graduate credit, and 13 from courses offered for nonmajor graduate credit. At least 22 credit hours must be earned at ISU.

Master's Double Degree Programs

A double degree requires fulfillment of the requirements for two graduate majors for which two differently named master's degrees and two diplomas are granted at the same time. For double degrees the final project (thesis or creative component) must integrate subject areas from both departments. One final oral examination must be held covering the combined thesis or creative component. Students planning to pursue double degrees must complete a double degree request form and submit it to the Dean of Graduate College for approval. Just one "Recommendation for Committee Appointment" form and one "Program of Study (POS)" form need to be submitted for the two degrees. However, two "Application for Graduation" forms, one for each degree, will need to be submitted. All forms should show clearly that the student is enrolled in a double-degree program.

Like other master's programs, three graduate faculty members can constitute a POS committee; however, POS committees for double degrees must include co-major professors from each of the majors. Although specific degree programs may require more, the program of study must include at least 44 hours of non-overlapping credit (22 for each major) in the two degrees.

Several such combinations are currently available: (1) Master of Architecture/Master of Business Administration; (2) Master of Architecture/Master of Community and Regional Planning; (3) Master of Community and Regional Planning/Master of Business Administration; (4) Master of Landscape Architecture/Master of Community and Regional Planning; (5) Master of Public Administration/Master of Community and Regional Planning; (6) Master of Public Administration/Master of Science in Information Assurance; (7) Master of Science in Statistics/Master of Business Administration; and (8) Master of Science in Information Systems/Master of Business Administration.

If a student outside one of the named areas is interested in an individually-developed double degree program, a written proposal for a double degree to serve those interests and needs must be submitted to the Dean of the Graduate College for review. See t*he Graduate College Handbook* for more information.

Drake University Law School/ Iowa State University Combined Degree

To provide training in the complementary fields of law, political science, and economics with a minimum amount of academic duplication, special arrangements for combined degree programs have been approved with the Drake University Law School. ISU and Drake offer a combined J.D.-M.A. in political science and J.D.-Ph.D. in economics. Drake Law School students are permitted to transfer the equivalent of nine semester credits of specified law courses to ISU for nonmajor graduate credit. Because of the difference in grading systems, the Law School grades are transferred as passes, provided the student has achieved a grade of C or better in those courses at Drake for the political science program or a grade of B or better for the economics program.

Applicants for either of the combined programs must meet the regular entrance requirements of, and be admitted to, both the Drake Law School and the ISU Graduate College.

Doctor of Philosophy

General Requirements

The degree doctor of philosophy is strongly research oriented. The primary requirements for the degree are: (1) high attainment and proficiency of the candidate in his or her chosen field, (2) development of a dissertation which is a significant contribution to knowledge and which shows independent and creative thought and work, and (3) successful passing of detailed examinations over the field of the candidate's major work, with a satisfactory showing of preparation in related courses. General requirements for Ph.D. candidates follow.

The Graduate College Handbook outlines the general requirements for completion of a graduate degree at ISU. Faculty in a major field have the responsibility for establishing educational objectives for their graduate program, including specific course requirements and research requirements appropriate to the master's or Ph.D. programs in the major. These requirements may place additional responsibilities on the student, the major professor, or the student's program of study (POS) committee beyond those listed in the Graduate College Handbook as deemed appropriate to the goals fo the major program.

Faculty and graduate students are active participants in the academic programs of Iowa State University. As active participants, they have a collective impact on the success of those programs and of the university in fulfilling its mission. Each graduate program is encouraged to implement a mechanism for responding to feedback from graduate students as a valuable resource for continuing improvement.

Appointment of the Student's Program of Study (POS) Committee. The POS committee for a doctoral program consists of at least five members of the graduate faculty. It must include at least three members, including the major professor, from within the student's major or program. The committee must include member(s) from different fields of emphasis so as to ensure diversity of perspectives. A term member of the graduate faculty may participate in the direction of a student's dissertation research as a co-major professor if a member of the graduate faculty serves as a co-major professor and jointly accepts responsibility for direction of the dissertation.

Changes to POS committee. Recommendations for changes in the POS committee must have the approval of the student, major professor, DOGE, and all committee members involved in the change (committee members who are on Faculty Professional Development Assignments, retired, or resigned do not have to sign) before seeking approval of the Graduate College. A form to seek approval is available in program offices or on the web at www.grad-college.iastate.edu/forms/forms.html. These changes must be approved by the Dean of the Graduate College before the preliminary or final oral examination is held. For more information on changes to the committee and to the Program of Study, see the *Graduate College Handbook*.

Program of Study. The student and the major professor develop the program of study with the consultation and approval of the POS committee. Early selection of a major professor, appointment of a POS committee, and development of a program of study are very important. It is recommended that the committee be formed as early as the second semester of graduate study. In no case can the committee be formed later than the term before the preliminary oral examination.

Credits. A minimum of 72 graduate credits must be earned for a Ph.D. degree. At least 36 graduate credits, including all dissertation research credits, must be earned at Iowa State University. At least 24 of these credits must be earned during two consecutive semesters or during a continuous period including two semesters and a summer session while in residence at the university. (This requirement does not apply to doctoral students who are employed more than half time at ISU). There is no specific university requirement regarding the number of credits to be taken inside or outside the major/program.

Transfer Credits. At the discretion of the POS committee, and with the approval of the program and the Graduate College, graduate credits earned as a graduate student at another institution or through a distance education program offered by another institution may be transferred if the grade was B or better. Such courses must have been acceptable toward an advanced degree at that institution and must have been taught by individuals having graduate faculty status at that institution. If a student wishes to transfer credits from graduate courses taken at or through another university as an undergraduate student, it is that student's responsibility to provide verification by letter from that institution that those graduate courses were not taken to satisfy undergraduate requirements for a degree.

A transcript must accompany the POS in order to transfer credits. The POS committee may ask for other materials, such as a course outline or accreditation of the institution, to evaluate the course. Transfer courses not completed when the POS is submitted must be completed before the term in which the student graduates. A transcript must then be submitted for review and final approval.

Research credits earned at another institution are generally not transferred. In rare circumstances, the transfer of S or P marks may be accepted for research credits only. It is the responsibility of the POS committee to obtain a letter from the responsible faculty member at the other institution stating that research credits recommended for transfer with S or P marks are considered to be worthy of a B grade or better.

Residency. At least 24 semester credits must be earned during two consecutive semesters or during a continuous period including two semesters and a summer session. This requirement does not apply to doctoral students who are employed at least half-time by Iowa State University and government laboratories located in Ames. Of the 72 graduate credits required for a Ph.D. at least 36 credits, including all dissertation research credits, must be earned under the supervision of the student's POS committee.

Major. A major is the area of study or academic concentration in which a student chooses to qualify for the award of a graduate degree. Majors are listed at the end of this section of the bulletin. Opportunities also exist for majoring in more than one area of study (co-major or joint major programs).

Minor. Students may request a minor in any program approved to grant a graduate degree and in programs approved to offer only a minor. Requirements for declared minors are determined by the minor program and the faculty member representing the minor field on the student's POS committee. The minor subject area must be tested at the preliminary oral and final oral examinations. A minor cannot be added to a program of study after the preliminary oral examination has been taken, nor can a minor be placed on the transcript after graduation, unless it was approved on the program of study, listed on all examination reports, and recorded on the "Application for Graduation" form (diploma slip). A student may not minor and major in the same field. A minor cannot be added to a degree that has already been awarded.

Time Limits. A student beginning a Ph.D. degree program at Iowa State with a master's degree from another institution is expected to complete the Ph.D. within five years, while a student beginning a Ph.D. degree program without the master's degree is expected to complete the program within seven years. If warranted, the Program of Study (POS) Committee may request by letter that the Dean of the Graduate College extend these time limits. Cases in which the student leaves Iowa State during his or her graduate career and later returns are dealt with individually by the student's program of study committee and the Graduate College. The inclusion in the program of study of coursework that is beyond the time limits ("over-age" courses) must be justified by the POS committee in a statement accompanying the submission of the program of study.

Preliminary Examination. The Graduate College requires a preliminary oral examination of Ph.D. degree students; most programs add a written portion to the preliminary oral examination. The Ph.D. degree preliminary oral examination rigorously tests a graduate student's knowledge of major, minor, and supporting subject areas as well as the student's ability to analyze, organize, and present subject matter relevant to the field. A "Request for Preliminary Examination" form must be submitted to the Graduate College by the major professor at least two weeks before the proposed date of the examination.

The following conditions should be met before the "Request for Preliminary Examination" form is submitted to the Graduate College: admitted to full admission status in a Ph.D. granting program, approved "Recommendation for Committee Appointment" form, approved POS form, English requirement met, not on probation, time limit not exceeded, qualifying examination (if required by program) passed, and registration for at least the equivalent of 2 credits, or for the R-credit course GR ST 600 (Examination Only) if no course work is needed, during the term in which the preliminary oral examination is taken. (Taking only an R-credit course where the fee is not equivalent to the 2-credit minimum charge is not acceptable for the term of the preliminary oral examination.)

A preliminary oral examination will not be scheduled for a student on provisional or restricted admission or on academic probation. Upon successful completion of the preliminary oral examination, the student is admitted to candidacy for the Ph.D. degree. If the graduate student fails all or part of the preliminary oral examination, the committee provides two options: gives a not pass and allows the student to retake the examination after six months or gives a not pass and does not allow the student to retake the examination. Six months must elapse between the first attempt and the next. The entire POS committee must be convened for the preliminary oral examination. The preliminary oral examination must be passed at least six months prior to the final oral examination. An exception to the rule is allowed if a request signed by the major professor(s) and the program's DOGE is approved by the Dean of the Graduate College.

Application for Graduation. Application for graduation should be made by the end of the first week of the semester (fall or spring) in which the student expects to receive the degree, or by the last day of the spring semester if graduation is planned during summer session. To apply for graduation, the student is required to submit to the Graduate College a signed "Application for Graduation" form, available in the program office or on the web at www.grad-college.iastate.edu/forms/ forms.html. Before submitting this form, a student must have submitted and had approved by the Graduate College a "Recommendation for Committee Appointment" form and a "Program of Study" form. Also the student must have been fully admitted to a program and have met the Graduate English requirement. Graduation may be delayed if the "Application for Graduation" form filing deadline is not met. If it becomes apparent that a student cannot graduate during the indicated term, he/she should call the Graduate College (515-294-4531) and cancel the previously submitted "Application for Graduation" form. The student must then file a new form for the next planned term of graduation.

Dissertation. A doctoral dissertation must demonstrate conclusively the ability of the author to conceive, design, conduct, and interpret independent, original, and creative research. It must attempt to describe significant original contributions to the advancement of knowledge and must demonstrate the ability to organize, analyze, and interpret data. In most instances, a dissertation includes a statement of purpose, a review of pertinent literature, a presentation of methodology and results obtained, and a critical interpretation of conclusions in relation to the findings of others. When appropriate, it involves a defense of objectives, design, and analytical procedures. Dissertation research should be worthy of publication and should appear in appropriate professional journals or in book form.

Responsibility for writing and editing of the dissertation rests with the student, under the supervision of the major professor, and not with the Graduate College. The Graduate College does not permit joint authorship of dissertations. It is the responsibility of the major professor to supervise the preparation of preliminary and final drafts of the dissertation, so as to assure the highest level of quality when the student presents the dissertation to the committee for final approval. Copies of the dissertation must be submitted to the POS committee at least two weeks before the final oral examination.

All theses and dissertations will be submitted electronically after the final oral examination is held. Please browse the Graduate College's web site (http://www.grad-college.iastate.edu/thesis/homepage.html) for new requirements, revised fees, and other pertinent information.

Shortly after the submission of the "Application for Graduation" form, a one-time, nonrefundable thesis fee is billed by the university accounting system. In addition, a graduation fee will be assessed by the Registrar's Office. This fee is nonrefundable if a student does not cancel his/her graduation by the Graduate College's cancellation deadline.

Final Oral Examination. The Ph.D. final oral examination, conducted after the dissertation is finished, is oral and often limited to a defense of the dissertation. To receive the degree at the end of a given semester, the student must hold the final oral examination before the final oral examination deadline for the semester.

The candidate is responsible for initiating the "Request for Final Oral Examination" form, which must be submitted to the Graduate College at least three weeks before the examination. This form can be obtained only from the student's program/department. The entire POS committee must be convened for the final oral examination. For more information on the final oral examination, see t*he Graduate College Handbook*.

Graduate Student Approval Slip for Graduation. Every candidate for an advanced degree is required to complete a "Graduate Student Approval Slip for Graduation" form. It is sent to the major professor or program to give to the student after the "Request for Final Examination" form is received and approved by the Graduate College. Signatures are required by the major program, the Graduate College Thesis specialist, and the Graduate College. Final clearance of academic requirements will be made when current term grades have been submitted and evaluated by the Graduate College.

All incompletes from previous terms must be completed by the deadline for completion of the Graduate Student Approval Slip. An incomplete or non-report grade that a student receives for the term of graduation will result in removal from that term's graduation list. The student will need to complete a new Application for Graduation and Graduate Student Approval Slip for the new term of graduation. If a conditional pass was recommended at the final oral examination, the major professor and the committee members, if so specified, must notify the Graduate College in writing no later than the due date for the Graduate Student Approval Slip for the term of graduation that the conditions have been met.

Graduate Majors

More information on each major can be found in the Courses and Programs section of this catalog under the department or program listed in parentheses after the degree information.

Accounting: M.Acc. (see *Accounting*)

Aerospace Engineering: M.Engr., M.S., Ph.D. (see *Aerospace Engineering*)

Agricultural Economics: M.S., Ph.D. (see *Economics*)

Agricultural Education: M.S., Ph.D. (see *Agricultural Education and Studies*)

Agricultural Engineering: M. Engr., M.S., Ph.D. (see *Agricultural Engineering*)

Agricultural History and Rural Studies: Ph.D. (see *History*)

Agricultural Meteorology: M.S., Ph.D. (see *Agronomy*)

Agronomy: M.S. (see *Agronomy*)

Analytical Chemistry: M.S., Ph.D. (see *Chemistry*)

Animal Breeding and Genetics: M.S., Ph.D. (see *Animal Science*)

Animal Ecology: M.S., Ph.D. (see *Natural Resource Ecology and Management*)

Animal Physiology: M.S., Ph.D. (see *Animal Science*)

Animal Science: M.S., Ph.D. (see *Animal Science*)

Anthropology: M.A. (see *Anthropology*)

Applied Linguistics and Technology: Ph.D. (see *English*)

Applied Mathematics: M.S., Ph.D. (see *Mathematics*)

Applied Physics: M.S., Ph.D. (see *Physics and Astronomy*)

Architectural Studies: M.S. (see *Architecture*)

Architecture: M. Arch., M. Arch./M.B.A., M. Arch./M.C.R.P. (see *Architecture*)

Art and Design: M.A. (see *Art and Design*)

Astrophysics: M.S., Ph.D. (see *Physics and Astronomy*)

Biochemistry: M.S., Ph.D. (see *Biochemistry, Biophysics and Molecular Biology*)

Bioinformatics and Computational Biology: M.S., Ph.D. (see *Bioinformatics and Computational Biology*)

Biomedical Sciences: M.S., Ph.D. (see *Biomedical Sciences*)

Biophysics: M.S., Ph.D. (see *Biochemistry, Biophysics and Molecular Biology*)

Biorenewable Resources and Technology: M.S., Ph.D. (see *Biorenewable Resources and Technology*)

Botany: M.S., Ph.D. (see *Botany*)

Business: M.S. (see *Business Administration*)

Business Administration: M.B.A., M. Arch./M.B.A., M.B.A./M.C.R.P., M.B.A./M.S. (Statistics), **M.B.A./M.S** (Information Systems) (see *Business Administration*)

Business and Technology: Ph.D. (see Business and Technology)

Chemical Engineering: M. Engr., M.S., Ph.D. (see *Chemical and Biological Engineering*)

Chemistry: M.S., Ph.D. (see *Chemistry*)

Civil Engineering: M.S., Ph.D. (see *Civil Engineering*)

Community and Regional Planning: M.C.R.P., M. Arch./M.C.R.P., M.B.A./M.C.R.P., M.L.A./M.C.R.P, M.P.A./M.C.R.P. (see *Community and Regional Planning*)

Computer Engineering: M.S., Ph.D. (see *Computer Engineering*)

Computer Science: M.S., Ph.D. (see *Computer Science*)

Condensed Matter Physics: M.S., Ph.D. (see *Physics and Astronomy*)

Creative Writing and Environment: M.F.A. (see *English*)

Crop Production and Physiology: M.S., Ph.D (see *Agronomy*)

Diet and Exercise: B.S./M.S. only (see *Food Science and Human Nutrition or Health and Human Performance*)

Earth Science: M.S., Ph. D. (see *Geological and Atmospheric Sciences*)

Ecology and Evolutionary Biology: M.S., Ph.D. (see *Ecology and Evolutionary Biology*)

Economics: M.S., Ph.D. (see *Economics*)

Education: M.Ed., M.Ed. Practitioner, M.S., Ph.D. (see *Curriculum and Instruction, Educational Leadership and Policy Studies*)

Electrical Engineering: M.S., Ph.D. (see *Electrical Engineering*)

Engineering Mechanics: M.Engr., M.S., Ph.D. (see *Engineering Mechanics*)

English: M.A. (see *English*)

Entomology: M.S., Ph.D. (see *Entomology*)

Environmental Science: M.S., Ph.D. (see *Environmental Science*)

Family and Consumer Sciences: M.F.C.S. (see *Family and Consumer Sciences, Master of*)

Family and Consumer Sciences Education: M.Ed., M.S., Ph.D (see *Family and Consumer Sciences Education and Studies*)

Fisheries Biology: M.S., Ph. D. (see *Natural Resource Ecology and Management*)

Food Science and Technology: M.S., Ph.D. (see *Food Science and Human Nutrition*)

Foodservice and Lodging Management: M.S., Ph.D. (see *Hotel, Restaurant, and Institution Management*)

Forestry: M.S., Ph.D. (see *Natural Resource Ecology and Management*)

Genetics: M.S., Ph.D. (see Genetics—Interdisciplinary)

Geology: M.S., Ph.D. (see *Geological and Atmospheric Sciences*)

Graphic Design: M.F.A. (see *Art and Design*)

High Energy Physics: M.S., Ph.D. (see *Physics and Astronomy*)

History: M.A. (see *History*)

History of Technology and Science: M.A., Ph.D. (see *History*)

Horticulture: M.S., Ph.D. (see *Horticulture*)

Human Computer Interaction: M.S., Ph.D. (see *Human Computer Interaction*)

Human Development and Family Studies: M.S., Ph.D. (see *Human Development and Family Studies*)

Immunobiology: M.S., Ph.D. (see *Immunobiology*)

Industrial and Agricultural Technology: M.S., Ph.D. (see *Technology Systems Management*)

Industrial Engineering: M.S., Ph.D. (see *Industrial Engineering*)

Information Assurance: M.S., M.S./M.P.A. (see *Information Assurance*)

Information Systems: M.S., M.S./M.B.A. (see *Management Information Systems*)

Inorganic Chemistry: M.S., Ph.D. (see *Chemistry*)

Integrated Visual Arts: M.F.A. (see *Art and Design*)

Interdisciplinary Graduate Studies: M.A., M.S (see *Interdisciplinary Graduate Studies*)

Interior Design: M.F.A. (see *Art and Design*)

Journalism and Mass Communication: M.S. (see *Journalism and Communication, Greenlee School of*)

Kinesiology: M.S., Ph.D. (see *Kinesiology*)

Landscape Architecture: M.L.A., M.L.A./M.C.R.P. (see *Landscape Architecture*)

Materials Science and Engineering: M.S., Ph.D. (see *Materials Science and Engineering*)

Mathematics: M.S., Ph.D. (see *Mathematics*)

Meat Science: M.S., Ph.D. (see *Animal Science, Food Science and Human Nutrition* (offered as Ph.D. only jointly with Animal Science))

Mechanical Engineering: M.S., Ph.D. (see *Mechanical Engineering*)

Meteorology: M.S., Ph.D. (see *Geological and Atmospheric Sciences*)

Microbiology: M.S., Ph.D. (see *Microbiology*)

Molecular, Cellular, and Developmental Biology: M.S., Ph.D. (see *Molecular, Cellular, and Developmental Biology*)

Neuroscience: M.S., Ph.D. (see *Neuroscience*)

Nuclear Physics: M.S., Ph.D. (see *Physics and Astronomy*)

Nutritional Sciences: M.S., Ph.D. (see *Nutritional Sciences*)

Operations Research (must be a joint major with Statistics): M.S. (see *Industrial Engineering/Statistics*)

Organic Chemistry: M.S., Ph.D. (see *Chemistry*)

Physical Chemistry: M.S., Ph.D. (see *Chemistry*)

Physics: M.S., Ph.D. (see *Physics and Astronomy*)

Plant Breeding: M.S., Ph.D. (see *Agronomy*)

Plant Pathology: M.S., Ph.D. (see *Plant Pathology*)

Plant Biology: M.S., Ph.D. (see *Plant Physiology*)

Political Science: M.A., (see *Political Science*)

Professional Agriculture: M.Ag. (see *Professional Agriculture*)

Psychology: M.S., Ph.D. (see *Psychology*)

Public Administration: M.P.A., M.P.A./M.C.R.P., M.P.A./M.S. (Information Assurance) (see *Political Science*)

Rhetoric and Professional Communication: Ph.D. (see *English*)

Rhetoric, Composition, and Professional Communication: M.A. (see *English*)

Rural Sociology: M.S., Ph.D. (see *Sociology*)

School Mathematics: M.S.M. (see *Mathematics*)

Science Education: M.A.T. (see *Curriculum and Instruction*)

Seed Technology and Business: M.S. (see *Seed Technology and Business*)

Sociology: M.S., Ph.D. (see *Sociology*)

Soil Science: M.S., Ph.D. (see *Agronomy*)

Statistics: M.S., M.B.A./M.S., Ph.D. (see *Statistics*)

Sustainable Agriculture: M.S., Ph.D. (see *Sustainable Agriculture*)

Systems Engineering: M.Engr. (see *Systems Engineering*)

Teaching English as a Second Language/Applied Linguistics: M.A. (see *English*)

Textiles and Clothing: M.S., Ph.D. (see *Textiles and Clothing*)

Toxicology: M.S., Ph.D. (see *Toxicology*)

Transportation: M.S. (see *Transportation*)

Veterinary Clinical Sciences: M.S. (see *Veterinary Clinical Science*)

Veterinary Microbiology: M.S., Ph.D. (see *Veterinary Microbiology and Preventive Medicine*)

Veterinary Pathology: M.S., Ph.D. (see *Veterinary Pathology*)

Veterinary Preventive Medicine: M.S. (see *Veterinary Diagnostic and Animal Production Medicine*)

Wildlife Biology: M.S., Ph.D. (see *Natural Resource Ecology and Management*)

Zoology: M.S., Ph.D (see *Zoology*)

Declared Minors

(in addition to the majors above which can also be minors)

Complex Adaptive Systems (see *Complex Adaptive Systems*)

Gerontology (see *Gerontology*)

Philosophy (see *Philosophy and Religious Studies*)

French (see *World Languages and Cultures*)

German (see *World Languages and Cultures*)

Latin (see *World Languages and Cultures*)

Linguistics (see *Linguistics*)

Russian (see *World Languages and Cultures*)

Spanish (see *World Languages and Cultures*)

Speech Communication (see *Speech Communication*)

Technology and Social Change (see *Technology and Social Change*)

Women's Studies (see *Women's Studies*)

Graduate Certificate Programs

A graduate certificate provides a mechanism for bestowing formal recognition of focused graduate study in a specialized area that is less comprehensive than required for a master's degree. At Iowa State University, a graduate certificate may be earned either before, after, or concurrently with the master's or doctoral degree. For more detailed information on certificate programs, browse the Graduate College web site at: www.grad-college.iastate.edu/publications/gchandbook/appendixd.html.

Advanced Medical Nutrition Therapy Certificate (see *http://www.fshn.hs.iastate.edu/grad/certificate.php*)

Biorenewable Resources and Technology Certificate (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/BRT-GradCert.html*)

Community College Leadership Certification (see www.cclp.hs.iastate.edu/)

Community College Teaching (see *http://www.cclp.hs.iastate.edu/teaching_learning.html*)

Dietetics Communication and Counseling Certificate (see *http://www.fshn.hs.iastate.edu/grad/certificate.php*)

Dietetics Management Certificate (see *http://www.fshn.hs.iastate.edu/grad/certificate.php*)

Environmental Engineering Certificate (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/environmental.html)*

Family Financial Planning Certificate (see *http://www.hs.iastate.edu/online/mfcs/ffp/homepage.php*)

Food Safety and Defense Graduate Certificate (see *http://www.fshn.hs.iastate.edu/grad/foodsafetycert.php*)

Forensic Sciences Certificate (see *http://www.chem.iastate.edu/certificate/)*

Gerontology Certificate (see *http://www.hs.iastate.edu/online/mfcs/gerontology/homepage.php*)

Geographic Information Systems Certificate (see *www.design.iastate.edu/GIS/*)

Graduate Student Teaching Certificate (see *http://www.celt.iastate.edu/gstc/homepage.html*)

Human Computer Interaction (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/hci.html*)

Information Assurance Certificate (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/infas.html*)

Power Systems Engineering Certificate (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/powersystems.html*)

Principal Licensure (Pre-LEAD) (see *http://www.elps.hs.iastate.edu/edadm/edadmhmpg3-prelead.php*)

Public Management Certificate (see *www.pols.iastate.edu/mpa.shtml*)

Seed Business Management (see *http://www.seeds.iastate.edu/class/certificates.htm*)

Seed Science and Technology (see *http://www.seeds.iastate.edu/class/certificates.htm)*

Special Education Certificate (see *http://www.teacher.hs.iastate.edu/addtnl_endorsements.php)*

Superintendent Licensure (see *www.elps.hs.iastate.edu/edadm/edadmhmpg3-acad.php)*

Systems Engineering (see *http://www.ede.iastate.edu/Graduate-Certificates/Grad-Cert/syscert.html*)

TESL (Teaching English as a Second Language) Certificate (see *http://www.public.iastate.edu/~apling/TESL_cert.html*)

Courses and Programs

Information About Courses

Course Numbers

The courses in each department are numbered from 1 to 699, according to the following groups:

1-99	Courses not carrying credit toward a degree (zero credit).
100-299	Courses primarily for freshman and sophomore students.
300-499	Courses primarily for junior and senior students.
500-599	Courses primarily for graduate students, but open to qualified undergraduates.
600-699	Courses for graduate students.

Credits and Contact Hours

The academic value of each course is stated in semester credits. Each credit is normally earned by attending one (50-minute) hour of lecture or recitation per week for the entire semester, or by attending a laboratory or studio period of two or three hours per week. As a guideline, undergraduate students typically will be expected to spend two hours in preparation outside of class for each lecture or recitation hour; additional outside work may be required for laboratory or studio classes.

Each course states the number of semester credits assigned to the course, preceded in parentheses by the number of hours in class (contact hours) expected of the student. The first of the two contact-hour numbers indicates the number of lecture or recitation class hours per week for the semester. The second is the number of laboratory or studio hours required per week. Laboratory and studio hours may include some time devoted to lectures and recitations. For example, Com S 103 is listed as (3-2) Cr. 4. In that case, the course is 4 semester credits, 3 hours of lecture and two hours of laboratory each week.

The term "Cr. arr." means that the amount of credit is arranged in advance between the student and the instructor. The credit to be earned depends on the amount of work expected of the student, in accordance with the policy that some combination of teacher-student contact and outside work by the student involving at least three hours per week for the semester is required for each credit.

The term "Cr. R." means that the course is required in a certain curriculum or as cognate to one or more other courses. It is also used for cooperative education courses and for some optional inspection trips, study tours, and professional development courses for which numerical credit is not granted. An R credit course does not carry numerical credit toward a student's degree, but it does apply toward the degree. The R credit course is generally listed on the degree program as a requirement for a specific curriculum/major that must be completed prior to graduation. R credit courses may be graded using the A-F grading scale or the satisfactory/fail grading scale. All R credit courses are assigned a numerical value for purposes of enrollment certification. Requests by students to drop an R credit course will be processed as an administrative drop during period 2 and thus will not be counted against the student's drop limit and will not appear on the student's transcript. (*See Index, Schedule Changes.*)

Semester of Offering

Within each course description may be found one or more of the following letters: F. S. SS., indicating which term—fall, spring, summer session—of the academic year the course is offered. "Alt." is the abbreviation for alternate. If there is sufficient demand, courses may be offered more frequently than announced. Insufficient demand or unforeseen staffing problems may result in the cancellation of announced offerings. Students are advised to refer to the Schedule of Classes or consult with departments for up-to-date course schedule information.

Course Prerequisite

A prerequisite indicates the specific academic background or general academic maturity considered necessary for the student to be ready to undertake the course. Prerequisites are usually stated in terms of specific courses, but equivalent preparation is usually acceptable. An instructor may, however, direct a student whose background does not meet the stated prerequisite, or its equivalent, to drop the course. Conversely, an instructor may waive the prerequisite for a course for which he or she is responsible. Thus, permission of the instructor is understood to be an alternate to the stated prerequisites in all courses.

It is university policy that the instructor shall inform- the students at the beginning of each course if students who have not met the prerequisite requirements must drop the course. Course prerequisites are listed in the Schedule of Classes as well as in the Courses and Programs section of this publication.

Cross-listed Courses

A course, including its complete description, may be listed in two or more departments. The participating department or departments are noted in parentheses. Credit for the course may be obtained through any of the cross-listed departments.

Designators/Course Abbreviations

For abbreviations for designating departments and programs See *Index, Designators.*

Dual-listed Courses

Dual-listed courses permit undergraduate and graduate students to be in the same class but to receive credit under two different course numbers. Credit in the graduate course is not available to students who have received credit in the corresponding undergraduate course. Both graduates and undergraduates receive the same amount of credit for the course, but additional work is required of all graduate students taking the course under the graduate-level course number. This extra work may take the form of additional reading, projects, examinations, or other assignments as determined by the instructor. The instructor must be a member of the Graduate Faculty or a Graduate Lecturer. Each dual-listed course is designated in the catalog with the phrase "Dual-listed with," although the student's official transcript of credits, both graduate and undergraduate, does not identify dual-listed courses as such. There is a limit to the number of dual-listed course credits that may be used to meet the requirement for an advanced degree. (For information about procedures for requesting permission to offer dual-listed courses, faculty should consult the *Graduate Faculty Handbook*.)

Off-campus courses-Residential Credit

Iowa State University offers distance education courses over the Iowa Communications Network (ICN), by videotape and on the World Wide Web. These courses are the same as those offered on campus, carry residential credit, and are taught by ISU faculty members. Credit earned in off-campus courses becomes a part of the student's academic record at Iowa State University and may be used to meet degree requirements in the same manner as credit earned on campus.

Priority Enrollment

High demand for courses in certain areas has necessitated enrollment management for some courses. When enrollment priority is established for a course, first consideration is given to students whose curriculum/major explicitly requires the course.

Special Course Fees

Courses for which special course fees are assessed are designated in the *Schedule of Classes*. Special course fees may be assessed for such extraordinary costs as materials fees (which may include consumable materials or equipment replacement), field trip expenses, developmental Math fees, and camp fees. In some cases, special course fee amounts vary from term to term. Additional information on camp fees and the developmental Math fee may be found in the fees and expenses section. See *Index, Fees.*

Graduate Programs

Graduate Major

A major in the Graduate College is the area of academic professional concentration, approved by the Board of Regents, in which the student chooses to qualify for the award of a graduate degree.

Graduate Area of Specialization

Areas of specialization are indicated in the graduate statements of some departments. This is a subdivision of a major in which a strong graduate-level program is available. When approved by the Graduate College, such areas of specialization are shown parenthetically after the major on official records, including transcripts and thesis/dissertation title pages.

Interdepartmental Programs

Interdepartmental programs are available at both graduate and undergraduate levels. An interdepartmental program is an administrative structure usually not functioning as a department, ordinarily headed by a supervisory committee, and offering a degree with major(s) in that subject area. Interdepartmental programs have been officially approved and may offer courses.

Nonmajor Graduate Credit

All courses included on the Program of Study of a graduate student must be approved by the student's program of study committee. Usually courses in the major are selected from 500- and 600- level courses in the major. Courses outside of the major can be selected from other 500- and 600- level courses and from 300- and 400- level courses which have been approved for nonmajor graduate credit. In the catalog, the approved 300- and 400- level courses are indicated by the words "Nonmajor graduate credit" in the course description.

Accounting

Marvin L. Bouillon, Chair of Department

Professors: Hira, Ravenscroft

Professors (Emeritus): Brown, Elvik, Handy

Associate Professors: Bouillon, Dilla, Doran, Jeffrey, Kurtenbach

Associate Professors (Emeritus): Murphy

Assistant Professors: Denison, Gary, Janvrin, No, Terando

Assistant Professors (Adjunct): Curtis

Instructors (Adjunct): Duffy, Mazzitelli

Senior Lecturer: Clem

Lecturer: Christensen, Hashmi, Whittle

Undergraduate Study

For undergraduate curriculum in business, major in accounting, see *College of Business, Curricula*.

The primary purpose of accounting is to provide relevant information to both internal users (management) and external users such as investors, creditors, government, and the general public. Accounting is an integral part of the management of business and public organizations. Accountants, therefore, participate in planning, evaluating, and controlling the activities of the firm. Accounting is needed by external users in order to make investment decisions, grant or withhold credit, and, in the case of government, to collect revenue and gather statistical information. In order to provide useful information, accountants collect, analyze, synthesize, and report data in an understandable manner.

The instructional objective of the Accounting Program is to provide a well-rounded professional education in accounting. Such an education should provide the student with: (1) a mastery of basic accounting concepts; (2) an ability to think critically and creatively about accounting problems; (3) an ability to communicate effectively and work with others as a member of a team; (4) an awareness and sensitivity for dealing with ethical concerns.

The major in accounting is designed to give students a conceptual foundation as well as to provide a wide range of basic skills and analytical tools for use in reporting for both public and private concerns. Students who complete the accounting major are well prepared to accept positions in industry, government, and the public accounting profession. The requirements for the accounting major are met by successful completion of the following courses: Acct 383, 384, 386, 387, 485, and 497. See the CPA note below for the 150-hour education requirement for CPA certification in Iowa.

In addition, it is highly recommended that an accounting major include Business Law II (Acct 316). The Department of Accounting should be consulted for information on specific alternative plans of study.

The department also offers a minor for College of Business students with a different major. They are required to take 15 credits from a list of approved courses, of which 9 credits need to be stand alone.

CPA Note: In addition to the 18 credits of accounting required for the accounting major, candidates for the CPA exam must complete two additional accounting courses to sit for the CPA exam, for a total of 24 hours beyond principles. Students may use the electives shown above or petition to take graduate courses to fulfill the additional six hours. Business Law II (Accounting 316) is also highly recommended; please note this class does not count towards the aforementioned 24 hours required to sit for the exam. In order to be certified or licensed to practice in Iowa, students must complete 150 credits. Qualified students should consider taking the Master of Accounting to satisfy the 150-credit requirement. Juniors and seniors in accounting who are interested in graduate study should contact the Coordinator of the MAcc Program so you may complete your graduate degree in an efficient manner. For states outside Iowa, be sure to check local rules, as each state determines its own licensing requirements.

Graduate Study

The department offers work for a graduate degree - the masters of accounting (M.Acc.). This is a 30-hour degree, with an optional creative components. The program requires 15 hours of graduate accounting courses, at least 9 hours of nonaccounting graduate electives, a communications course and an international course from an approved list. Students who choose the creative component option may replace two required hours of accounting with the creative component. Included in the 15 required hours of graduate accounting courses is a 3-credit required course, Acct 598. The M.Acc. is appropriate for any student wanting to pursue a variety of accounting careers. The M.Acc. program is an efficient way for qualified candidates to meet the 150-hour education requirement for CPA certification in Iowa.

The department participates in the M.B.A. full-time and part-time programs. The M.B.A. program is a 48-credit, nonthesis, noncreative component curriculum. Twenty four of the 48 credits are core courses and the remaining 24 are graduate electives.

Within the M.B.A. program, students may develop an area of specialization in accounting. This specialization requires that 12 of the 24 credits of graduate electives be from accounting.

The specialization in accounting is designed to help meet the 150 hour education requirement for CPA certification in Iowa.

Courses primarily for undergraduate students

Acct 215. Legal Environment of Business. (3-0) Cr. 3. F.S.SS. *Prereq: Sophomore classification.* General history, structure, and principles of law. The legal system, as an agency of social control; good business practices, and tool for change. The court systems, Constitution, torts, contracts, administrative agencies, and agency law.

Acct 284. Financial Accounting. (3-0) Cr. 3. F.S.SS. *Prereq: 15 hours of credit at ISU or sophomore standing.* Introduction to the basic concepts and procedures of financial accounting from a user perspective. The course examines the accounting cycle, business terminology, basic control procedures, and the preparation and evaluation of financial reports, with an emphasis on financial statement analysis.

Acct 285. Managerial Accounting. (3-0) Cr. 3. F.S.SS. *Prereq: 284.* Preparation and use of internal managerial reports for decision-making, planning and performance evaluation.

Acct 316. Business Law. (3-0) Cr. 3. F.S. *Prereq: 215.* Continuation of 215. Sales under the Uniform Commercial Code, negotiable instruments, secured transactions, property transactions, partnerships, and wills and estates.

Acct 383. Intermediate Managerial Accounting. (3-0) Cr. 3. F.S. *Prereq: 285 or 508.* Generation, communication and use of information to assist management with planning, control, and decision making in manufacturing and service organizations. Includes traditional and contemporary models of cost estimation, assignment, and control, responsibility accounting, and nonrecurring decisions. Emphasis on developing written and oral communication skills, as well as spreadsheet capabilities.

Acct 384. Accounting Information Systems. (3-0) Cr. 3. *Prereq: 285.* Analysis of concepts and procedures underlying the automated accumulation and processing of accounting data. EDP internal control and audit techniques. Trends in accounting information systems.

Acct 386. Intermediate Accounting I. (3-0) Cr. 3. F.S. *Prereq: 285 or 508.* The conceptual framework of financial accounting. Communication of financial information on the income and retained earnings statements, statement of cash flows, and the balance sheet. Accounting concepts relating to current and operational assets of the firm.

Acct 387. Intermediate Accounting II. (3-0) Cr. 3. F.S. *Prereq: 386.* Financial accounting and reporting practices for business entities. Generally accepted accounting principles (GAAP) relative to firm liabilities, equity, income, taxes, employee benefits, leases, accounting changes and cash flows. Discussion of current issues in financial accounting.

Acct 483. Advanced Managerial Accounting. (Dual-listed with 583). (3-0) Cr. 3. *Prereq: 383 or 581.* Business simulation focusing on generation and communication of information to assist management with financial decision-making. Emphasis on developing teamwork, written communication, and oral presentation skills.

Acct 485. Principles of Federal Income Tax. (3-0) Cr. 3. F.S. *Prereq: 285 or 508.* An introduction to the fundamentals of income tax related to entities and individual taxpayers, and concepts applicable to all tax entities. Depreciation, like-kind exchanges, and capital gain treatment. Transaction planning to maximize participation in preferential tax opportunities. Nonmajor graduate credit.

Acct 486. Volunteer Income Tax Assistance. (0-2) Cr. 1. Repeatable. S. *Prereq: 284.* Introduction to and field work in the preparation of individual income tax returns (state and federal). Basic coverage of filing and residency Status, taxable income, exemptions, deductions, and credits. Tax software usage and online filing.

Acct 488. Governmental and Non-profit Institution Accounting. (3-0) Cr. 3. *Prereq: 387.* Budgeting, accounting, auditing, and financial reporting principles associated with private and public nonprofit organizations. Includes survey of state, local, municipal, and federal government accounting, as well as accounting for colleges, universities, public schools, health care facilities, voluntary health and welfare organizations and other not for profit entities. Nonmajor graduate credit.

Acct 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: 285, senior classification, permission of instructor.*

Acct 495. Advanced Accounting Problems. (Dual-listed with 595). (3-0) Cr. 3. *Prereq: 387.* Partnerships, branch operations, accounting for business combinations and affiliated companies, consolidated financial statements; reporting for multinational operations. Nonmajor graduate credit.

Acct 497. Introduction to Auditing. (3-0) Cr. 3. F.S. *Prereq: 384, 387 and Stat 326.* The conceptual framework of auditing. Professional ethics. External reporting concepts. Audit methodology including risk analysis, internal control, procedures for gathering evidence and the role of Statistical sampling in auditing. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Acct 508. Survey of Financial Accounting. (2-0) Cr. 2. *Prereq: Graduate classification.* A general introduction to financial accounting information. Financial

topics covered include the use and analysis of financial information, the regulatory environment, and the use of the internet and electronic spreadsheets as a means of accessing and analyzing financial data.

Acct 533. Data Management for Decision Makers. (Cross-listed with MIS). (3-0) Cr. 3. *Prereq: MIS 503.* Addresses data needs of functions such as marketing, finance, and production. Advanced skills needed to design, develop and use database, data warehousing and data mining systems for effective decision support. Emphasis on importance of contemporary technologies.

Acct 581. Accounting for Decision Making. (3-0) Cr. 3. *Prereq: 508 or equivalent.* Decision analysis applied to managerial accounting issues. Generation of information for management decision making and control. Responsibility accounting and non-recurring decisions.

Acct 582. Corporate Governance and Leadership. (Cross-listed with Mgmt). (3-0) Cr. 3. *Prereq: Mgmt 502 or permission.* Examination of top managers and corporate boards of directors in terms of roles, responsibilities, and tasks. Examination of corporate governance structure and functioning. Topics include CEO tenure and compensation, board monitoring and composition, board responsibility and accountability, board structure and performance, CEO and board roles in strategic management, shareholder and stakeholder representation, corporate social responsibility, ethics and corporate governance, international governance, and executive leadership style.

Acct 583. Advanced Managerial Accounting. (Dual-listed with 483). (3-0) Cr. 3. *Prereq: 383 or 581.* Business simulation focusing on generation and communication of information to assist management with financial decision-making. Emphasis on developing teamwork, written communication, and oral presentation skills.

Acct 585. Tax Implications of Business Decisions. (3-0) Cr. 3. *Prereq: 485.* The impact of federal tax legislation on the formation, operation and liquidation or reorganization of entities. Income-tax planning for executives.

Acct 586. Advanced Federal Taxation. (3-0) Cr. 3. F.S. *Prereq: 485.* Advanced topics in Federal Taxation. An in-depth study of partnership, corporation, fiduciary, and estate and give taxation. Tax administration, practice and tax planning are covered. Strongly recommended for those who plan a career in public accounting or taxation.

Acct 588. Governmental and Non-profit Institution Accounting. (3-0) Cr. 3. *Prereq: 387 or 592.* Budgeting, accounting, auditing, and financial reporting principles associated with private and public nonprofit organizations. Includes survey of state, local, municipal and federal government accounting, as well as accounting for colleges, universities, public schools, health care facilities, voluntary health and welfare organizations and other not for profit entities.

Acct 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor. For students* wishing to do individual research in a particular area of accounting.

Acct 591. Fraud Examination and Prevention. (3-0) Cr. 3. *Prereq: 497 or 508.* Principles and methodology of fraud detection and deterrence. Addresses the following: Causes and elements of fraud, costs to society, asset theft, financial statement representation, internal controls for fraud prevention, evidence gathering, and legal aspects of fraud.

Acct 592. Financial statement Analysis. (3-0) Cr. 3. *Prereq: 284 or 508.* The presentation and analysis of financial statement information from the point of view of the primary users of such data: owners and creditors. Topics covered will include the financial reporting system, the primary financial statements, and effects of accounting method choice on reported financial data, and firm valuation.

Acct 594. Business Valuation. (3-0) Cr. 3. *Prereq: 387 or 592.* Using financial statement analysis to value the firm. Topics covered include assessing how well a firm's financial statements reflect the economic effects of its resource management strategies and constructing proforma financial information that will serve as inputs to valuation models.

Acct 595. Advanced Accounting Problems. (Dual-listed with 495). (3-0) Cr. 3. *Prereq: 387.* Partnerships, branch operations, accounting for business combinations and affiliated companies, consolidated financial statements; reporting for multinational operations.

Acct 596. International Accounting. (3-0) Cr. 3. *Prereq: 386 or 508.* Accounting and reporting requirements and managerial issues faced by multinational corporations. The international environment of standard setting will be examined. Technical issues such as transfer pricing, inflation accounting and taxation will be discussed.

Acct 597. Advanced Auditing and Assurance Services. (3-0) Cr. 3. *Prereq: 497.* A study of advanced auditing and assurance issues. Topics include risk analysis, internal control, fraud detection, analytical procedures, evaluating operational and strategic objectives, and reporting and implementing audit findings.

Acct 598. Financial Accounting: Theory and Contemporary Issues. (3-0) Cr. 3. F. *Prereq: 387 or 592.* Theoretical discussion of the financial accounting and reporting environment. The usefulness of financial accounting information for decision making will be examined. A number of current financial accounting issues and the financial accounting standard setting process will be discussed and examined. MAcc students should take this course during their last semester.

Acct 599. Creative Component. Cr. 2. *Prereq: Admission to the Master of Accounting Program*. This course prepares students to complete their creative component project option in the Master of Accounting degree.

Aerospace Engineering

Thomas Shih, Chair of Department

Distinguished Professors: Soukoulis, R. B. Thompson

Distinguished Professors (Emeritus): D. Thompson, Young

Professors: Chandra, Chimenti, Durbin, Holger, Kelkar, Levitas, Lu, Oliver, Rajagopalan, Rothmayer, Rudolphi, Sarkar, Schmerr, Shih, Takle, Wang, Wie, Zachary

Professors (Emeritus): Akers, Greer, Inger, Iversen, Jenison, McConnell, McDaniel, Munson, Pierson, Rizzo, Rogge, Rohach, Tannehill, Tsai, Weiss, Wilson

Professors (Adjunct): Hsu, Nakagawa

Associate Professors: Bastawros, Bryden, Dayal, Hilliard, Hindman, Mitra, Sherman, Sturges

Associate Professors (Emeritus): Hermann, Seversike, Trulin, Vogel

Associate Professors (Adjunct): Biner, Cox, Roberts

Associate Professors (Collaborators): Flatau

Assistant Professors: Chung, Holland, Hong, Hu, Jacobson

Assistant Professors (Adjunct): Byrd, Gray

Assistant Professors (Collaborators): Chavez

Senior Lecturers: Deam, Haugli, Schaefer

Lecturers: Boylan

Undergraduate Study

For undergraduate curriculum in aerospace engineering leading to the degree bachelor of science, see College of Engineering, Curricula. This curriculum is accredited by the Engineering Accreditation Commission of ABET.

The aerospace engineer is primarily concerned with the design, analysis, testing, and overall operation of vehicles which operate in air, water, and space. The curriculum is designed to provide the student with an education in the fundamental principles of aerodynamics, flight dynamics, propulsion, structural mechanics, flight controls, design, testing, and space technologies. A wide variety of opportunities awaits the aerospace engineering graduate in research, development, design, production, sales, and management in the aerospace industry, and in many related industries in which fluid flow, control, and transportation problems play major roles.

A cooperative education program in aerospace engineering is available in cooperation with government agencies and industry. The usual four-year curriculum is extended over a five-year span to permit alternating industrial experience periods and academic periods. This arrangement offers valuable practical experience and financial assistance during the college years. See *College of Engineering, Cooperative Programs.*

Undergraduate Mission and Educational Objectives

The Department of Aerospace Engineering maintains an internationally recognized academic program in aerospace engineering via ongoing consultation with students, faculty, industry, and aerospace professionals. Results of these consultations are used in a process of continuous academic improvement to provide the best possible education for our students.

Mission statement: The mission of the aerospace engineering program is to prepare the aerospace engineering student for a career with wide-ranging opportunities in research, development, design, production, sales, and management in the aerospace industry and in the many related industries which are involved with the solution of multi-disciplinary, advanced technology problems.

Program Educational Objectives:

Graduates should be actively contributing, valued members in their chosen profession showing continued professional growth.

Graduates should use their strong foundation in science, mathematics, and engineering to create innovative practices and/or technologies.

Graduates should demonstrate teamwork, leadership, planning, and initiative in advancing organizational goals.

Graduates should act with integrity, based on an awareness of the impact of their work –economic, environmental, and Societal impact – and work to maintain high levels of cultural adaptability.

Graduates should demonstrate critical thinking and effective, multi-modal communication skills.

Graduates should strive to learn continuously through professional improvement opportunities and self study.

Graduates should work to ensure superior quality, customer satisfaction, and safety outcomes in their work.

Nondestructive Evaluation (NDE)
The NDE minor is multidisciplinary and open to undergraduates in the College of Engineering. The minor may be earned by completing 16 credits including:
(1) MatE/E M 362 and 362L
(2) Two courses (6-7 credits) from: E M 350, Aer E/E E/E M/Mat E 490 (in the area of NDE), M S E/E M 550.
(3) Two courses (6 credits) from: Aer E 321, 421, 422, 423, 426; E E 424; E M 424, 425; Mat E 418, 443, 444; M E 417, 418; Stat 305.

A combined average grade of C or higher is required in courses applied to the minor and the minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

Graduate Study

The department offers work for the degrees master of engineering, master of science, and doctor of philosophy with major in aerospace engineering, and minor work to students taking major work in other departments. For all graduate degrees it is possible to establish a co-major program with another graduate degree granting department. Within the aerospace program, work is available in the following areas: aerospace systems design, atmospheric and space flight dynamics, computational fluid dynamics, control systems, wind engineering, fluid mechanics, optimization, structural analysis, and non-destructive evaluation.

The degrees master of science and doctor of philosophy require an acceptable thesis in addition to the coursework. For the degree master of engineering, a creative component or suitable project is required. Appropriate credit is allotted for this requirement.

Minor work for aerospace engineering majors is usually selected from mathematics, physics, electrical engineering, engineering mechanics, mechanical engineering, materials science, meteorology, computer science, and computer engineering.

The normal prerequisite to major graduate work in aerospace engineering is the completion of a curriculum substantially equivalent to that required of aerospace engineering students at this university. However, because of the diversity of interests within the graduate programs in aerospace engineering, a student whose prior undergraduate or graduate education has been in allied engineering and/or scientific fields may also qualify. In such cases, it may be necessary for the student to take additional work to provide the requisite background. A prospective graduate student is urged to specify the degree program and the specific field(s) of interest on the application for admission.

Courses normally will be offered at the times stated in the course description. Where no specific time of offering is stated, the course may be offered during any semester provided there is sufficient demand.

Courses primarily for undergraduate students

Aer E 101H. Engineering Honors Orientation. Cr. R. F. *Prereq: Membership in the Freshman Honors Program.* Introduction to the College of Engineering and the Aerospace Engineering profession. Information concerning university, college, and department policies, procedures and resources with emphasis on the Freshman Honors Program. Topics include experiential education study abroad opportunities, and department mentorships.

Aer E 112. Orientation to Learning and Productive Team Membership. (Cross-listed with FS HN, Hort, TSM, NREM). (2-0) Cr. 2. F. Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

Aer E 160. Aerospace Engineering Problems With Computer Applications Laboratory. (2-2) Cr. 3. F.S. *Prereq: Satisfactory scores on mathematics placement assessments; credit or enrollment in Math 142, 165.* Solving aerospace engineering problems and presenting solutions through technical reports. Significant figures. SI units. Graphing and curve fitting. Flowcharting. Introduction to material balances, mechanics, electrical circuits, statistics engineering economics, and design. Spreadsheet programs. Introduction to UNIX/LINUX computing environments, and programming in FORTRAN. Team projects.
H. Honors. F.

Aer E 161. Numerical, Graphical and Laboratory Techniques for Aerospace Engineering. (3-2) Cr. 4. F.S. *Prereq: 160 or equivalent course.* Computer solutions to aerospace engineering problems using the FORTRAN language and Matlab(R), with emphasis on numerical methods. Introduction to computing environments including UNIX/LINUX. Graphical description of geometrical objects with emphasis on aerospace design. Solid modeling using computer graphics software. Develop proficiency with basic instrumentation utilized in subsequent Aerospace Engineering laboratory courses. Computational and Statistical analysis of lab results. Written and oral technical reports, team projects.
H. Honors. S.

Aer E 192. Aerospace Seminar. Cr. R. S. (1-0) Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities, specifically experiential learning and study abroad. Academic program planning, departmental symposium participation.
H. Honors.

Aer E 243. Aerodynamics I. (3-0) Cr. 3. F.S. *Prereq: Grade of C- or better in 261, Math 265, enrollment in 243L.* Introduction to fluid mechanics and aerodynamics. Fluid properties, statics, and kinematics. Conservation equations in differential and integral form. Bernoulli's equation. Dimensional analysis. Basic potential flow concepts and solutions. Examples of numerical methods. Applications of multi-variable calculus to fluid mechanics and aerodynamics.

Aer E 243L. Aerodynamics Laboratory I. (0-3) Cr. 0.5. F.S. *Prereq: Enrollment in 243.* Introduction to fluid dynamic principles and instruments in aerodynamics through laboratory studies and experiments. Report writing.

Aer E 261. Introduction to Performance and Design. (4-0) Cr. 4. F.S. *Prereq: 161, Math 166, Phys 221.* Introduction to aerospace disciplinary topics, including: aerodynamics, structures, propulsion, and flight dynamics with emphasis on performance.

Aer E 265. Scientific Balloon Engineering and Operations. (Cross-listed with Mteor). (0-2) Cr. 1. Repeatable. F. Engineering aspects of scientific balloon flights. Integration of science mission objectives with engineering requirements. Operations team certification. FAA and FCC regulations, communications, and command systems. Flight path prediction and control.**Aer E 290. Independent Study.** Cr. arr. Repeatable. *Prereq: Sophomore classification, approval of the department.*

A. Flight ground instruction
B. In-flight training (Prereq: 301.)
C. Other

Aer E 291. Aerospace Seminar. Cr. R. F. (1-0) Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Academic program planning, departmental symposium participation.
H. Honors

Aer E 292. Aerospace Seminar. Cr. R. S. (1-0) Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Academic program planning, departmental symposium participation. Satisfactory-fail only.
H. Honors

Aer E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course prior to commencing work. Satisfactory-fail only.

Aer E 301. Flight Experience. Cr. R. F. *Prereq: Credit or enrollment in 355.* Two hours of in-flight training and necessary ground instruction. Course content prescribed by the Aerospace Engineering Department. Six hours of flight training certified in a pilot log book can be considered by the course instructor as evidence of satisfactory performance in the course. Satisfactory-fail only.

Aer E 311. Gas Dynamics. (3-0) Cr. 3. S. *Prereq: 243, M E 330, enrollment in 311L.* Properties of liquids and gases, review of thermodynamic processes and relations, energy equation, compressible flow, shock and expansion waves, isentropic flow, Fanno and Rayleigh flow. Nonmajor graduate credit.

Aer E 311L. Gas Dynamics Laboratory. (0-3) Cr. 0.5. S. *Prereq: 243, 243L, enrollment in 311.* Introduction to experimental compressible flow and propulsion principles, techniques and instruments through laboratory studies and experiments. Report writing.

Aer E 321. Flight Structures Analysis and Laboratory. (2.5-1) Cr. 3. F. *Prereq: E M 324.* 3 hours of lecture weekly and laboratory alternating weeks. Determination of flight loads. Materials selection for flight applications. Analysis of flight structures including trusses, beams, frames, and shear panels employing classical and finite element methods. Laboratory experiments on flight structures. Nonmajor graduate credit.

Aer E 331. Flight Control Systems I. (3-0) Cr. 3. S. *Prereq: 355.* Linear system analysis. Control system designs using root-locus and frequency response methods. Applications in flight control systems. Nonmajor graduate credit.

Aer E 343. Aerodynamics II. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 311 and enrollment in 343L.* Incompressible, subsonic, transonic, supersonic, hypersonic flow over airfoils and wings. Viscous flow theory. Laminar boundary layers. Transition and turbulent flow. Nonmajor graduate credit.

Aer E 343L. Aerodynamics Laboratory II. (0-2) Cr. 1. S. *Prereq: Enrollment in 343.* Advanced concepts in aerodynamics and propulsion through laboratory experience. Experiments include model tests. Techniques in subsonic and supersonic measurements. Report writing.

Aer E 351. Astrodynamics I. (3-0) Cr. 3. F. *Prereq: E M 345, Aer E 261, Credit or enrollment in Aer E 243.* Introduction to astrodynamics. Two-body motion. Geocentric, lunar and interplanetary trajectories and applications. Launch and atmospheric re-entry trajectories. Nonmajor graduate credit.

Aer E 355. Aircraft Flight Dynamics and Control. (3-0) Cr. 3. F. *Prereq: 261, Math 267, E M 345.* Aircraft rigid body equations of motion, linearization, and modal analysis. Longitudinal and lateral-directional Static and dynamic stability analysis. Flight handling characteristics analysis. Longitudinal and lateral-directional open loop response to aircraft control inputs. Aircraft flight handling qualities. Nonmajor graduate credit.

Aer E 361. Computational Techniques for Aerospace Design. (2-2) Cr. 3. F.S. *Prereq: 243, Math 267, E M 324, E M 345.* Advanced programming, workstation environment, and development of computational tools for aerospace analysis and design. Nonmajor graduate credit.

Aer E 391. Aerospace Seminar. Cr. R. F. (1-0) Professional skills development activities including: interviewing, program of study specialization considerations, post baccalaureate study options, career planning.

Aer E 392. Aerospace Seminar. Cr. R. S. (1-0) Professional skills development activities including: program of study specialization considerations, post baccalaureate study options, career planning. Preliminary senior design project planning and mentor selection. Satisfactory-fail only.

Aer E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period. Students must register for this course prior to commencing work. Satisfactory-fail only.

Aer E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* Professional work period, one semester maximum per academic year. Students must register for this course prior to commencing work. Satisfactory-fail only.

Aer E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course prior to commencing work. Satisfactory-fail only.

Aer E 411. Aerospace Vehicle Propulsion I. (3-0) Cr. 3. F. *Prereq: 311.* Atmospheric propulsion system performance and cycle analysis. Momentum theorem, thrust and propulsive efficiency. Thermodynamics of compressible flow with heat and work addition. Components and principles of turbojets and turbofans. Rocket engines and ramjet principles. Nonmajor graduate credit.

Aer E 412. Aerospace Vehicle Propulsion II. (3-0) Cr. 3. *Prereq: 343, 411.* Electricity and magnetism. Plasma physics. Ion engine performance. Introduction to advanced electromagnetic propulsion systems. Energy sources and nuclear propulsion. Low thrust mission analysis. Space mission requirements Nonmajor graduate credit.

Aer E 417. Experimental Mechanics. (Cross-listed with E M). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: E M 324.* Introduction of different aspects of measuring deformation, strains, and stress for practical engineering problems. Strain gage theory and application. Selected laboratory experiments. Nonmajor graduate credit.

Aer E 421. Advanced Flight Structures. (2.5-1) Cr. 3. S. *Prereq: 321, Math 266 or 267.* Analysis of indeterminate flight structures including finite element laboratory. Static analysis of complex structural components subject to thermal and aerodynamic loads. Analytical and finite element solutions for stresses and displacements of membrane, plane stress, plate structures. Buckling of beams, frames, and plate structures. Introduction to vibration of flight structures. Steady state and transient structural response using normal modal analysis. Nonmajor graduate credit.

Aer E 422. Aeroelasticity. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 421 or E M 450 or M E 450.* Vibration theory. Steady and unsteady flows. Mathematical foundations of aeroelasticity, static and dynamic aeroelasticity. Linear unsteady aerodynamics, nonsteady aerodynamics of lifting surfaces. Stall flutter. Aeroelastic problems in civil engineering structures. Aeroelastic problems of rotorcraft. Experimental aeroelasticity. Selected wind tunnel laboratory experiments. Nonmajor graduate credit.

Aer E 423. Composite Flight Structures. (2-2) Cr. 3. *Prereq: E M 324; Mat E 272.* Fabrication, testing and analysis of composite materials used in flight structures. Basic laminate theory of beams, plates and shells. Manufacturing and machining considerations of various types of composites. Testing of composites for material properties, strength and defects. Student projects required. Nonmajor graduate credit.

Aer E 426. Design of Aerospace Structures. (1-6) Cr. 3. *Prereq: E M 324.* Detailed design and analysis of aerospace vehicle structures. Material selection, strength, durability and damage tolerance, and validation analysis. Design for manufacturability. Nonmajor graduate credit.

Aer E 432. Flight Control Systems II. (3-0) Cr. 3. *Prereq: 331.* Aircraft lateral directional stability augmentation. Launch vehicle pitch control system design. Control of flexible vehicles. Satellite attitude control. Flight control designs based on state-space methods. Introduction to sample-data systems. Nonmajor graduate credit.

Aer E 442. V/STOL Aerodynamics and Performance. (3-0) Cr. 3. *Prereq: 355.* Introduction to the aerodynamics, performance, stability, control and critical maneuvering characteristics of V/STOL vehicles. Topics include hovercrafts, jet flaps, ducted fans and thrust vectored engines. Nonmajor graduate credit.

Aer E 446. Computational Fluid Dynamics. (3-0) Cr. 3. *Prereq: 343.* Introduction to modern computational fluid dynamics. Finite difference and finite volume methods. Explicit, implicit, and iterative techniques. Solutions of elliptic, parabolic, and hyperbolic equations. Emphasis on applications. Commercial software. Nonmajor graduate credit.

Aer E 448. Fluid Dynamics of Turbomachinery. (Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: M E 335 or equivalent.* Applications of principles of fluid mechanics and thermodynamics in performance analysis and design of turbomachines and related fluid system components. Nonmajor graduate credit.

Aer E 451. Astrodynamics II. (3-0) Cr. 3. *Prereq: 351.* Simple orbit determination and prediction. Advanced orbit maneuvers, single-, double-, and triple-impulse; fixed-impulse, finite-duration. 3-D rigid-body dynamics, Euler's equations, satellite stabilization and attitude control. Earth gravity field models and gravity harmonics, orbit perturbations, variational methods, relative orbital mechanics, Clohessy-Wiltshire equations. Nonmajor graduate credit.

Aer E 461. Modern Design Methodology with Aerospace Applications. (2-2) Cr. 3. F.S. *Prereq: 361, 311, 321, 351, 355.* Introduction to modern engineering design methodology. Computational constrained optimal design approach including selection of objective function, characterization of constraint system, materials and strength considerations, and sensitivity analyses. Nonmajor graduate credit.

Aer E 462. Design of Aerospace Systems. (1-4) Cr. 3. F.S. *Prereq: 461.* Fundamental principles used in engineering design of aircraft, missile, and space systems. Preliminary design of aerospace vehicles.

Aer E 464. Spacecraft Systems. (3-0) Cr. 3. *Prereq: 351.* An examination of spacecraft systems including attitude determination and control, power, thermal control, communications, propulsion, guidance, navigation, command and data handling, and mechanisms. Explanation of space and operational environments as they impact spacecraft design. Includes discussion of safety, reliability, quality, maintainability, testing, cost, legal, and logistics issues. Nonmajor graduate credit.

Aer E 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Cpr E, E E, Engr, I E, Mat E, M E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing, and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

Aer E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or senior classification, approval of the department.*
A. Aero and/or Gas Dynamics
B. Propulsion
C. Aerospace Structures
D. Flight Dynamics
E. Spacecraft Systems
F. Flight Control Systems
G. Aeroelasticity
H. Honors
I. Design
J. Non-destructive Evaluation
K. Wind Engineering
L. Multi-functional Ultra-light Structures
O. Other

Aer E 491. Aerospace Seminar. Cr. R. F.S. (1-0) Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Engineering ethics case studies and discussions. Academic program planning, departmental symposium participation.

Aer E 492. Aerospace Seminar. Cr. R. F.S. (1-0) Professional skills development activities. Writing and presentation of a technical paper at the department's Aerospace Symposium or at a recognized student or professional meeting of the American Institute of Aeronautics and Astronautics (AIAA). Satisfactory-fail only.

Aer E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

Aer E 499. Senior Project. Cr. arr. Repeatable. F.S. *Prereq: Senior classification, credit or enrollment in 491.* Development of aerospace principles and concepts through individual research and projects. Written report.

Courses primarily for graduate students, open to qualified undergraduate students

Aer E 514. Advanced Mechanics of Materials. (Cross-listed with E M). (3-0) Cr. 3. F. *Prereq: E M 324.* Theory of stress and strain, stress-strain relationships. Unsymmetrical bending, curved beams, shear center. Torsion of thin-walled noncircular sections. Equilibrium, compatibility equations. Airy stress functions. Membrane stresses in shells, thick-walled cylinders.

Aer E 517. Experimental Mechanics. (Cross-listed with E M). (3-2) Cr. 4. Alt. S., offered 2010. *Prereq: E M 510 or 514 or 516.* Fundamental concepts for Force, displacement, stress, and strain measurements. Strain gages. Full field deformation measurements with laser interferometry and digital image processing. Advanced experimental concepts at the micro and nano scale regimes.

Aer E 521. Airframe Analysis. (3-0) Cr. 3. F. *Prereq: 421 or E M 424.* Analysis of Static stresses and deformation in continuous aircraft structures. Various analytical and approximate methods of analysis of isotropic and anisotropic plates and shells.

Aer E 522. Design and Analysis of Composite Materials. (3-0) Cr. 3. F. *Prereq: E M 324.* Composite constituent materials, micro-mechanics, laminate analysis, hygro-thermal analysis, composite failure, joining of composites, design of composite beams and plates, honeycomb core, manufacturing of composites, short fiber composites, and demonstration laboratory.

Aer E 524. Numerical Mesh Generation. (3-0) Cr. 3. *Prereq: Math 385, proficiency in programming.* Introduction to modern mesh generation techniques. Structured and unstructured mesh methods, algebraic and PDE methods, elliptic and hyperbolic methods, variational methods, error analysis, Delaunay triangulation, data structures, geometric modeling with B-spline and NURBS surfaces, surface meshing.

Aer E 525. Finite Element Analysis. (Cross-listed with E M). (3-0) Cr. 3. S. *Prereq: E M 425, Math 385.* Variational and weighted residual approach to finite element equations. Emphasis on two- and three-dimensional problems in solid mechanics. Isoparametric element formulation, higher order elements, numerical integration, imposition of constraints and penalty, convergence, and other more advanced topics. Use of two- and three-dimensional computer programs. Dynamic and vibrational problems, eigenvalues, and time integration. Introduction to geometric and material nonlinearities.

Aer E 531. Automatic Control of Flight Vehicles. (3-0) Cr. 3. S. *Prereq: 331.* Applications of classical and modern linear control theory to automatic control of flight vehicles. Spacecraft attitude control. Control of flexible vehicles. Linear-quadratic regulator design applications.

Aer E 532. Compressible Fluid Flow. (Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: M E 335 or Aer E 541.* Thermodynamics of compressible flow. Viscous and inviscid compressible flow equations. One dimensional steady flow; isentropic flow, normal shock waves oblique and curved shocks, constant area flow with friction and heat transfer. Linear theory and Prandtl-Glauert similarity. Method of characteristics. Subsonic, transonic, supersonic and hypersonic flows.

Aer E 541. Incompressible Flow Aerodynamics. (3-0) Cr. 3. F. *Prereq: 343 or M E 335.* Kinematics and dynamics of fluid flow. Derivation of the Navier-Stokes, Euler and potential flow equations. Introduction to generalized curvilinear coordinates. Ideal fluids. Two-dimensional and three-dimensional potential flow. Complex variable methods.

Aer E 543. Viscous Flow Aerodynamics. (3-0) Cr. 3. S. *Prereq: 541.* Navier-Stokes equations. Incompressible and compressible boundary layers. Similarity solutions. Computational and general solution methods. Introduction to stability of laminar flows, transition and turbulent flow.

Aer E 545. Advance Experimental Technique for Thermal-Fluid Studies. (3-0) Cr. 3. S. *Prereq: 343 or M E 335 or E M 378.* Introduction of various experimental techniques widely used for fluid mechanics, aerodynamics, heat transfer, and combustion studies. Pressure gauge and transducers; Pitot tube; hot wire anemometry; shadowgraph and Schlieren Photography; laser Doppler velocimetry; particle image velocimetry (PIV); advanced PIV techniques (stereo PIV, 3-D PIV, Holograph PIV, microscopic PIV); laser induced fluorescence; pressure sensitive painting, temperature sensitive painting; molecular tagging velocimetry; molecular tagging thermometry. Extensive application and demonstration laboratory experiments will be included.

Aer E 546. Computational Fluid Mechanics and Heat Transfer I. (Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 541 or ME 538.* Introduction to finite difference and finite volume methods used in modern engineering. Basic concepts of discretization, consistency, and stability. Applications of numerical methods to selected model partial differential equations.

Aer E 547. Computational Fluid Mechanics and Heat Transfer II. (Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: M E 546.* Application of computational methods to current problems in fluid mechanics and heat transfer. Methods for solving the Navier-Stokes and reduced equation sets such as the Euler, boundary layer, and parabolized forms of the conservation equations. Introduction to relevant aspects of grid generation and turbulence modeling.

Aer E 551. Orbital Mechanics. (3-0) Cr. 3. F. *Prereq: 351.* Review of 2-body problem. Orbital maneuvers. Relative motion in orbit. Orbit perturbation analysis. Gravity field expansions and effects on orbiters. 3-body problem with applications.

Aer E 556. Guidance and Navigation of Aerospace Vehicles. (3-0) Cr. 3. F. *Prereq: 331.* Principles of guidance systems for spacecraft, launch vehicles, homing and ballistic missiles. Optimal guidance. Interplanetary transfer guidance with low thrust. Principles of inertial navigation. Theory and applications of the Global Positioning System. Celestial navigation procedures. Application of Kalman filtering to recursive navigation theory.

Aer E 565. Systems Engineering and Analysis. (Cross-listed with E E, I E). (3-0) Cr. 3. *Prereq: Coursework in basic Statistics.* Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated systems. Life-cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test evaluation, and systems engineering planning and organization. Not available for degrees in industrial engineering.

Aer E 566. Avionics Systems Engineering. (Cross-listed with E E). (3-0) Cr. 3. S. *Prereq: E E 565.* Avionics functions. Applications of systems engineering principles to avionics. Top-down design of avionics systems. Automated design tools.

Aer E 569. Mechanics of Composite and Combined Materials. (Cross-listed with E M). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: E M 324.* Mechanics of fiber-reinforced materials. Micromechanics of lamina. Macromechanical behavior of lamina and laminates. Strength and interlaminar stresses of laminates. Failure criteria. Stress analysis of laminates. Thermal moisture and residual stresses. Joints in composites.

Aer E 570. Wind Engineering. (Cross-listed with E M). (3-0) Cr. 3. F. *Prereq: E M 378, 345.* Atmospheric circulations, atmospheric boundary layer wind, bluff-body aerodynamics, aeroelastic phenomena, wind-tunnel and full-scale testing, wind-load code and standards, effect of tornado and thunderstorm winds, design applications.

Aer E 572. Turbulence. (Cross-listed with Ch E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 543 or M E 538.* Qualitative features of turbulence. Statistical and spectral representation of turbulent velocity fields: averages, moments, correlations, length and time scales and the energy cascade. Averaged equations of motion, closure requirements, Reynolds stress, dissipation rate. Isotropic turbulence, homogeneous shear flows, free shear flows, wall bounded flows. Scalar transport, particulate transport.

Aer E 573. Random Signal Analysis and Kalman Filtering. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 370 or 411 or Math 341 or 395.* Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

Aer E 574. Optimal Control. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* The optimal control problem. Variational approach. Pontryagin's principle. Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

Aer E 575. Introduction to Robust Control. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. *Prereq: E E 577.* Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H2, Hoo, and I1 control problems. Tools for robustness analysis and synthesis.

Aer E 576. Digital Feedback Control Systems. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 475 or Aer E 432 or M E 411 or 414 or Math 415; and Math 267.* Sampled data, discrete data, and the z-transform. Design of digital control systems using transform methods; root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

Aer E 577. Linear Systems. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 414 or Math 415; and Math 307.* State variable and input-output descriptions of linear continuous-time and discrete time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by state feedback. Design of feedback systems. Stability of linear dynamical systems.

Aer E 578. Nonlinear Systems. (Cross-listed with E E, Math, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* Classification of nonlinear control systems. Existence and uniqueness of solutions. Approximate analysis methods. Periodic orbits. Concept of stability and Lyapunov stability theory. Absolute stability of feedback systems. Input-output stability. Passivity.

Aer E 581. Perturbation Methods. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Math 267.* Mathematical perturbation methods with applications to ordinary differential equations. Perturbation expansions. Order of magnitude and gauge functions. Matched asymptotic expansions. Boundary layer problems. Multiple scales. Resonance and mode coupling. Solvability conditions for differential equations. Physical and engineering applications.

Aer E 590. Special Topics. Cr. arr. Repeatable.
A. Aero and/or Gas Dynamics
B. Propulsion
C. Aerospace Structures
D. Flight Dynamics
E. Spacecraft Systems
F. Flight Control Systems
G. Aeroelasticity
H. Viscous Aerodynamics
I. Design
J. Hypersonics
K. Computational Aerodynamics
L. Optimization
M. Non Destructive Evaluation
N. Wind Engineering

Aer E 591. Graduate Student Seminar Series. Cr. R. Repeatable. Presentation of professional topics by department graduate students. Development of presentation skills used in a professional conference setting involving question and answer format.

Aer E 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

Aer E 647. Advanced High Speed Computational Fluid Dynamics. (Cross-listed with M E). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 547.* An examination of current methods in computational fluid dynamics. Differencing strategies. Advanced solution algorithms. Grid generation. Construction of complex CFD algorithms. Current applications. Use of state of the art CFD codes.

Aer E 690. Advanced Topics. Cr. arr. Repeatable.
A. Aero and/or Gas Dynamics
B. Propulsion
C. Aerospace Structures
D. Flight Dynamics
E. Spacecraft Systems
F. Flight Control Systems
G. Aeroelasticity

H. Viscous Aerodynamics
I. Design
J. Hypersonics
K. Computational Aerodynamics
L. Non Destructive Evaluation
M. Wind Engineering

Aer E 697. Engineering Internship. Cr. R. Repeatable. *Prereq: Permission of DOGE (Director of Graduate Education), graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

Aer E 699. Research. Cr. arr. Repeatable.

African and African American Studies

www.las.iastate.edu/AfricanAmericanStudies/

Interdepartmental Undergraduate Program

Undergraduate Study

African and African American Studies, a cross-disciplinary program in the College of Liberal Arts and Sciences, offers students the opportunity to explore the African Americans' experience and African American contributions to American culture. Students in the program analyze and learn about African American experiences through the study of history, literature, art, religion, and Society. They gain knowledge and develop skills and sensitivities to help them function effectively in today's diverse Society.

African and African American Studies at Iowa State University is an expanding program. Most of the courses in the program satisfy general education requirements in the College of Liberal Arts and Sciences, the human relations requirement for teachers, and the university's diversity requirement. Students can minor or even design their own Interdisciplinary Studies major with an emphasis in African American Studies. Relevant courses are offered through other departments.

A minor in African and African American Studies requires six courses in the program with a minimum of 18 credits, including Introduction to African American Studies (Af Am 201) and Seminar in African American Culture (Af Am 460). The remaining credits must come from at least two departments, with at least two courses taken at the junior level or above. Independent study and internship opportunities are available for credit, but do not count in the minimum requirements for the minor.

Graduate Study

Several courses are open for nonmajor graduate credit. See individual listings for more information.

Courses primarily for undergraduate students

Af Am 201. Introduction to African American Studies. (3-0) Cr. 3. F.S. An interdisciplinary introduction to the study of African American culture. Includes history, the social sciences, literature, religion, and the arts, as well as conceptual frameworks for investigation and analysis of the African American experience.

Af Am 325. Peoples and Cultures of Africa. (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 201 or 306 recommended.* Origins and distribution of peoples of Africa; geographical characteristics as related to culture types, including early civilizations; a comparative examination of economic, subsistence, language, social and political organization, and religious systems throughout the continent; change processes, the impact of colonialism, and the nature of contemporary African Societies.

Af Am 330. Ethnic and Race Relations. (Cross-listed with Soc). (3-0) Cr. 3. F.S.SS. *Prereq: Soc 130 or 134.* Analysis of ethnic and race relations, particularly in America; emphasis on the Sociology and psychology of race and ethnic relations.

Af Am 334. African American Religious Experience. (Cross-listed with Relig). (3-0) Cr. 3. F. *Prereq: Prior course work in Religious Studies or African American Studies required.* Examination of the African American experience from the perspective of black religion and the black church, with attention to political, economic, and social, as well as spiritual, concerns. Nonmajor graduate credit.

Af Am 347. African American Literature to 1960. (Cross-listed with Engl). (3-0) Cr. 3. *Prereq: Engl 250.* Intensive study of African American writing, possibly including slave narratives, Harlem Renaissance works, literature of social protest, and Forerunners of contemporary works that reveal key thematic, stylistic, and historical range of the literature. Nonmajor graduate credit.

Af Am 348. Contemporary African American Literature. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Engl 250.* Intensive reading in literature by African Americans from 1960 to the present. Nonmajor graduate credit.

Af Am 350. African American Women. (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: 3 credits in Womens' Studies or African American Studies.* Economic, social, political and cultural roles of African American women in the U.S. Includes literary, philosophical, and artistic expressions. Myths and realities explored. Nonmajor graduate credit.

Af Am 353. History of African Americans I. (Cross-listed with Hist). (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Examines African roots of black culture and the African American experience in the United States from the colonial period through the Civil War. Topics include Atlantic Slave Trade, slavery and American identity, abolition, the emergence of Black Nationalism, and black participation in the Civil War.

Af Am 354. History of African Americans II. (Cross-listed with Hist). (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Explores African American political thought and political action from Reconstruction to the present. Topics include rise of Jim Crow segregation, urban migration, Garvey movement, Harlem Renaissance, Depression and world wars, Pan-Africanism, civil rights, Black Power, and black feminism.

Af Am 460. Seminar in African American Culture. (3-0) Cr. 3. S. Intensive study of a selected topic in African-American Studies in one or more disciplines. Selected readings of various authors, movements, eras, or genres. Primary and secondary source materials. Nonmajor graduate credit.

Af Am 490. Independent Study. Cr. arr. Repeatable.

Courses offered by other departments

Engl 349. Topics in Multicultural Literatures of the United States. (3-0) Cr. 3. See English.

Relig 475. Seminar: Issues in the Study of Religion. (3-0) Cr. 3. See Philosophy and Religious Studies

Agricultural Education and Studies

Robert Martin, Chair of Department

University Professors (Emeritus): Williams

Professors: Acker, Honeyman, Martin, G. Miller, W. Miller

Professors (Emeritus):Carter, CrawFord, Gamon, Gauger, Hoerner, Lawrence, Parsons, Trede

Associate Professors: Grudens-Schuck, McEowen

Associate Professors (Emeritus): Bruene, Jones

Assistant Professors: Dollisso, Esters, Morris, Polito, Retallick, Steiner

Lecturers: Brown, Paulsen

Undergraduate Study

For undergraduate curricula in agricultural education and agricultural studies leading to the degree bachelor of science, see College of Agriculture, Curricula.

The department offers two curricula for students desiring to enter careers in agriculture and related fields. These curricula are agricultural education and agricultural studies. The agricultural education curriculum prepares persons for careers as agricultural education instructors and educational specialists for industry and governmental agencies. The agricultural education curriculum has two options, teacher certification and communications. The agricultural studies curriculum prepares persons for careers in production agriculture and agricultural industry. Graduates of both curricula accept positions in agricultural business, industry, agencies, and production agriculture.

Graduates will have a broad base of agricultural knowledge, and will be skilled in decision making, planning, organizing, presenting, and evaluating information. Through the successful completion of the required coursework, active participation in clubs and organizations, and the acquisition of technical skills and experiences associated with work experiences, internships, and international travel, graduates of our baccalaureate programs will meet the university, college, and departmental outcomes in the following nine areas: 1) professional, interpersonal, and cross-cultural communications; 2) Problem-solving/critical thinking; 3) leadership; 4) entrepreneurship; 5) life-long learning; 6) ethics; 7) environmental awareness; 8) U.S. diversity; and 9) international perspectives.

More information regarding the departmental learning outcomes can be found at www.ageds.iastate.edu/assessment/agedsindex.htm.

The department offers a minor in agricultural education which may be earned by completion of a minimum of 15 credits in agricultural education and studies courses, with a minimum of two courses at the 400 level. Courses that can be taken for a minor are 211, 310, 311, 315, 412 or 418, 414, 450, 490, 496, and 499.

Visit the departmental website at www.AgEds.iastate.edu/

Graduate Study

The department offers the degrees master of science and doctor of philosophy with a major in agricultural education, a specialization in agricultural extension education, opportunities for emphasis in international agricultural education, and a minor for students majoring in other curricula. Graduate students who have earned a bachelor's degree in an agricultural discipline may plan a course of study that leads to teacher certification. Candidates pursuing the master of science degree may do so by completing either a thesis or nonthesis-program of study.

Students have an opportunity to develop competence in disciplinary foundations and ethics, program planning, learning theory, instructional methods, program leadership and administration, program evaluation, research methodologies, data analysis and interpretation, writing for publication, and grantsmanship.

The department administers the interdepartmental graduate program in professional agriculture designed for off-campus students pursuing a master of agriculture degree; see *Off-Campus Credit Courses and Programs.*

The department also cooperates in the international development studies option of the General Graduate Studies Program.

Courses and workshops are offered, both on and off campus, for extension educators, teachers, and industry personnel.

Courses primarily for undergraduate students

AgEds 110. Orientation. (1-0) Cr. 0.5. F. Orientation to the department. Careers in agriculture.
A. Agricultural Education
B. Agricultural Studies
C. General Agriculture

AgEds 111. Orientation for Agricultural Excellence Scholars. (1-0) Cr. 1. Repeatable. F. *Prereq: Enrollment as an agricultural excellence scholar.* The roles of professionals in agriculture, academic preparation for assuming the role of a professional in agriculture, and meeting the demands of the scholar's curriculum.

AgEds 112. Agriculture Biotechnology Colloquium. (1-0) Cr. 1. S. *Prereq: Enrollment as an agricultural excellence scholar.* The scientific basis of biological and social sciences in agriculture.

AgEds 211. Early Field Based Experience. (1-0) Cr. 1. Repeatable. F.S.SS. *Prereq: 110.* Five days on-site in an agricultural setting observing competencies and issues in problem solving, decision-making, initiative taking, teamwork, leadership, written and oral communications, critical thinking and creativity. When students register it is their responsibility to make an appointment with the departmental coordinator (very early in the semester) to plan their experience.
A. High School Agriculture Program
B. Extension
C. Agricultural Industries and Agencies

AgEds 215. Career Seminar. (1-0) Cr. 1. F.S. *Prereq: Sophomore classification.* Overview of career opportunities. Evaluation of interests and accomplishments and setting career goals. Development of job search and interviewing skills. Establishing networks of job contacts.

AgEds 290. Special Problems in Agricultural Education and Studies. Cr. arr. Repeatable. F.S.SS.

AgEds 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AgEds 310. Foundations of Agricultural Education Programs. (2-0) Cr. 2. S. Historical development of agricultural education programs. Philosophic premises, program goals and objectives. Educational and social issues impacting the implementation of agricultural education programs.

AgEds 311. Presentation and Sales Strategies for Agricultural Audiences. (3-0) Cr. 3. F.S. Utilizing instructional methods, techniques, and problem solving, presentation and sales strategies with agricultural audiences.

AgEds 312. Science With Practice. (1-3) Cr. 2. F.S. *Prereq: College of Agriculture and Life Sciences majors only.* A planned learning experience wherein each student and faculty mentor develops a learning agreement that encompasses specific activities and expectations. Students are engaged in reflective activities that include journals, micro-reflections, formal presentations, and a comprehensive portfolio. Students will be able to recognize and articulate what is learned through the experience and transfer what is learned to future experiences.

AgEds 315. Personal and Professional Leadership in Agriculture. (3-0) Cr. 3. F.S. Learn leadership theories and group facilitation skills for personal and professional applications in agricultural education, industry, and communities.

AgEds 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AgEds 401. Planning Agriculture and Life Sciences Education Programs. (Dual-listed with 501). (3-0) Cr. 3. F. *Prereq: 310.* Responsibilities of an agricultural education teacher, curriculum development, experiential learning opportunities including FFA and SAE, and assessment and maintenance of program quality.

AgEds 402. Methods of Teaching in Agriculture and Life Sciences. (Dual-listed with 502). (3-0) Cr. 3. F. *Prereq: Concurrent enrollment in 401.* Topics include: principles of teaching and learning, individualized and group methods, application of learning, instructional management, special populations, and evaluation.

AgEds 412. Internship in Agricultural Education and Studies. Cr. arr. Repeatable. F.S.SS. *Prereq: 211, junior classification in AgEds and permission of instructor.* A supervised two to twelve week learning experience in an approved learning setting with application to educational, agricultural and/or environmental practices and principles. Nonmajor graduate credit.

AgEds 414. Developing Agricultural Education Programs in Non-formal Settings. (2-0) Cr. 2. S. *Prereq: 211 and permission of instructor.* Basic concepts in planning, conducting, and evaluating educational programs in non-formal settings. Includes programming for youth and adults in Extension, agricultural industry, and related agencies. Nonmajor graduate credit.

AgEds 416. Pre-Student Teaching Experience in Agricultural Education. Cr. 1. F.S. *Prereq: 211, 402 and admission to teacher education program.* A one-week field-based experience in an approved secondary agricultural education program. Concurrent enrollment in 417 is required.

AgEds 417. Supervised Teaching in Agriculture and Life Sciences. Cr. arr. Repeatable. F.S. *Prereq: 211, 402 and admission to teacher education program.* Supervised teaching in public schools.

AgEds 418. Supervised Extension Experience. Cr. arr. Repeatable. F.S.SS. *Prereq: 211, junior classification, permission of instructor.* Supervised professional experience in an approved county, area or State Cooperative Extension Service office. Nonmajor graduate credit.

AgEds 450. Farm Management and Operation. (1-6) Cr. 3. Repeatable. F.S.SS. *Prereq: Econ 235, Econ 330, junior classification.* Participation in the management and operation of a diversified Iowa farm. The class is responsible for the plans, records, and decisions for buying and selling the farm's livestock, crops, and equipment. Special speakers on current topics. May be taken for credit 3 times at different times of the year with permission of the instructor. Nonmajor graduate credit.

AgEds 451. Agricultural Law. (3-2) Cr. 4. S. *Prereq: Senior classification.* The legal framework impinging upon decision-making by firms, families, and individuals, real and personal property, contracts, secured transactions, negotiable instruments, debtor-creditor relations, bankruptcy, farm income tax organization of firms, intergenerational property transfers, trusts and farm estate planning, civil and criminal liabilities, environmental law, federal and state regulatory powers. Nonmajor graduate credit.

AgEds 488. Methods of Teaching Agricultural Mechanics. (2-3) Cr. 3. F.S. Methods and management techniques in agricultural mechanics laboratories. Emphasis will be on safety, mechanical skills development and management of students, facilities, equipment, and materials.

AgEds 490. Independent Study in Agricultural Education and Studies. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior or senior classification, permission of instructor.*
A. Philosophy, Curriculum, and Methods
B. Leadership, Evaluation, and Administration
C. Business, Industry, and Production Agriculture
D. Extension and International Agriculture
E. Instructional Technology
F. Environmental Issues
G. Entrepreneurship
H. Honors
I. Communications

AgEds 496. Agricultural Travel Course. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Limited enrollment. Extended field trips to study agriculture and education related topics. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students. Nonmajor graduate credit.
A. International
B. Domestic

AgEds 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AgEds 499. Undergraduate Research. Cr. arr. F.S.SS. *Prereq: Permission of instructor, adviser, and departmental chair.* Research experience in agricultural education and studies with application to selected problems.

Courses primarily for graduate students, open to qualified undergraduate students

AgEds 501. Planning Agriculture and Life Sciences Education Programs. (Dual-listed with 401). (3-0) Cr. 3. F. *Prereq: 310.* Responsibilities of an agricultural education teacher, curriculum development, experiential learning opportunities including FFA and SAE, and assessment and maintenance of program quality.

AgEds 502. Methods of Teaching in Agriculture and Life Sciences. (Dual-listed with 402). (3-0) Cr. 3. F. *Prereq: Concurrent enrollment in 501.* Topics include principles of teaching and learning, individualized and group methods, application of learning, instructional management, special populations, and evaluation.

AgEds 510. Introduction to Research in Agricultural Education. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Determining your research focus; developing research problems and objectives; reviewing the literature and establishing a theoretical framework; establishing procedures for data collection and analysis; ethical issues.

AgEds 514. Organizing Agricultural Information for Professional and Scientific Meetings. (1-2) Cr. 2. F. *Prereq: Graduate classification in agriculture.* Concepts and practices in planning, preparing, and presenting materials used in professional meetings and scientific papers by agriculturalists with special emphasis on computerized delivery methods.

AgEds 520. Instructional Methods for Adult and Higher Education in Agriculture and Natural Resources. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Theory and practice of adult education. Teaching and learning in formal and non-formal instructional programs for adult learners.

AgEds 524. Program Development and Evaluation in Agricultural and Extension Education. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Theories and practice of program planning for nonformal education. Addresses use of program logic modeling and considers critical theories of planning to address power and interests in program development, needs assessment, and evaluation.

AgEds 533. Introduction to Learning Theory in Agricultural Education. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Introduction to a variety of theoretical perspectives of learning and how they may be used within the context of agricultural education. Emphasis will be on the major domains of learning, developmental considerations, basic assumptions, concepts, and principles of various learning theories; understanding how each theoretical perspective may be used in both formal and non-formal educational settings.

AgEds 550. Foundations of Agricultural Education. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Philosophical premises, ethical principles, historical development, contextual applications, and knowledge bases for agricultural education.

AgEds 552. Data Analysis and Interpretation. (2-0) Cr. 2. F. *Prereq: 510.* Strategies for analyzing, interpreting, and reporting quantitative research data in the social and behavioral sciences.

AgEds 561. Technology Transfer and the Role of Agricultural and Extension Education. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* The impact of agricultural and extension education processes on development and their role in the transfer of agricultural technology. Utilizing situational analysis techniques to analyze and solve problems in international agricultural education programs.

AgEds 590. Special Topics in Agricultural Education. Cr. arr. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education.*
A. Curriculum
B. Methods
C. Philosophy
D. Evaluation
E. Administration
F. Leadership
G. Guidance
I. Instructional Technology
J. Extension
K. International Agriculture
L. Program Planning

AgEds 593. Workshop in Agricultural Education. Cr. arr. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education.*
A. Curriculum
B. Methods
C. Evaluation
D. Administration
E. Leadership
F. Extension
G. Program Planning
H. Instructional Technology
M. Biotechnology Workshop

AgEds 599. Creative Component. Cr. arr. Repeatable. F.S.SS. For nonthesis M.S. degree programs.

Courses for graduate students

AgEds 604. Evaluation in Agricultural and Extension Education. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 401 or 524.* Criteria and procedures for designing and facilitating evaluations of programs in agricultural and extension education. Critique of evaluation theories. Match quantitative and qualitative methods and instruments to evaluation contexts. Evaluation reporting and utilization.

AgEds 615. Seminar in Agricultural Education. (1-0) Cr. 1. Repeatable. F.S.SS. Satisfactory-fail only.
A. Writing for publication
B. Ethics
C. Grant writing
D. Career planning
E. Contemporary issues

AgEds 617. Professional Internship for Agricultural Educators. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Analysis of the roles and activities of professionals in agricultural education. Supervised professional field-based experience in public and private settings. Satisfactory-fail only.

AgEds 625. Leadership, Administration, Supervision and Management of Agricultural Education Programs. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Graduate classification.* Principles and best practices for leading, administering, supervising, and managing agricultural education programs. Analyzing selected case studies that apply theory to practice in agricultural situations.

AgEds 699. Research. Cr. arr. Repeatable.

Agricultural Engineering

(Administered by the Department of Agricultural and Biosystems Engineering)

Rameshwar Kanwar, Chair of Department

Distinguished Professor: Brown

Distinguished Professors (Emeritus): H. Johnson

University Professors: Bern

University Professors (Emeritus): Baker

Professors: Chen, Downing, Glanville, Harmon, Hoff, Hurburgh, L. Johnson, Kanwar, Misra, Schwab, Van Leeuwen, Xin

Professors (Emeritus): Beer, Bekkum, Buchele, Bundy, Hazen, Hoerner, Keeney, Lovely, Maney, Mangold, Marley, Melvin, Miller, Pedersen, Riley, R. Smith

Professors (Collaborators): Laflen

Associate Professors: Anex, Bhandari, Birrell, Brumm, Burns, Freeman, Koziel, Mickelson, Raman, Steward, Tim

Associate Professors (Emeritus): Anderson, Greiner, Lorimor

Associate Professors (Collaborators): Han

Assistant Professors: Darr, Grewell, Helmers, Kaleita-Forbes, Keren, Kim, Soupir, Tang, Yu

Assistant Professors (Emeritus): Boyd, Bradshaw

Assistant Professors (Adjunct): Inyang, Shahan, Tong

Assistant Professors (Collaborators): Dunn, Malone

Lecturer: Snell

Undergraduate Study

For the undergraduate curriculum in agricultural engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission of ABET.

Agricultural Engineering Curriculum Educational Goal, Objectives, and Learning Outcomes: The goal of the curriculum in agricultural engineering is to train students to integrate basic physical and biological sciences with engineering design principles to solve problems related to production, processing, storage, handling, distribution, and use of food, feed, fiber and other biomaterials, and the management of related natural resources worldwide.

The agricultural engineering bachelor of science degree program has the following educational objectives for its graduates. Two to five years after graduation, through the professional practice of engineering, graduates should:

1. Have demonstrated competence in methods of analysis involving use of Mathematics, fundamental physical and biological sciences, engineering sciences, and computation needed for the practice of biological systems engineering in food, fiber, energy and environmental companies and agencies.

2. Have developed skills necessary to the design process; including the abilities to think creatively, to formulate problem statements, to communicate effectively, to synthesize information, and to evaluate and implement problem solutions.

3. Be capable of addressing issues of ethics, safety, professionalism, cultural diversity, globalization, environmental impact, and social and economic impact in engineering practice.

4. Have demonstrated continuous professional and technical growth, with practical experience, so as to be licensed as a professional engineer or achieve that level of expertise

5. Demonstrated the ability to:

a. be a successful leader of multi-disciplinary teams,
b. efficiently manage multiple simultaneous projects,
c. work collaboratively,
d. implement multi-disciplinary systems-based solutions,
e. apply innovative solutions to problems through the use of new methods or technologies,
f. contribute to the business success of their employer, and
g. build community

The agricultural engineering degree program outcomes are statements that describe what our students are expected to know and be able to do by the time of graduation. To meet the established agricultural engineering program educational objectives, the expected outcomes for agricultural engineering bachelor of science graduates are:

a) an ability to apply knowledge of mathematics, science, and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) an ability to function on multi-disciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) achievement of the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and Societal context
i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
l) proficiency in mathematics through differential equations
m) proficiency in biological and engineering sciences
n) competence in the application of engineering to agriculture, aquaculture, food, Forestry, human, natural resource, or other biological systems.

Graduates find employment in diverse ag- and bio-related industries and government agencies dealing with agricultural machines and buildings, animal and environmental control, grain processing and handling, soil and water resources, food, and biotechnology. Their work involves engineering design, development, testing, research, manufacturing, consulting, sales, and service. The department has cooperative programs established for interested and qualified students. The four-year curriculum is extended over a five-year period and interspersed with work periods at cooperating organizations. This plan offers valuable practical experience and financial assistance during the years in college

The department also offers a bachelor of science curriculum in biological systems engineering. See College of Engineering, Curricula. Additionally, the department offers bachelor of science curricula in agricultural systems technology and in industrial technology. See College of Agriculture and Life Sciences, Curricula.

Well-qualified juniors and seniors in agricultural engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue a bachelor of science degree in agricultural engineering and a master of science degree in agricultural engineering. Refer to Graduate Study for more information.

Graduate Study

The department offers work for the degrees master of science, master of engineering, and doctor of philosophy with a major in agricultural engineering, and offers minor work for students in other majors. Within the agricultural engineering major the student may specialize in:

- advanced machinery engineering (agricultural safety and health, sensors and artificial intelligence, controls and automation, precision agriculture, and biorenewables)
- animal and plant production engineering (air emissions measurement and abatement, animal welfare, environmental control in animal housing, manure treatment, crop modeling, plant stress physiology, precision agriculture, and decision support systems)
- environmental stewardship engineering (erosion control, drainage/water management, pollutant fate and transport, nutrients management, wetlands, vegetated filter/buffer strips, hydrological/water quality/crop modeling, geographic information science (GIS)

- remote sensing, water quality, and watershed management, or
- process engineering for food safety and value addition (processing technologies and systems for adding value, quality management systems, agricultural product, marketing practices and standards, instrumentation for grain, seed, and food quality enhancement).

A prerequisite to graduate work is the completion of an undergraduate curriculum substantially equivalent to that required of agricultural engineering undergraduate students at this institution. However, because of the diversity of interests within the graduate programs in agricultural engineering, a student may qualify for graduate study even though the undergraduate training has been in a discipline other than agricultural engineering. Supporting work will be required depending on the student's background and area of interest with requirements defined by departmental graduate student guidelines: www.iastate.edu/grad_students.asp

Well-qualified juniors and seniors in agricultural engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue a bachelor of science degree in agricultural engineering and a master of science degree in agricultural engineering. Under concurrent enrollment, students are eligible for assistantships and simultaneously take undergraduate and graduate courses.

For the master of science program, at least 30 credits of acceptable graduate work must be completed with a minimum of 22 credits of course work; corresponding numbers for the master of engineering program are 32 and 27. For the doctor of philosophy degree, at least 72 credits of acceptable graduate work must be completed with a minimum of 42 credits of course work. All Ph.D. students must complete a teaching/extension experience prior to graduation.

The department also offers both master of science and doctor of philosophy degrees in industrial and agricultural technology (see Graduate Majors).

The department also participates in interdepartmental majors in environmental science, sustainable agriculture, biorenewable resources and technology, human and computer interaction, and toxicology (see Index).

Courses primarily for undergraduate students

A E 110. Experiencing Agricultural and Biosystems Engineering. (0-2) Cr. 1. S. Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of agricultural and biosystems engineering. Report writing, co-ops, internships, careers, registration planning.

A E 201. Entrepreneurship and Internship Seminar. (Cross-listed with BSE, TSM). (1-0) Cr. 1. F.S. *Prereq: Sophomore classification in A E, AST, BSE or ITec.* 8 week course. Overview of the entrepreneurial process and its importance in the economy and the engineering/technical workplace. Preparation for internship experiences. Relationship of workplace competencies to entrepreneurship, intrapreneurship, and internships; portfolios.

A E 216. Fundamentals of Agricultural and Biosystems Engineering. (Cross-listed with BSE). (2-2) Cr. 3. S. *Prereq: 110, Engr 160, credit or enrollment in Math 166.* Application of Mathematics and engineering sciences to mass and energy balances in agricultural and biological systems. Emphasis is on solving engineering problems in the areas of heat and mass transfer, air and water vapor systems; animal production systems, grain systems; food systems, hydrologic systems, and bioprocessing.

A E 271. Engineering Applications of Parametric Solid Modeling. (1-2) Cr. 1. F.S. *Prereq: Engr 170 or TSM 116 or equivalent.* 8 week-course. Creating, editing, and documenting part and assembly models using Solidworks.

A E 272. Parametric Solid Models, Drawings, and Assemblies Using Pro/ENGINEER. (1-2) Cr. 1. F.S. *Prereq: Engr 170 or TSM 116 or equivalent.* 8 week-course. Applications of Pro/ENGINEER software. Create solid models of parts and assemblies. Utilize the solid models to create design documentation: standard drawing views, dimensions, and notes.

A E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

A E 301. Leadership and Ethics Seminar. (Cross-listed with BSE, TSM). (1-0) Cr. 1. F.S. *Prereq: 201.* 8 week course. Leadership and ethics experiences through case studies and seminar presentations by practitioners. Relationship of workplace competencies to leadership and ethics; portfolios.

A E 316. Applied Numerical Methods for Agricultural and Biosystems Engineering. (Cross-listed with BSE). (2-2) Cr. 3. F. *Prereq: Engr 160, Math 266.* Computer aided solution of agricultural engineering problems by use of numerical techniques and Mathematical models. Systems analysis and optimization applicable to agricultural and biological systems.

A E 325. Biorenewable Systems. (Cross-listed with Agron, An S, BusAd, Econ, TSM). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing.

A E 340. Functional Analysis and Design of Agricultural Field Machinery. (2-2) Cr. 3. F. *Prereq: 110, 203, 216.* Principles of operation, design, selection, testing and evaluation of agricultural field machinery and systems. Functional and mechanical performances. Crop and soil interaction with machines. Machine systems, including land preparation, crop establishment, crop protection, harvesting and post-harvest, materials handling systems.

A E 342. Agricultural Tractor Power. (2-3) Cr. 3. S. *Prereq: M E 330 or Ch E 381 or M E 231.* Thermodynamic principles and construction of tractor engines. Fuels, combustion, and lubrication. Kinematics and dynamics of tractor power applications; drawbar, power take-off and traction mechanisms. Nonmajor graduate credit.

A E 363. Agri-Industrial Applications of Electric Power and Electronics. (3-2) Cr. 4. F. *Prereq: Phys 222.* Single phase and three phase circuit design. Electrical safety. Electric motors and controls. Programmable logic controllers. Digital logic, instrumentation and sensors. Nonmajor graduate credit.

A E 388. Sustainable Engineering and International Development. (Cross-listed with C E, E E, M E, Mat E). (2-2) Cr. 3. F. *Prereq: Junior classification in engineering.* Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as non-government organizations (NGOs). Course readings, final project/design report.

A E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period.

A E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* One semester maximum per academic year professional work period.

A E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

A E 401. Professionalism Seminar. (Cross-listed with BSE, TSM). (1-0) Cr. 1. F.S. *Prereq: 301.* 8 week course. Examination of professionalism in the context of engineering and technology. Time, project and personnel management. Communications and professional portfolios. Professional licensure. Transition to professional careers.

A E 403. Modeling and Controls for Agricultural Systems. (Dual-listed with 503). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 363, Math 267.* Modeling dynamic systems with ordinary differential equations. Introduction to state variable methods of system analysis. Analysis of mechanical, electrical, and fluid power systems. Analytical and numerical solutions of differential equations. Introduction to classical control theory. Feedback and stability examined in the s domain. Frequency response as an analytical and experimental tool. MATLAB will be used throughout the course for modeling.

A E 404. Instrumentation for Agricultural and Biosystems Engineering. (Dual-listed with 504). (2-2) Cr. 3. F. *Prereq: 363 or Cpr E 281.* Interfacing techniques for computer-based data acquisition and control systems. Basic interfacing components including A/D and D/A conversion, signal filtering, multiplexing, and process control. Sensors and theory of operation applied to practical monitoring and control problems.

A E 406. Applied Computational Intelligence for Agricultural and Biological Systems. (Dual-listed with 506). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: 216 or equivalent, Math 166, Stat 305.* Applications of biologically inspired computational intelligence tools to solve problems in agricultural and biological systems. Introduction to Artificial Neural Networks, Support Vector Machines, Fuzzy Logic, Genetic Algorithms, Bayesian and Decision Tree Learning. Fundamental machine vision techniques will be introduced in the first part of course and integrated into the lab exercises for learning different computational intelligence techniques. MATLAB will be used throughout the course for algorithm implementation.

A E 408. GIS and Natural Resources Management. (Dual-listed with 508). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: Working knowledge of computers and Windows environment.* Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS.

A E 411. Bioprocessing and Bioproducts. (Dual-listed with 511). (Cross-listed with BioE, BSE, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

A E 413. Fluid Power Engineering. (Cross-listed with M E). (2-2) Cr. 3. F. *Prereq: Credit or enrollment in E M 378 or M E 335, A E 216 or M E 270.* Properties of hydraulic fluids. Performance parameters of fixed and variable displacement pumps and motors. Hydraulic circuits and systems. HydroStatic transmissions. Characteristics of control valves. Analysis and design of hydraulic systems for power and control functions. Nonmajor graduate credit.

A E 415. Agricultural Engineering Design I. (Cross-listed with BSE). (1-2) Cr. 2. F.S. *Prereq: 271 or 272, E M 324.* Identification of current design problems in agricultural engineering. Development of alternate solutions using creativity and engineering analysis and synthesis techniques. Nonmajor graduate credit.

A E 416. Agricultural Engineering Design II. (Cross-listed with BSE). (1-2) Cr. 2. F.S. *Prereq: 415.* Selection of promising solutions to design problems identified in 415 for development by design teams. Presentation of designs through oral and written reports and prototypes. Nonmajor graduate credit.

A E 424. Air Pollution. (Dual-listed with 524). (Cross-listed with C E, EnSci). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology.
E. Agricultural sources of pollution

A E 431. Design and Evaluation of Soil and Water Conservation Systems. (Dual-listed with 531). (2-3) Cr. 3. F. *Prereq: E M 378 or Ch E 356.* Hydrology and hydraulics in agricultural and urbanizing watersheds. Design and evaluation of systems for the conservation and quality preservation of soil and water resources. Use and analysis of hydrologic data in engineering design; relationship of topography, soils, crops, climate, and cultural practices in conservation and quality preservation of soil and water for agriculture. Small watershed hydrology, water movement and utilization in the soil-plant-atmosphere system, agricultural water management, best management practices, and agricultural water quality.

A E 436. Design and Evaluation of Soil and Water Monitoring Systems. (Dual-listed with 536). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: A E 431 or permission of the instructor.* Development of monitoring systems that support effective planning, performance evaluation, modeling, or environmental impact assessment of soil-, water-, and waste-management systems. Typical soil and water pollutants and physical, chemical, and biological characteristics that affect sample location and timing. Sample collection, documentation, chain-of-custody, and quality assurance procedures.

A E 451. Food and Bioprocess Engineering. (Dual-listed with 551). (3-0) Cr. 3. F. *Prereq: 216 and M E 436 or Ch E 357, or FS HN 351 and Math 266 or 267.* Application of engineering principles and Mathematical modeling to the quantitative analysis of food and bioprocessing systems. Physical/chemical characteristics of foods and biological systems, flow processes, thermal processes and separation processes.

A E 466. Multidisciplinary Engineering Design. (Cross-listed with Aer E, Cpr E, E E, Engr, I E, Mat E, M E.) (1-4) Cr. 3. Repeatable. F.S. Prereq: Student must be within two semesters of graduation and receive permission of the instructor. Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

A E 469. Grain Processing and Handling. (Dual-listed with 569). (2-3) Cr. 3. S. *Prereq: 216.* Cereal grain and oilseed properties, quality measurement, processing, and end-use value. Design of drying systems using computer simulation. Corn wet and dry milling. Soybean oil extraction. Grain handling systems.

A E 472. Design of Environmental Modification Systems for Animal Housing. (Dual-listed with 572). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 216, M E 330.* Principles and design of animal environmental control systems. Insulation, heat and mass transfer, fans, ventilation, air distribution, heating and cooling equipment, energy use, duct design, control strategies.

A E 478. Wood Frame Structural Design. (Dual-listed with 578). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 216, E M 324.* Design of light-framed wood structures using LRFD and ASD design procedures. Includes analysis of wind, snow, dead, and live loads. Applications include animal housing and machine storage. Fasteners, laminated posts, truss design and use of National Design Specifications.

A E 490. Independent Study. Cr. arr. Repeatable.
B. Biosystems Engineering
C. Computer-aided Design
E. Environmental Systems
F. Food Engineering
H. Honors
O. Occupational Safety
P. Power and Machinery Engineering
Q. Structures
R. Process Engineering
S. Environmental and Natural Resources Systems
U. Waste Management

A E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduate students

A E 503. Modeling and Controls for Agricultural Systems. (Dual-listed with 403). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 363, Math 267.* Modeling dynamic systems with ordinary differential equations. Introduction to state variable methods of system analysis. Analysis of mechanical, electrical, and fluid power systems. Analytical and numerical solutions of differential equations. Introduction to classical control theory. Feedback and stability examined in the s domain. Frequency response as an analytical and experimental tool. MATLAB will be used throughout the course for modeling. Individual and/or group projects required for graduate credit.

A E 504. Instrumentation for Agricultural and Biosystems Engineering. (Dual-listed with 404). (2-2) Cr. 3. F. *Prereq: 363 or Cpr E 281.* Interfacing techniques for computer-based data acquisition and control systems. Basic interfacing components including A/D and D/A conversion, signal filtering, multiplexing, and process control. Sensors and theory of operation applied to practical monitoring and control problems. Individual and group projects required for graduate credit.

A E 506. Applied Computational Intelligence for Agricultural and Biological Systems. (Dual-listed with 406). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: 216 or equivalent, Math 166, Stat 305.* Applications of biologically inspired computational intelligence tools to solve problems in agricultural and biological systems. Introduction to Artificial Neural Networks, Support Vector Machines, Fuzzy Logic, Genetic Algorithms, Bayesian and Decision Tree Learning. Fundamental machine vision techniques will be introduced in the first part of course and integrated into the lab exercises for learning different computational intelligence techniques. MATLAB will be used throughout the course for algorithm implementation. Individual and/or group projects required for graduate credit.

A E 508. GIS and Natural Resources Management. (Dual-listed with 408). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: Working knowledge of computers and Windows environment.* Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS. In addition to other assignments, graduate students will prepare research literature reviews on topics covered in class and develop enterprise applications.

A E 511. Bioprocessing and Bioproducts. (Dual-listed with 411). (Cross-listed with BSE, BRT, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

A E 515. Integrated Crop and Livestock Production Systems. (Cross-listed with Agron, An S, SusAg). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: SusAg 509.* Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

A E 524. Air Pollution. (Dual-listed with 424). (Cross-listed with C E, EnSci). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above or permission of instructor.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology.
E. Agricultural sources of pollution

A E 531. Design and Evaluation of Soil and Water Conservation Systems. (Dual-listed with 431). (Cross-listed with EnSci). (2-3) Cr. 3. F. *Prereq: E M 378 or Ch E 356.* Hydrology and hydraulics in agricultural and urbanizing watersheds. Design and evaluation of systems for the conservation and quality preservation of soil and water resources. Use and analysis of hydrologic data in engineering design;

relationship of topography, soils, crops, climate, and cultural practices in conservation and quality preservation of soil and water for agriculture. Small watershed hydrology, water movement and utilization in the soil-plant-atmosphere system, agricultural water management, best management practices, and agricultural water quality. Graduate students will prepare several research literature reviews on topics covered in the class in addition to the other assignments.

A E 533. Erosion and Sediment Transport. (Cross-listed with EnSci). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 422 or C E 372, Math 266.* Soil erosion processes, modified universal soil loss equation and its application to conservation planning, sediment properties, initiation of sediment motion and over land flow, flow in alluvial channels and theory of sediment transport, channel stability, reserves sedimentation, wind erosion, BMPs for controlling erosion.

A E 536. Design and Evaluation of Soil and Water Monitoring Systems. (Dual-listed with 436). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: 431/531.* Development of monitoring systems that support effective planning, performance evaluation, modeling, or environmental impact assessment of soil-, water-, and waste-management systems. Typical soil and water pollutants and physical, chemical, and biological characteristics that affect sample location and timing. Sample collection, documentation, chain-of-custody, and quality assurance procedures. In addition to other assignments, graduate students will prepare several research literature reviews on topics covered in the class and develop monitoring plans.

A E 551. Food and Bioprocess Engineering. (Dual-listed with 451). (3-0) Cr. 3. F. *Prereq: 216 and M E 436 or Ch E 357, or FS HN 351 and Math 266 or 267.* Application of engineering principles and Mathematical modeling to the quantitative analysis of food and bioprocessing systems. Physical/chemical characteristics of foods and biological systems, flow processes, thermal processes and separation processes. Term paper required for graduate credit.

A E 569. Grain Processing and Handling. (Dual-listed with 469). (2-3) Cr. 3. S. *Prereq: 216.* Cereal grain and oilseed preservation, quality measurement, and end-use value. Design of drying systems using computer simulation. Corn wet and dry milling. Soybean oil extraction. Grain handling systems. Individual and group projects required for graduate credit.

A E 572. Design of Environmental Modification Systems for Animal Housing. (Dual-listed with 472). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 216, M E 330.* Principles and design of animal environmental control systems. Insulation, heat and mass transfer, fans, ventilation, air distribution, heating and cooling equipment, duct design, and controls. Individual and group projects required for graduate credit.

A E 578. Wood Frame Structural Design. (Dual-listed with 478). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 216, E M 324.* Design of light-framed wood structures. Includes analysis of wind, snow, dead, and live loads. Applications include animal housing and machine storage. Fasteners, laminated posts, truss design and use of National Design Specifications. Individual project required for graduate credit.

A E 590. Special Topics. Cr. arr. Repeatable.
B. Biosystems Engineering
F. Food Engineering
O. Occupational Safety
P. Power and Machinery Engineering
Q. Structures and Environment
R. Process Engineering
S. Water and Environment
U. Waste Management

A E 598. Technical Communications for a Master's Degree. (Cross-listed with TSM). Cr. 1. F.S.SS. A technical paper draft based on the M.S. thesis or creative component is required of all master's students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on M.S. thesis or creative component is required of all master's students. This presentation must be in a form that satisfies the normal presentation requirements of a professional Society. The presentation itself (oral or poster) may be made at a professional Society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Satisfactory-fail only.

A E 599. Creative Component. Cr. arr. Repeatable.

Courses primarily for graduate students

A E 601. Graduate Seminar. (Cross-listed with TSM). (1-0) Cr. 1. F. Keys to writing a good MS thesis or PhD dissertation. How to begin formulating research problems. Discussion of research problems, review of literature, research hypothesis, objectives, methods, procedures, and reports. Research grant proposals, patents and intellectual property rights, and international research centers of excellence will be discussed.

A E 610. Foundations of Sustainable Agriculture. (Cross-listed with Anthr, Soc, SusAg, Agron). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging systems of agriculture in terms of core concepts of sustainability and their theoretical contexts.

A E 690. Advanced Topics. Cr. arr. Repeatable.

A E 694. Teaching Practicum. (Cross-listed with TSM). Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification and permission of instructor.* Graduate student experience in the agricultural and biosystems engineering departmental teaching program.

A E 697. Engineering Internship. Cr. R. Repeatable. *Prereq: Permission of department chair, graduate classification.* One semester and one summer maximum per academic year professional work period.

A E 698. Technical Communications for a Doctoral Degree. (Cross-listed with TSM). Cr. 1. F.S.SS. A technical paper draft based on the dissertation is required of all Ph.D. students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on the dissertation is required of all Ph.D. students. This presentation must be in a form that satisfies the normal presentation requirements of a professional Society. The presentation itself (oral or poster) may be made at a professional Society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Satisfactory-fail only.

A E 699. Research. Cr. arr. Repeatable.
B. Biosystems Engineering
C. Computer-aided Design
E. Environmental Systems
F. Food Engineering
O. Occupational Safety
P. Power and Machinery Engineering
Q. Structures
R. Process Engineering
S. Environment and Natural Resources
U. Waste Management

Agronomy

Kendall Lamkey, Chair of Department

Distinguished Professors: Fehr, Horton

Distinguished Professors (Emeritus): Frey, Hallauer, Pesek, Russell, Shaw

Professors: P. Anderson, Arritt, Barnhart, Beavis, Burras, Chen, Cianzio, Cruse, Elmore, Fales, Gallus, Gutowski, Hartzler, Killorn, Lamkey, Lee, Liebman, Loynachan, Mallarino, Miller, Moore, Mullen, Owen, P. Peterson, T. Peterson, Sandor, Sawyer, Schnable, Tabatabai, Takle, Taylor, Thompson, Wang, Westgate, Wolt

Professors (Emeritus): M. Anderson, Atkins, Benson, Burris, Campbell, I. Carlson, R. Carlson, Fenton, Green, Hodges, Imsande, Keeney, Larson, Pearce, Schafer, Schaller, A. Scott, Shibles, Shrader, Skrdla, Stritzel, H. Thompson, L. Thompson, Troeh, Voss, Wedin, Whigham, Woolley, Yarger

Professors (Collaborators): Hatfield, Jaynes, Karlen, Kaspar, Laird, Logsdon, Masters, Palmer, Shoemaker

Associate Professors: Al-Kaisi, Becraft, Bhattacharyya, Dekker, Delate, Knapp, Lubberstedt, Manu, Wiedenhoeft

Associate Professors (Collaborators): Cambardella, Grant, Kovar, Moorman, Pollak, Sauer, M. Scott

Assistant Professors: Goggi, Heaton, Henning, Hornbuckle, Pedersen, Polito, Salas-Fernandez

Assistant Professor (Adjunct): Fu

Assistant Professors (Collaborators): Blanco, Cannon, Edwards, Gardner, Graham, Guan, Singer, Widrlechner

Lecturers: Christensen, Ciha, Dobill, McAndrews, Sleugh, Zdorkowski

Undergraduate Study

For undergraduate curriculum in Agronomy, see *College of Agriculture, Curricula.*

The Department of Agronomy has a curriculum noted for its scientific rigor and breadth in crop science, soil science, agricultural meteorology, and plant breeding. It prepares students for science-based professional positions, graduate study, or research careers across the spectrum of Agronomy.

The curriculum provides both flexibility and direction for students by offering four in-depth options: crop management and business, agroecology, soil and environmental science, quality and plant breeding and biotechnology. A minimum of 15 credits of Agronomy courses must be earned at Iowa State for students transferring from other institutions. The program also has many opportunities for undergraduate students to be involved in cutting edge research and international agriculture.

Graduates have the theoretical and practical knowledge needed for efficient and sustainable production of food, feed, fuel, and fiber. Graduates are skilled in communications, critical thinking, problem solving, and working effectively with others.

They understand the ethical, cultural, and environmental dimensions of issues facing professionals in agriculture and natural resources.

An Agronomy major prepares students for employment in agricultural business and industry, agricultural service organizations, crop production and soil management, environmental and natural resource management, and farm management. Graduates pursue careers in the seed, fertilizer, and agricultural chemical industries as field Agronomists, crop and soil management specialists, research technicians, sales and marketing specialists, and production managers. State and federal agencies employ Agronomists as extension specialists, county extension directors, environmental and natural resource specialists, research associates, soil surveyors, soil conservationists, and in regulatory agencies as plant, food, and grain inspectors. Additional areas of work open to Agronomists include integrated pest management, land appraisal, agricultural finance, turfgrass management, and the home lawn care industry.

The department offers an international scholar program leading to a credentialed title of "Agronomy International Scholar" for agronomy majors who have distinguished themselves in global understanding and international experience. Contact the department for requirements.

The department offers work for a minor in Agronomy. Students are required to complete an approved minor program that includes Agron 114, 154, 212, 354, and 6 additional credits, of which a minimum of 3 credits must be at the 300+ level. Nine credits for the Agronomy minor must be earned at Iowa State.

Graduate Study

The department offers programs that lead to the degrees master of science and doctor of philosophy, with majors in agricultural meteorology; crop production and physiology with optional specializations in seed science and weed science; plant breeding; and soil science with specialization in soil chemistry, soil fertility, soil management, soil Microbiology and biochemistry, soil morphology and genesis, or soil physics. Minor work is offered for students with majors in other departments. A M.S. nonthesis option is available for students desiring a general degree program with additional coursework and a written creative component substituting for thesis research.

Graduates have a broad knowledge base germane to their area of study. They are trained to integrate and apply knowledge to different situations. Students develop skills in scientific reasoning, organization, and logical presentation of ideas.

The department offers a Master of Science degree in Agronomy designed for the continuing education of professional Agronomists. The Program is taught at a distance using computer-based instructional media. It is a nonthesis degree requiring completion of a written creative component.

The department cooperates in the interdepartmental program in professional agriculture; interdepartmental majors in ecology and evolutionary biology; genetics; MCDB (molecular, cellular, and developmental biology); plant physiology; sustainable agriculture; and environmental science.

Prerequisite to major work in this department is completion of an undergraduate degree program with emphasis on Agronomic, biological, and physical sciences.

Courses primarily for undergraduate students

Agron 105. Leadership Experience. Cr. R. F.S.SS. A participatory experience in activities or completion of a course that enhances the development of leadership and group-dynamic skills. See adviser for departmental requirements.

Agron 110. Professional Development in Agronomy: Orientation. (0.5-0) Cr. 0.5. F. Orientation to college life, the profession of Agronomy, and the Agronomy curriculum.

Agron 114. Principles of Agronomy. (2-3) Cr. 3. F.S. Mullen. A foundation course in Agronomy applying crop, soil, and environmental sciences in understanding agricultural systems in the world. Includes introductory concepts of plant, soil, tillage, pest, environmental, and sustainable aspects of crop production. Off-campus version offered through internet by interactive computer courseware.

Agron 120. Introduction to Renewable Resources. (Cross-listed with Env S, NREM). (3-0) Cr. 3. F.S. Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

Agron 154. Fundamentals of Soil Science. (2-2) Cr. 3. F.S. *Prereq: Chem 163.* Manu. Introduction to physical, chemical, and biological properties of soils, their formation, classification, and distribution. Use of soil survey and computer databank information in balancing Agronomic, economic, and environmental concerns in soil management. Credit for only one of Agron 154, 155, or 156 may be applied toward graduation.

Agron 155. Soils for Horticultural Scientists. (2-2) Cr. 3. F.S. *Prereq: Chem 163.* Restricted to students in Horticulture. Manu. Physical, chemical and biological properties of natural and manufactured soils. Use of soil information when producing plants on natural and manufactured soils. Credit for only one of Agron 154, 155, or 156 may be applied toward graduation.

Agron 156. Soils for Urban Use. (2-2) Cr. 3. F.S. Restricted to students outside the College of Agriculture. Manu. Fundamental properties of soils and their application to urban Settings. Development of a site plan for area of land using data from soil survey and computerized data bank information. Field trip. Credit for only one of Agron 154, 155 or 156 may be applied toward graduation.

Agron 160. Water Resources of the World. (Cross-listed with Geol, Mteor, Env S). (3-0) Cr. 3. S. Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in Society and the environment.

Agron 206. Introduction to Meteorology. (Cross-listed with Mteor). (3-0) Cr. 3. F.S. Basic concepts in meteorology, including atmospheric measurements, radiation, stability, precipitation, winds, fronts, forecasting, and severe weather. Applied topics include global warming, ozone depletion, world climates and weather safety. Self-study laboratory assignments utilize interactive computerized exercises, worksheets and computerized real-time forecasting. Self-study section may be available to distant education students.

Agron 210. Professional Development in Agronomy: Career Planning. (1-0) Cr. 1. F. *Prereq: Sophomore classification.* Career planning, résumé and cover letter preparation, and interviewing techniques. Career orientation through invited speakers.

Agron 212. Crop Growth, Productivity and Management. (3-2) Cr. 4. F.S. *Prereq: 114.* Production and management practices for corn, soybean, small grain, and forage crops common to Midwestern U.S. agriculture. Emphasis on growth and development, plant characteristics, management practices, crop use, quality, and problem-solving.

Agron 260. Soils and Environmental Quality. (Cross-listed with Env S). (3-0) Cr. 3. F.S. Burras. Role of soils in environmental quality and natural resources management. Emphasis on soil erosion and conservation, water quality, and environmental planning. Saturday field trip.

Agron 283. Pesticide Application Certification. (Cross-listed with Ent, For, Hort). (2-0) Cr. 2. S. Holscher. Core background and specialty topics in agricultural, and Horticultural pesticide applicator certification. Students can Select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

Agron 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator, sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Agron 310. Professional Development in Agronomy: Work Experience. Cr. R. F.S.SS. Professional work experience in Agronomy. See adviser for departmental requirements. Satisfactory-fail only.

Agron 311. Professional Internship in Agronomy. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Agron 110, Agronomy majors only, permission of instructor before internship begins.* Wiedenhoeft. A supervised learning experience in a professional setting related to crop production, plant breeding, soil science or environmental science.

Agron 316. Crop Structure-Function Relationships. (3-0) Cr. 3. F.S. *Prereq: Biol 211.* Knapp. Basic principles concerning the growth, development, and production of crop communities in relation to their environment. Nonmajor graduate credit.

Agron 317. Principles of Weed Science. (2-2) Cr. 3. F. *Prereq: Biol 211.* Hartzler. Biology and ecology of weeds. Interactions between weeds and crops. Principles and practices of integrated weed management systems. Herbicide mechanisms, classification, and fate in plants and soils.

Agron 317L. Principles of Weed Science Laboratory. (0-3) Cr. 1. F. *Prereq: Enrollment in Agron 317.* Optional lab to accompany Agron 317. Identification, biology and management of important weeds of Agronomic and Horticultural habitats. Field trips.

Agron 320. Genetics, Agriculture and Biotechnology. (Cross-listed with Gen). (3-0) Cr. 3. F.S. *Prereq: Biol 212.* Transmission genetics with an emphasis on applications in agriculture, the structure and expression of the gene, how genes behave in populations and how recombinant DNA technology can be used to improve agriculture. Credit for graduation will not be allowed for more than one of the following: Gen 260, 313, 320 and Biol 313 and 313L.

Agron 325. Biorenewable Systems. (Cross-listed with A E, An S, BusAd, Econ, TSM). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing.

Agron 330. Crop and Seed Identification Laboratory. (0-4) Cr. 2. S. *Prereq: 114.* Identification, Agronomic and binomial classification of crops, weeds, and diseases. Analysis of crop seed samples for contaminants of weed and other crop seeds.

Agron 331. Intercollegiate Crops Team. (0-6) Cr. 2. F.S. *Prereq: Permission of instructor.* Intensive training in preparation for intercollegiate competition in national crops contests.

Agron 334. Forage Crop Management. (3-0) Cr. 3. F.S. *Prereq: 114.* Barnhart. Production and management of forage crops; concepts applied to yield, quality, and stand persistence; systems of forage utilization including grazing, hay, and silage. Students enrolling for graduate credit will be expected to complete an additional class project. Nonmajor graduate credit.

Agron 338. Seed Science and Technology. (Cross-listed with Hort). (2-3) Cr. 3. F. *Prereq: 114 or Hort 221, Biol 211.* Goggi. Seed production, maturation, dormancy, vigor, deterioration, and related aspects of enhancement, conditioning, storage, and quality evaluation. Aspects of the seed industry and regulation of seed marketing.

Agron 342. World Food Issues: Past and Present. (Cross-listed with Env S, FS HN, T SC). (3-0) Cr. 3. F.S. *Prereq: Junior classification.* Zdorkowski, Ford. Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects. Nonmajor graduate credit.
H. Honors Section. (Honors Program students only.)

Agron 351. Turfgrass Establishment and Management. (Cross-listed with Hort). (3-0) Cr. 3. F. *Prereq: Hort 221 or Agron 114 or Biol 211.* Principles and practices of turfgrass propagation, establishment, and management. Specialized practices relative to professional lawn care, golf courses, athletic fields, highway roadsides, and seed and sod production. The biology and control of turfgrass pests. Nonmajor graduate credit.

Agron 351L. Turfgrass Establishment and Management Laboratory. (Cross-listed with Hort). (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 351.* Those enrolled in the Horticulture curriculum are required to take 351L in conjunction with 351 except by permission of the instructor. Nonmajor graduate credit.

Agron 354. Soils and Plant Growth. (Cross-listed with Hort). (3-0) Cr. 3. F.S. *Prereq: Agron 154 and Biol 101 or 211.* Killorn or Loynachan. Effects of chemical, physical, and biological properties of soils on plant growth, with emphasis on nutritive elements, pH, organic matter maintenance, and rooting development. Nonmajor graduate credit.

Agron 354L. Soils and Plant Growth Laboratory. (Cross-listed with Hort). (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 354.* Henning. Laboratory exercises in soil testing that assess a soil's ability to support nutritive requirements for plant growth.

Agron 356. Site-Specific Crop and Soil Management. (3-3) Cr. 4. F. *Prereq: 114 and 354.* Polito. Development of solutions to crop and soil management problems in consultation with a producer-client. Identification of client needs, gathering technical information, and use of geographic information systems as a tool for making crop and soil management decisions. Development and presentation of solutions for crop and soil management issues confronting the client. Emphasis will be placed on identifying and solving complex problems that require integration of biological, physical, chemical, and economic components within a crop and soil management system. Nonmajor graduate credit.

Agron 360. Environmental Soil Science. (Cross-listed with EnSci). (2-3) Cr. 3. S. *Prereq: Agron 260 or Geol 100 or 201.* Burras and Killorn. Application of soil science to contemporary environmental problems; comparison of the impacts that different management strategies have on short- and long-term environmental quality and land development. Emphasis on participatory learning activities.

Agron 370. Field Experience in Soil Description and Interpretation. (0-3) Cr. 1. Repeatable. F.S. *Prereq: 154 and permission of instructor.* Sandor. Description and interpretation of soils in the field and laboratory, emphasizing hands-on experience. Evaluation of soil information for land use. Students may participate in intercollegiate judging contests.

Agron 392. Systems Analysis in Crop and Soil Management. (2-3) Cr. 3. F.S. *Prereq: 316, 354.* Wiedenhoeft. Management strategies at the level of the farm field. Emphasis will be on participatory learning activities.

Agron 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Agron 402. Watershed Hydrology. (Cross-listed with EnSci, Geol, Mteor, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

Agron 402I. Watershed Hydrology and Surficial Processes. (Cross-listed with Ia LL, EnSci). Cr. 4. SS. *Prereq: Four courses in physical or biological sciences or engineering.* Effects of geomorphology, soils, and land use on transport of water and materials (nutrients, contaminates) in watersheds. Fieldwork will emphasize investigations of the Iowa Great Lakes watershed. Nonmajor graduate credit.

Agron 404. Global Change. (Dual-listed with 504). (Cross-listed with EnSci, Env S, Mteor). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Nonmajor graduate credit.

Agron 405. Environmental Biophysics. (Dual-listed with 505). (Cross-listed with Mteor, EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities. Nonmajor graduate credit.

Agron 406. World Climates. (Cross-listed with Mteor, EnSci). (3-0) Cr. 3. F. *Prereq: Agron/Mteor 206.* Arritt. Distribution and causes of different climates around the world. Effects of climate and climate variations on human activities including Society, economy and agriculture. Current issues such as climate change and international efforts to assess and mitigate the consequences of a changing climate. Semester project and in-class presentation required. Nonmajor graduate credit.

Agron 407. Mesoscale Meteorology. (Dual-listed with 507). (Cross-listed with Mteor). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 166 and Mteor 454.* Arritt, Gallus. Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

Agron 410. Professional Development in Agronomy: Senior Forum. (1-0) Cr. 1. F.S. *Prereq: Senior classification.* Development of an appropriate content for professionalism. Topics include professional certification, ethics, and maintaining an active network of information sources and professional contacts in support of lifelong learning. Student interpretation, writings, presentations, and discussions.

Agron 417. Evolutionary Ecology of Weeds. (Dual-listed with 517). (3-0) Cr. 3. *Prereq: 317* Dekker. Ecology and evolution of invasive plants and weeds in habitats disturbed by humans. Life history trait evolution and adaptation to agricultural opportunities and the consequent processes of invasion, colonization, enduring occupation and population shifts. Roles played by mating systems and biodiversity, soil seed pools and community assembly, competitive interactions with neighbors and fitness.

Agron 421. Introduction to Plant Breeding. (Cross-listed with Hort). (3-0) Cr. 3. F. *Prereq: Gen 320 or Biol 313.* Breeding methods used in the genetic improvement of self-pollinated, cross-pollinated and asexually reproducing Agronomic and Horticultural crops. Applications of biotechnology techniques in the development of improved cultivars. Nonmajor graduate credit.

Agron 446. International Issues and Challenges in Sustainable Development. (Cross-listed with Globe, IntSt). Cr. 4. S. *Prereq: 3-credit biology course, Sophomore or higher classification, permission of Instructor.* Mullen. Interdisciplinary study and analysis of agricultural, biophysical, environmental, sociological, economical, political, and historical factors affecting sustainable development of communities and countries from art and science perspectives. International field experience with foreign language training required. A program fee is charged to students for international study abroad.

Agron 450. Issues in Sustainable Agriculture. (Cross-listed with Env S). (3-0) Cr. 3. F. Zdorkowski. Agricultural science as a human activity; contemporary agricultural issues from agroecological perspective. Comparative analysis of intended and actual consequences of development of industrial agricultural practices.

Agron 452. GIS for Geoscientists. (Dual-listed with 552). (Cross-listed with Geol, EnSci). (2-2) Cr. 3. F. *Prereq: Geol 100, Geol 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses. Nonmajor graduate credit.

Agron 459. Environmental Soil and Water Chemistry. (Dual-listed with 559). (Cross-listed with EnSci). (3-3) Cr. 4. F. *Prereq: Agron 354 or EnSci 360; Chem 164, 165, or 178; Math 140. Chem 211 or 231 recommended.* Thompson. An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, and applications to contemporary environmental issues. Nonmajor graduate credit.

Agron 463. Soil formation and Landscape Relationships. (Dual-listed with 563). (Cross-listed with EnSci). (2-4) Cr. 4. S. *Prereq: Agron 154 or 260.* Sandor. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for one of Agron 463 or 463I may be applied for graduation. Nonmajor graduate credit.

Agron 463I. Soil formation and Landscape Relationships. (Dual-listed with 563I).(Cross-listed with EnSci, Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: 154 or 260.* Burras. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for one of Agron 463 or 463I may be applied for graduation. Nonmajor graduate credit.

Agron 477. Soil Physics. (Dual-listed with 577). (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: 354. Recommended: Math 166.* Horton. The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

Agron 484. Organic Agricultural Theory and Practice. (Dual-listed with 584). (Cross-listed with Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 9 cr. in biological or physical sciences.* Delate & DeWitt. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and Socio-economic processes and policies in organic agriculture from researcher and producer perspectives. Nonmajor graduate credit.

Agron 485. Soil and Environmental Microbiology. (Dual-listed with 585). (Cross-listed with EnSci, Micro). (2-3) Cr. 3. F. *Prereq: 154 or 402, Micro 201 (Micro 203 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues. Nonmajor graduate credit.

Agron 490. Independent Study. Cr. 1-3. Repeatable maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in Agronomy; permission of instructor in specialty area after consultation.* Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.
E. Entrepreneurship
G. General
H. Honors
Z. Service Learning

Agron 491. Seed Science Internship Experience. (Cross-listed with TSM, Hort). Cr. arr. Repeatable. F.S.SS. *Prereq: Agron 338, advanced approval and participation of employer and instructor.* A professional work experience and creative project for seed science secondary majors. The project requires the prior approval and participation of the employer and instructor. The student must submit a written report.

Agron 493. Workshop in Agronomy. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Staff. Workshop experience in crops, soils, or agricultural meteorology. Nonmajor graduate credit.

Agron 495. Agricultural Travel Course Preparation. Cr. R. Repeatable. F.S. *Prereq: Permission of instructor.* Limited enrollment. Students enrolled in this course intend to register for Agron 496 the following term. Topics will include the agricultural industries, climate, crops, culture, economics, geography, history, livestock, marketing, soils, and preparation for travel to locations to be visited.

Agron 496. Agricultural Travel Course. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Limited enrollment. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on crop and livestock production. Location and duration of tours will vary. Tour expenses paid by students. Check with department for current offerings.
A. International Tour
B. Domestic Tour

Agron 497. Agroecology Field Course. (3-0) Cr. 3. F. *Prereq: Jr. or Sr. classification with at least 8 credits in Agronomy.* A one-week intensive class, offered off-campus. Student will visit farms within the Midwest and analyze the sustainability of each farm.

Agron 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

Agron 500. Orientation Seminar. (2-0) Cr. 1. F. *Prereq: International Agronomy graduate students only.* Loynachan. An introduction to Iowa and U.S. agriculture for international scholars in Agronomic majors. Field trips when possible. Departmental role in the functioning of research, teaching, and extension in fulfilling the charge given the land-grant university.

Agron 501. Crop Growth and Development. (3-0) Cr. 3. F. *Prereq: 114, Math 140, Chem 163, Biol 101.* Physiological processes in crop growth, development and yield: photosynthesis, respiration, water relations, mineral nutrition, assimilate partitioning, seedling vigor, light interception and canopy growth, root growth, reproduction and yield. Required course for the Master of Science in Agronomy degree program.

Agron 502. Chemistry, Physics, and Biology of Soils. (3-0) Cr. 3. F. *Prereq: 114, 154, Biol 101, Chem 163, and Math 140.* Soil chemical, physical, and biological properties that control processes within the soil, their influence on plant/soil interactions, and soil classification. Basic concepts in soil science and their applications. Required course for the Master of Science in Agronomy degree program.

Agron 503. Climate and Crop Growth. (3-0) Cr. 3. F. *Prereq: 114 and Math 140.* Applied concepts in climate and agricultural meteorology with emphasis on the climate-agriculture relationship and the micro-climate-agriculture interaction. Basic meteorological principles are also presented to support these applied concepts. Required course for the Master of Science in Agronomy degree program.

Agron 504. Global Change. (Dual-listed with 404). (Cross-listed with Mteor, EnSci). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior, senior, or graduate standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change.

Agron 505. Environmental Biophysics. (Dual-listed with 405). (Cross-listed with Mteor, EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities. Semester project required.

Agron 507. Mesoscale Meteorology. (Dual-listed with 407). (Cross-listed with Mteor). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 166 and Mteor 454.* Arritt, Gallus. The physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure. Semester project and in-class presentation required.

Agron 508. Biophysical Crop Ecology. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 505.* Taylor. Principles of resource capture (light and water) applied to growth and development. Ecological implications of radiation, temperature, moisture, and the biological properties of size, shape, resistance to water vapor loss, and absorptivity to solar and thermal radiation. Physiological stress in the soil, plant, atmosphere continuum.

Agron 509. Agroecosystem Analysis. (Cross-listed with Anthr, Soc, SusAg). (3-4) Cr. 3. F. *Prereq: Senior or above classification.* Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (agronomic, economic, ecological, social, etc), and scales of operation.

Agron 510. Crop Improvement. (Cross-listed with STB). (3-0) Cr. 3. F. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* A study of the basic principles and methods in the genetic improvement of crop plants. Methods used in manipulating genomes through the use of biotechnology. Methods of cultivar development. Quantitative procedures for describing response to selection. Analysis of the relationship of reproductive characters and growth characteristics to response to selection.

Agron 511. Crop Improvement. (3-0) Cr. 3. S. *Prereq: 114, Math 140, Chem 163, Biol 101.* Basic principles in the genetic improvement of crop plants. Methods of cultivar development in self-pollinated and cross-pollinated crop species. Required course for the Master of Science in Agronomy degree program.

Agron 512. Soil-Plant Environment. (3-0) Cr. 3. S. *Prereq: 502. Recommended 501.* Loynachan. Soil properties and their impact on soil/plant relationships. Soil structure, aeration, moisture, and nutrients will be discussed in the context of soil fertility and environmental quality management. Required course for the Master of Science in Agronomy degree program.

Agron 513. Quantitative Methods for Agronomy. (3-0) Cr. 3. S. *Prereq: 114, Math 140, Stat 104.* Quantitative methods for analyzing and interpreting Agronomic information. Principles of experimental design, hypothesis testing, analysis of variance, regression, correlation, and graphical representation of data. Use of JMP for organization, analyzing, and presenting data. Required course for the Master of Science in Agronomy degree program.

Agron 514. Integrated Pest Management. (3-0) Cr. 3. SS. *Prereq: 114, 501, Math 140, Chem 163, Biol 101. Recommended: 502, 503.* Principles and practices of weed science, entomology, and plant pathology applied to crop production systems. Biology, ecology and principles of integrated crop pest management. Required course for the Master of Science in Agronomy degree program.

Agron 515. Integrated Crop and Livestock Production Systems. (Cross-listed with A E, SusAg, An S). (3-0) Cr. 3. F. *Prereq: 509.* Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

Agron 516. Crop Physiology. (3-0) Cr. 3. S. Westgate. Investigation of Molecular, whole plant, and plant community processes essential to biomass production and seed formation, and analysis of molecular approaches to overcome the limitations imposed on these processes by the environment.

Agron 517. Evolutionary Ecology of Weeds. (Dual-listed with 417). (3-0) Cr. 3. S. *Prereq: 317.* Dekker. Ecology and evolution of invasive plants and weeds in habitats disturbed by humans. Life history trait evolution and adaptation to agricultural opportunities and the consequent processes of invasion, colonization, enduring occupation and population shifts. Roles played by mating systems and biodiversity, soil seed pools and community assembly, competitive interactions with neighbors and fitness.

Agron 518. Microwave Remote Sensing. (Cross-listed with E E, Mteor). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 265 or equivalent or permission of instructor.* Hornbuckle. Microwave remote sensing of Earth's surface and atmosphere. Overview of relevant electromagnetic theory and antenna theory. Planck emission and the radiative transfer equation. The electrical properties of natural materials at microwave frequencies. Specific examples include remote sensing of atmospheric temperature and water vapor, precipitation, and soil and vegetation water content.

Agron 519. Herbicide Physiology and Biochemistry. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 317; Biol 330.* Owen. Herbicide mechanisms of action, selectivity, uptake, and translocation. Specific sites of herbicide action as they affect plant physiology. Herbicide resistance in weeds and crops. Implications of herbicides on weed management.

Agron 521. Principles of Cultivar Development. (3-0) Cr. 3. F. *Prereq: 421; Stat 401.* Theoretical and practical analysis of alternative breeding methods to improve crop plants. Strategies to incorporate germplasm resources, develop populations, maximize genetic gain, and use marker-assisted selection. Relationship of breeding methods to commercial seed production.

Agron 522. Field Methods in Plant Breeding. (0-6) Cr. 2. SS. *Prereq: 521.* Field experience in planning and conducting plant breeding research for germplasm and cultivar development. Satisfactory-fail only.

Agron 526. Field Plot Technique. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Stat 401.* Moore. Planning experiments for agricultural research, analysis of data, and concepts in data interpretation.

Agron 527. Plant Genetics. (3-0) Cr. 3. S. *Prereq: Gen 410.* Bhattacharyya. Fundamental genetic and cytogenetic concepts from plant perspective including recombination, linkage analysis, genetic and molecular mapping, male sterility, self incompatibility, apomixis, and polyploid evolution.

Agron 529. Publishing in Plant Science Journals. (Cross-listed with Hort, NREM). (2-0) Cr. 2. S. *Prereq: Permission of instructor; evidence of a publishable unit of the student's research data.* Process of preparing a manuscript for submission to a refereed journal in the biological sciences. Emphasis on publishing self-generated data from thesis or dissertation research.

Agron 530. Ecologically Based Pest Management Strategies. (Cross-listed with SusAg, Ent, Pl P). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: SusAg 509.* Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

Agron 531. Crop Ecology and Management. (3-0) Cr. 3. F. *Prereq: 501, 502, 503. Recommended: 512, 514.* Ecological principles underlying crop production systems. Crop production in the context of management approaches, system resources and constraints,

and interactions. Emphasis on the ecology of row and forage crops common to the Midwest. Required course for the Master of Science in Agronomy degree program.

Agron 532. Soil Management. (3-0) Cr. 3. F. *Prereq: 501, 503, 512. Recommended 513.* Evaluates the impact of various soil management practices on soil and water resources. Combines and applies basic information gained in Agron 502 and Agron 512. Emphasizes the Agronomic, economic, and environmental effects of soil management strategies. Required course for the Master of Science in Agronomy degree program.

Agron 533. Crop Protection. (3-0) Cr. 3. F. *Prereq: 514.* Integrated management systems for important crop pests. Cultural, biological and chemical management strategies applicable to major crops grown in the Midwest. Required course for the Master of Science in Agronomy degree program.

Agron 534. Seed and Variety, Testing and Technology. (Cross-listed with STB). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* The components of seed quality and how they are assessed in the laboratory, including traits derived from modern biotechnology. The impact of new technologies on seed quality testing. Variety maintenance procedures and breeder seed. Variety identification: phenotype and grow-out trials, isozyme testing, and DNA marker testing. Procedures for evaluating varieties. The variance tests appropriate for fixed effects analysis of variance. Statistical inference and stratification for yield trials. Use of strip plot testing.

Agron 535. Introduction to the Seed Industry. (Cross-listed with STB). Cr. 1. *Prereq: Curriculum requires undergraduate specialization in a business or biological science.* An analysis of the defining characteristics of the seed industry and introduction to the Master in Seed Technology and Business curriculum. The tasks of crop improvement and seed production will be analytically related to basic management functions and classifications of management activities that are used in the study of business administration. Management tasks and roles will be analyzed in related to the public policy issues that shape the seed industry, including ethical and economical approaches to biotechnology, intellectual property, and corporate responsibility.

Agron 536. Quantitative Methods for Seed. (Cross-listed with STB). (1-0) Cr. 1. F. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Quantitative Methods for analyzing and interpreting Agronomic and business information for the seed industry. Principles of experimental design and hypothesis testing, regression, correlation and graphical representation of data. Use of spreadsheets for manipulating, analyzing and presenting data.

Agron 537. Plant Stress Biology. (Cross-listed with Hort, EEOB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 330A or equivalent and BBMB 404-405.* Physiology and molecular biology of plant responses to environmental stress. Emphasis on the role of hormones and hormone interactions in governing stress responses. Lectures are prepared from journal papers that elucidate key mechanisms controlling responses to drought, flooding, salt, nutrient deficiencies, freezing, pathogens and herbivores. Plants studied include genetic model systems and crops of Horticultural and Agronomic value.

Agron 538. Seed Physiology. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: 338; Chem 231 or Chem 331.* Goggi. Physiological aspects of seed development, maturation, longevity, dormancy, and germination. Emphasis on current literature and advanced methodology.

Agron 539. Seed Conditioning and Storage. (Cross-listed with STB). (2-0) Cr. 2. F. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* The technical operations which may be carried out on a seed lot from harvest until it is ready for marketing and use. The opportunities for quality improvement and the risks of deterioration which are present during that time. Analysis of the costs of and benefits of operations. Evaluation of equipment based on benefits to the customer and producer. Interpretation of the role of the conditioning plant and store as focal points within the overall operations of a seed company.

Agron 541. Applied Agricultural Meteorology. Cr. 2-3. F.S.SS. *Prereq: 206 or upper division Biological Science.* Taylor. Applied concepts in agricultural meteorology. Basic concepts of weather and of crop/climate relationships influencing production, protection, yield and associated production risk factors. Self study sections are available to resident and to distant education students all semesters. Credit for only one of Agron 503 or 541 may be applied toward graduation.

Agron 546. Organizational Strategies for Diversified Farming Systems. (Cross-listed with Soc, Hort, SusAg). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: SusAg 509.* Examination of the organization and operation of complex, diversified farming systems using tools and perspectives drawn from ecology, Agronomy, and Sociology. The course includes a significant field component focused on an Iowa farm.

Agron 547. Seed Production. (Cross-listed with STB). (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of instructor.* Survey of crop production; including management of soil fertility, planting dates, populations, weed control, and insect control. Analysis of the principles of seed multiplication and the key practices which are used to ensure high quality in the products. Field inspection procedures and production aspects that differ from other crop production. Foundation seed production. Analysis of the typical organization of field production tasks. Resources and capabilities required. Survey of differences in seed production strategies between crops and impact of differences on management of seed production.

Agron 551. Growth and Development of Perennial Grasses. (Cross-listed with Hort). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Junior or senior or graduate classification or permission of instructor.* The grass plant. Selected topics on anatomy, morphology, and physiology relative to growth and development of perennial grasses. Emphasis on growth and development characteristics peculiar to grasses and variations of such characteristics under natural and managed conditions.

Agron 552. GIS for Geoscientists. (Dual-listed with 452). (Cross-listed with Geol, EnSci). (2-2) Cr. 3. F. *Prereq: Geol 100, Geol 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscience data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

Agron 553. Soil-Plant Relationships. (Cross-listed with EnSci). (3-0) Cr. 3. F. *Prereq: Agron 354.* Killorn. Composition and properties of soils in relation to the nutrition and growth of plants.

Agron 554. Advanced Soil Management. (2-0) Cr. 2. Alt. F., offered 2009. *Prereq: 354; Math 165.* Cruse. Implications of soil management on the soil environment and root activity. Effect of soil physical properties on soil erosion.

Agron 555. Soil Clay Mineralogy. (Cross-listed with Geol). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Agron 473, Chem 178. Recommend: Geol 311.* Structure and behavior of clay minerals in soil environments, with emphasis on layer silicates and on Fe, Mn, and Al oxides.

Agron 555L. Soil Clay Mineralogy Laboratory. (Cross-listed with Geol). (0-3) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in 555.* Thompson. Application of X-ray diffraction, thermal analysis, infrared spectroscopy, and chemical analyses to identification and behavior of clay minerals in soils.

Agron 558. Laboratory Methods in Soil Chemistry. (Cross-listed with EnSci). (2-3) Cr. 3. F. *Prereq: Agron 354 and Chem 178 or 211.* Tabatabai. Experimental and descriptive inorganic and organic analyses. Operational theory and principles of applicable instruments, including spectrophotometry, atomic and molecular absorption and emission spectroscopy, mass spectrometry, X-ray diffraction and fluorescence, gas and ion chromatography, and ion-selective electrodes.

Agron 559. Environmental Soil and Water Chemistry. (Dual-listed with 459). (Cross-listed with EnSci). (3-3) Cr. 4. F. *Prereq: Agron 354 or EnSci 360; Chem 164, 165, or 178; Math 140. Chem 211 or 231 recommended.* Thompson. An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, chemical-equilibrium speciation programs, and applications to contemporary environmental issues.

Agron 561. Population and Quantitative Genetics for Breeding. (Cross-listed with An S). (4-0) Cr. 4. F. *Prereq: Stat 401.* Population and quantitative genetics for plant and animal genetics. Study of the genetic basis and analysis of variation in quantitative traits in domestic or experimental populations using phenotypic and molecular marker data, including estimation of heritability and other genetic parameters, linkage analysis and mapping of quantitative trait loci, and the impact of inbreeding, heterosis, and genotype-by-environment interaction.

Agron 563. Soil formation and Landscape Relationships. (Dual-listed with 463). (Cross-listed with EnSci). (2-4) Cr. 4. S. *Prereq: 154 or 260.* Sandor. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for one of Agron 563 or 563I may be applied for graduation.

Agron 563I. Soil formation and Landscape Relationships. (Dual-listed with 463I).(Cross-listed with EnSci, Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: 154 or 260.* Burras. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for only Agron 563 or 563I may be applied for graduation.

Agron 565. Professional Practice in the Life Sciences. (Cross-listed with PI P, An S, BCB, Hort, Micro, V MPM). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.
A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

Agron 570. Risk Assessment for Food, Agriculture and Veterinary Medicine. (Cross-listed with VDPAM, Tox). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 104 or consent of instructor: Wolt, Hurd.* Risk assessment principles as applied to biological systems. Exposure and effects characterization in human and animal health and ecological risk assessment. Risk analysis frameworks and regulatory decision-making. Introduction to quantitative methods for risk assessment using epidemiological and distributional analyses. Uncertainty analysis.

Agron 575. Soil Formation and Transformation. (Cross-listed with EnSci). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 463 or equivalent.* Advanced study of soil formation, emphasizing relationships among soils, landscapes, environment, humans, and land use.

Agron 577. Soil Physics. (Dual-listed with 477). (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: 354. Recommended: Math 166.* Horton. The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

Agron 578. Laboratory Methods in Soil Physics. (Cross-listed with EnSci). (0-3) Cr. 1. S. *Prereq: 577 concurrent.* Horton. Methods of measuring soil physical properties such as texture, density, and water content, and transport of heat, water, and gases.

Agron 584. Organic Agricultural Theory and Practice. (Dual-listed with 484). (Cross-listed with Hort, SusAg). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 9 cr. in biological or physical sciences.* Delate & DeWitt. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and Socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

Agron 585. Soil and Environmental Microbiology. (Dual-listed with 485). (Cross-listed with EnSci, Micro). (2-3) Cr. 3. F. *Prereq: 154 or 402, Micro 201 (Micro 203 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

Agron 590. Special Topics. Cr. arr. Repeatable. *Prereq: 15 credits in Agronomy.* Literature reviews and conferences on selected topics in crops, soils, or agricultural meteorology according to needs and interest of student.

Agron 591. Agronomic Systems Analysis. (3-0) Cr. 3. S. *Prereq: 511, 513, 531, 532, 533.* Analysis of cropping systems from a problem-solving perspective. Case studies will be used to develop the students' ability to solve Agronomic problems. Required course for the Master of Science in Agronomy degree program.

Agron 592. Current Issues in Agronomy. (3-0) Cr. 3. S. *Prereq: 501, 503, 511, 512, 513, 514.* Study and discussion of topics of current interest to the field of Agronomy. While Agron 591 deals with Agronomics at the farm and landscape level, Agron 592 seeks to address issues on a broader scale including off-farm agricultural impacts. Required course for the Master of Science in Agronomy degree program.

Agron 593. Workshop in Agronomy. (1-0) Cr. 1. SS. *Prereq: 501, 502, 503, 514 (or current enrollment). Recommended: 511, 512, 513.* Practical field and laboratory experience integrating coursework in climatology, crops, and soils. Workshop includes lectures, labs and local agri-business tours. Required course for the Master of Science in Agronomy degree program.

Agron 595. Seed Quality, Production, and Research Management. (Cross-listed with STB). (3-0) Cr. 3. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Advanced survey of the organization, staff capabilities and management characteristics typical in seed production and crop improvement in seed enterprises. Analysis of the use of quality information in the management of seed operations and sales. Process management applications for seed. Production planning for existing capacity. Analysis of the manager's tasks in the annual cycle and how the tasks of these managers relate to the general categories of business management roles. Difference in management strategies used with different situations and groups of employees.

Agron 599. Creative Component. Cr. arr. *Prereq: Nonthesis M.S. option only.* A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.
A. Agricultural Meteorology
B. Crop Production and Physiology
C. Plant Breeding
D. Soil Chemistry
E. Soil Fertility
F. Soil Management
G. Soil Microbiology and Biochemistry
H. Soil Morphology and Genesis
I. Soil Physics
K. Seed Science
L. Weed Science
M. Agronomy

Courses for graduate students

Agron 600. Seminar. (1-0) Cr. 1. Repeatable. F.S. Reports and discussion of recent literature and research.
A. Plant Breeding.
B. Soils. F.S.
C. Crop Production and Physiology. F.S.

Agron 609. Agricultural Meteorology Conference. (1-0) Cr. 1. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Literature reviews and conferences with instructor on special problems relating to agricultural meteorology, beyond the scope of current courses offered.

Agron 610. Foundations of Sustainable Agriculture. (Cross-listed with SusAg, A E, Anthr, Soc). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging agricultural systems in terms of the core concepts of sustainability and their theoretical contexts.

Agron 616. Advanced Topics in Plant Physiology and Biochemistry. (4-0) Cr. 4. Alt. S., offered 2010. *Prereq: Graduate classification; permission of instructor.* Westgate. An in-depth treatment of physiological, biochemical and molecular processes regulating plant growth and development. Emphasis on individual study followed by in-class presentations and discussion.

Agron 621. Advanced Plant Breeding. (3-0) Cr. 3. S. *Prereq: 521, 526, 561; Gen 410.* Lamkey. Estimation and interpretation of genetic effects and variances of plant populations, analysis of mating designs, heritability estimation, intra- and interpopulation selection methods, prediction of genetic gain, inbreeding and heterosis, classification and development of parental materials, selection indices, and combining ability analysis.

Agron 625. Genetic Strategies in Plant Breeding. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 521, Gen 410.* Lee. Evaluation of genetic, molecular, and cellular approaches to crop improvement; gene transfer methods. Application and role of basic plant biology in breeding programs and processes; genome structure and function, gene isolation, expression, regulation, and modification. Integration of molecular and cellular methods in breeding strategies; analysis of alternative breeding methods, regulatory and ethical issues.

Agron 655. Advanced Soil Fertility. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 553.* Evaluation of soil fertility and fertilizers; theory and applications.

Agron 677. Advanced Soil Physics. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: 577; Math 266, 267. Recommended: Com S 207.* Horton. The flow and distribution of water, chemicals, and heat in soils. Physical principles and applications.

Agron 685. Advanced Soil Biochemistry. (Cross-listed with Micro, EnSci). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Agron 585.* Tabatabai. Chemistry of soil organic matter and biochemical transformations brought about by microorganisms and enzymes in soils.

Agron 696. Research Seminar. (Cross-listed with BBMB, GDCB, PlBio, Hort, For). Cr. 1. Repeatable. Research seminars by faculty and graduate students. Satisfactory-fail only.

Agron 698. Agronomy Teaching Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification in Agronomy and permission of instructor.* Graduate student experience in the Agronomy teaching program. Satisfactory-fail only.

Agron 699. Research. Cr. arr. Repeatable.
A. Agricultural Meteorology
B. Crop Production and Physiology
C. Plant Breeding
D. Soil Chemistry
E. Soil Fertility
F. Soil Management
G. Soil Microbiology and Biochemistry
H. Soil Morphology and Genesis
I. Soil Physics
J. Plant Physiology
K. Seed Science
L. Weed Science

Air Force Aerospace Studies

www.iastate.edu/~airforce/

Col. James Cramp, Chair of Department

Professors: Cramp

Assistant Professors (Adjunct): Menschner, Morgan, Wendelin

Undergraduate Study

The objectives of the Department of Air Force Aerospace Studies are to provide qualified students the opportunity to earn a commission as an officer in the active duty Air Force, and to build better citizens for those not interested in joining the Air Force.

The curriculum is divided into two basic phases, the general military course (GMC) and the professional officer course (POC). The GMC is introductory and consists of four consecutive 1-hour courses normally taken during the freshman and sophomore years. GMC completion is not a prerequisite for entry into the POC, although it is recommended by the department.

Prior to entry into the POC, most students complete field training at an Air Force base. Students who have completed the GMC participate in a 4-week program, which provides a concentrated experience in the Air Force environment. The training program includes junior officer training, aircraft and aircrew orientation, career orientation, survival training, an introduction to typical base functions, and physical training. A 6-week training program is provided for those students entering the POC who did not complete the GMC. This program includes all that is offered in the 4-week program, plus academic and leadership laboratory experiences included in the on-campus GMC courses.

Selection for the professional officer course is on a competitive basis, and cadets enrolling in this course must meet certain academic, mental, physical, and moral standards. Qualified cadets may be selected as flight candidates and receive flight instruction prior to attending Undergraduate Pilot Training (UPT) or Undergraduate Navigator Training (UNT). Upon enrollment in the POC, all cadets are required to complete a contractual agreement with the Air Force, which obligates them to 4 years of active duty as an officer in the United States Air Force. Air Force active duty commitment is 10 years for pilots and 6 years for navigators. Uniforms and AFROTC texts are supplied to the cadets, and those in the POC receive a subsistence allowance between $450-500 per month.

Students who fail to observe the contract terms may be called to active duty in an enlisted grade or be required to repay monies received from the Air Force.

Air Force ROTC scholarships are available and provide payment of full tuition and fees. In addition, Scholarship cadets receive between $$300-500 monthly subsistence allowance and $900 per year book allowance. Upon acceptance of a scholarship, the student executes a contract with the Air Force. Scholarships can be awarded for periods of 2, 3, or 4 years, with up to 1 additional year for qualified applicants in selected majors. To determine eligibility and initiate application procedures for the scholarship program, interested students should contact the department.

Entry into the program is not dependent on departmental major or year in the university. The AFROTC program is open to both male and female students.

The College of Liberal Arts and Sciences offers a minor in military studies. Requirements for the minor include taking a minimum of 15 credits of ROTC instruction, which may be taken from one or a number of the ROTC programs. At least 6 credits must be in courses numbered 300 or above.

Courses primarily for undergraduate students

AFAS 101. Leadership Laboratory I. (0-2) Cr. 1. F. Instructions on Air Force customs and courtesies; drill and ceremonies, issuing military commands, physical training, studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 102. Leadership Laboratory II. (0-2) Cr. 1. S. Continuation of AFAS 101. Air Force customs and courtesies; drill and ceremonies, issuing military commands, instructing team members, physical training, directing and evaluating the preceding skills, studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 141. Foundations of the United States Air Force. (1-0) Cr. 1. F. Basic introduction to the United States Air Force and Air Force Reserve Officer Training Corps. Mission and organization of the Air Force, officership and professionalism, military customs and courtesies, Air Force officer opportunities, and communication skills. Leadership Laboratory is mandatory for AFROTC cadets complements this course by providing cadets with followership experiences.

AFAS 142. Foundations of the United States Air Force. (1-0) Cr. 1. S. A continuation of 141. Topics include Air Force installations, Air Force core values, leadership and team building, further study of interpersonal communication, the Oath of Office and Commissioning. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 151. Air Force Physical Training. (0-2) Cr. 1. Repeatable. S. F. *Prereq: Enrollment as a cadet in an Air Force Aerospace Studies Class.* Use of basic military training skills and instruction to develop confidence, leadership, communication skills and physical fitness. The team approach is utilized in the instruction and application of Air Force physical fitness requirements. Students will learn various Air Force physical fitness techniques as well as how to conduct physical fitness sessions. Full participation in all events will be determined based on student's physical and medical eligibility. Satisfactory-fail only.

AFAS 201. Leadership Laboratory I. (0-2) Cr. 1. F. Instruction for junior cadets on Air Force customs and courtesies, drill and ceremonies, issuing military commands, instructing, physical training, directing, and evaluating the preceding skills, the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Continued military training related to wearing the uniform, engaging in military customs and courtesies, and participating in military ceremonies. This laboratory is required if applying for the POC. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 202. Leadership Laboratory II. (0-2) Cr. 1. S. A continuation of AFAS 201, instructing junior cadets on Air Force customs and courtesies, drill and ceremonies, issuing military commands, instructing, physical training, directing, and evaluating the preceding skills, the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Continued military training related to wearing the uniform, engaging in military customs and courtesies, and participating in military ceremonies. This laboratory is required if applying for the POC. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 241. The Evolution of USAF Air & Space Power I. (1-0) Cr. 1. F. Examines the general aspects of air and space power through a historical perspective. Utilizing this perspective, the course covers a time period from the first balloons and dirigibles to the Korean War. Historical examples are provided to illustrate the development of Air Force capabilities (competencies), and missions (functions) to demonstrate the evolution of what has become today's USAF air and space power. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 242. The Evolution of USAF Air & Space Power II. (1-0) Cr. 1. S. Examines the general aspects of air and space power through a historical perspective. Utilizing this perspective, the course covers a time period from the Korean War to the space-age global positioning systems of the Persian Gulf War. Historical examples are provided to illustrate the development of Air Force capabilities (competencies), and missions (functions) to demonstrate the evolution of what has become today's USAF air and space power. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 301. Leadership Laboratory I. (0-3) Cr. 1. F. Mid-level management of leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if taking AFAS 341 and pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 302. Leadership Laboratory II. (0-3) Cr. 1. S. Continuation of AFAS 301, mid-level management of leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 341. Air Force Leadership Studies I. (3-0) Cr. 3. F. *Prereq: 141, 142, 241, and 242.* Continuation of the study of leadership, management fundamentals, professional knowledge, Air Force personnel and evaluation systems, leadership ethics, and the communication skills required of an Air Force junior officer. Case studies are used to examine Air Force leadership and management situations as a means of demonstrating and exercising practical application of the concepts being studied. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 342. Air Force Leadership Studies II. (3-0) Cr. 3. S. *Prereq: 341.* A continuation of the study of leadership, management fundamentals, professional knowledge, Air Force personnel and evaluation systems, leadership ethics, and the communication skills required of an Air Force junior officer. Case studies are used to examine Air Force leadership and management situations as a means of demonstrating and exercising practical application of the concepts being studied. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 401. Leadership Laboratory I. (0-3) Cr. 1. F. Advanced leadership experiences involving the planning and controlling of the upper level management of military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if taking AFAS 441 and pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 402. Leadership Laboratory II. (0-3) Cr. 1. S. Advanced leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if taking AFAS 442 and pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies. Satisfactory-fail only.

AFAS 441. National Security Affairs & Preparation for Active Duty I. (3-0) Cr. 3. F. *Prereq: 342.* Examines the national security process to include the development of U.S. Policy and strategy; structure of the Department of Defense: advanced study of Joint and Air Force Doctrine; and, advanced study of joint operations. Examines administrative actions and military law as they pertain to force management. Includes a regional studies component with focus on Africa, Latin America, South Asia and East Asia. Begins preparation for active duty through emphasis on current issues affecting professional military officers. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AFAS 442. National Security Affairs & Preparation for Active Duty II. (3-0) Cr. 3. S. *Prereq: 342.* Continuation of AFAS 441. Extends examination of the national security process to a full spectrum of officer, enlisted, and civilian force management issues. Extends the regional studies component through focus on Europe, Russia and the Middle East. Continues preparation for active duty through emphasis on current issues affecting professional military officers. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

American Indian Studies

(Interdepartmental Undergraduate Minor)

Program Director: Sidner Larson

The American Indian Studies Program is a cross-disciplinary program in the College of Liberal Arts and Sciences that emphasizes perspectives from American Indian Studies, Anthropology, art, history, literature, political science and Sociology. The primary goal of the American Indian Studies program is to conduct interdisciplinary investigations of the intellectual practices, lived history, values, political Status, rights, and responsibilities of tribal nations. Students have the opportunity to learn about the cultural heritage of American Indians, their historical relationship with non-Indians, and their participation in contemporary American

Society. They analyze the tropes and techniques common to American Indian oral and written literatures; comparison/contrast of American Indian cultures to mainstream and other world cultures; and, articulation of the role American Indians are playing in approaches to modern social and environmental issues.

The courses in the American Indian Studies Program provide added background for students whose career interests may include multicultural education, human Services, legal services, or public administration.

Within the College of Liberal Arts and Sciences, courses in American Indian Studies can be used as electives, in a minor, or in an interdisciplinary studies major (for details, see *Index, Interdisciplinary Studies*). Students majoring in another college who wish to use these courses should consult with their advisers.

A minor in the College of Liberal Arts and Sciences must include at least 15 credits of courses in the field. A minor in American Indian Studies must include 210, two courses chosen from among the following: 310, 322, 332 and 346, and two additional courses chosen from the program courses listed below. The American Indian Studies Program Committee will, upon application by the student and review of the program, certify that the student has completed a minor in American Indian Studies.

Because course offerings vary from year to year, any student interested in a minor in American Indian Studies should contact the American Indian Studies office for advising. (See *Index, LAS Cross-Disciplinary Programs*.)

Courses primarily for undergraduate students

Am In 210. Introduction to American Indian Studies. (3-0) Cr. 3. F.S.SS. Introduction to the multidisciplinary aspects of American Indian Studies. Topics include literature, the arts, history, anthropology, sociology, education, and contemporary Indian politics. Guest lectures, media presentations, and discussion of assigned readings.

Am In 240. Introduction to American Indian Literature. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: Credit in or exemption from Engl 150.* Appreciation of oral and written forms of American Indian literatures. Tropes and techniques in oral, visual and written texts. Focus on the role of American Indians in interdisciplinary approaches to modern social and environmental issues as expressed in literary works.

Am In 310. Topics in American Indian Studies. (3-0) Cr. 3. Repeatable. F.S. Issues within specific topical areas of American Indian Society and culture, such as social work with Indian families, tribal government, and environmental policy.

Am In 315. Archaeology of North America. (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 202 or 308.* Prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; culture-historical sequences of major culture areas; linkages of archaeological traditions with selected ethnohistorically known Native American groups.

Am In 322. Peoples and Cultures of Native North America. (Cross-listed with Anthr). (3-0) Cr. 3. F.SS. *Prereq: Anthr 201 or Am In 210.* Origin, distribution, and traditional life of native peoples of North America. Survey of culture areas; ecology and subsistence, language, kinship, life cycle, political, economic, and religious systems; impact of European contact.

Am In 323. Topics in Latin American Anthropology. (Cross-listed with Anthr). (3-0) Cr. 3. Repeatable. *Prereq: Anthr 201 or 306 recommended.* Exploration of contemporary Latin American social dynamics within specific historical, political and economic contexts; discussion of current ethnographic approaches to studying key Sociocultural issues in Latin America. Topics vary each time offered.
A. Violence and Memory
B. Social movements and Democracy
C. Race, Class and Gender
D. Regional Focus

Am In 328. American Indian Religions. (Cross-listed with Relig). (3-0) Cr. 3. An introduction to the beliefs and rituals of Native American religious traditions, with attention to cultural and historical contexts and implications. Nonmajor graduate credit.

Am In 342. American Indian Women Writers. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Engl 250.* Literature of American Indian women writers which examines their social, political, and cultural roles in the United States. Exploration of American Indian women's literary, philosophical, and artistic works aimed at recovering elements of identity, redescribing stereotypes, resisting colonization, and constructing femininity. Nonmajor graduate credit.

Am In 346. American Indian Literature. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Engl 250.* Survey of literature by Native Americans from pre-Columbian tales and songs to contemporary novels and poetry. Nonmajor graduate credit.

Am In 420. Cultural Continuity and Change on the Prairie-Plains. (Cross-listed with Anthr). (3-0) Cr. 3. F. *Prereq: Anthr 315 or 322.* Ecological adaptations, sociocultural changes, and continuities of traditions among Prairie and Plains Indian groups through time; impacts of Euro-American Society and technology on Indians of the Great Plains; perspectives from ecology, archaeology, ethnology, history, and contemporary literary sources.

Am In 426. Topics in Native American Architecture. (Cross-listed with Dsn S, Arch). (3-0) Cr. 3. Repeatable. F.S. *Prereq: Junior classification.* History, theory, and principles of Native American/American Indian architecture, landscape architecture and planning considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 426 may be applied to degree program. Nonmajor graduate credit.

Am In 432. Current Issues in Native North America. (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 201 or 306; 322 or Am In 210 recommended.* Conditions and issues of contemporary Native Americans; historical background of eighteenth and nineteenth century Indian-White relationships; examination of legal Status, the reservation system, treaty violations, Indian militancy, education and urbanization, self-determination, social impact of resource development, and other current concerns.

Am In 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in American Indian Studies; permission of instructor.* Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits in Am In 490 may be counted toward graduation.

Courses offered by other departments

Anthr 428. Topics in Archaeological Laboratory Methods and Techniques. See *Anthropology*.

Anthr 429. Archaeological Field School. See *Anthropology*.

C I 280C. Pre-Student Teaching Experience: Native American Tutoring. See *Curriculum Instruction.*

Hist 370. History of Iowa. See *History*.

Hist 465. The American West. See *History*.

Pol S 312. Minicourse in American Government and Politics. See *Political Science.* Acceptable only when offered as a course in American Indian tribal government and political theory.

Soc 330. Ethnic and Race Relations. See *Sociology*.

Animal Science

www.ans.iastate.edu/

Maynard Hogberg, Chair of Department

Distinguished Professors: Anderson, Beitz, Lamont, Rothschild, Sebranek

Distinguished Professors (Emeritus): Freeman, Jacobson, Sell, Trenkle, Willham

University Professors: Kenealy

University Professors (Emeritus): Parrish

Professors: Ahn, Baas, Berger, Brant, Cordray, Dekkers, Dickson, Fernando, Garrick, Harris, Hoffman, Hogberg, Honeyman, Kilmer, E. Lonergan, S. Lonergan, Loy, Mabry, Morrical, Nissen, Olson, Prusa, Robson, Russell, Spike, M. Spurlock, Strohbehn, Tuggle, Xin

Professors (Emeritus): Brackelsberg, Ewan, Foreman, Haynes, Holden, Jurgens, Kiser, Marple, Owings, Rouse, Rust, Speer, Stevermer, Stromer, Topel, Voelker, Wickersham, Wilson, Wunder, Young, Zimmerman, Zmolek

Professors (Collaborators): Clutter, Horst, Kehrli, Nonnecke, Quigley, Reinhardt, Scanes

Associate Professors: Auwerda, Cunnick, Huiatt, Jeftinija, Patience, Reecy, Skaar, Spurlock, Stalder, Timms, Tyler, Youngs

Associate Professors (Collaborators): Frye, Gunsett, Kerr, Mahanna, Sosnicki

Assistant Professors: Butters-Johnson, Ellinwood, Gabler, Ross, Selsby

Assistant Professors (Collaborators): Bonner, Campbell, Lippolis, McVicker, Pita, Rathmacher

Senior Lecturer: Boury

Lecturers: Ferwerda, Olsen, Thayne

Clinician: Leuschen

Undergraduate Study

The Department of Animal Science Undergraduate Program intends for its graduates to be able to detail the symbiotic relationship of animals and humans, to solve the complex problems of animal enterprise management, and to apply their knowledge and skills in a technically demanding global community. To enable learners to pursue a wide array of career interests, the department offers learning experiences ranging from the basic to the applied sciences. The department's undergraduate degree program has 10 major program goals. They are to provide a comprehensive animal science education in (1) science, (2) animal management, and (3) agri-business. In addition, our program strives to create an environment developing: (4) effective communication skills, (5) skills enabling students to gather and integrate information to solve problems, (6) self learners, (7) leaders and team builders, and (8) awareness of domestic and global issues driving changes in the animal industries. Our program also works to (9) provide career skills appropriate to job market needs, and (10) provide superior counseling for fulfilling individual student objectives.

Learner outcomes for each of these goals, for each of our courses, and other information defining the program can be found at our web site: www.ans.iastate.edu/.

The department offers the degrees bachelor of science in animal science and bachelor of science in dairy science, as well as complementary work toward admission to schools of law, medicine, and veterinary medicine which may be done while satisfying requirements for the degree bachelor of science degree (see Index). A minimum of 15 credits of animal science coursework must be

earned at Iowa State University. A combined bachelor of science and master of science in animal science is also offered.

The department offers a minor in Animal Science. The minor requires: 101, 114, 214, 214L, one course from: 216, 223, 224, 225, 226, 229, 235, 270, two courses from: 319, 331, 352, 360. A total of 9 credits must be earned at Iowa State University in animal science coursework that meets a degree requirement for the B.S. degree in animal science. Students interested in the Animal Science minor should contact an Animal Science advisor.

The department offers a minor in Meat Science. The minor requires: 270, 360, 460; one course from: 489, 490C, six credits from: FS HN 311, 403, 405, 406, 410, 412, 419, 420, 471, Micro 407. Students majoring in Animal Science will NOT be allowed to count the 9 required credits (270, 360, 460) toward their Animal Science degree. Students interested in the Meat Science minor should contact an Animal Science advisor.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in animal breeding and genetics; animal nutrition; meat science; animal physiology; and animal science. Minor work is offered in these areas to students taking major work in other departments.

A strong undergraduate program is required for students interested in graduate study. Fundamental training in biology, chemistry, mathematics, and statistics is requisite to a satisfactory graduate program. Graduate programs in animal science include supporting work in areas such as agronomy; anatomy; microbiology; biochemistry; chemistry; economics; food science and human nutrition; genetics; physics; physiology; and statistics. Students may choose graduate programs involving a co-major with one of these areas. Graduate work in meat science is offered as a co-major in animal science and food science and human nutrition.

The department also cooperates in the interdepartmental program in professional agriculture and interdepartmental majors in genetics, immunobiology, MCDB (molecular, cellular, and developmental biology), nutritional sciences, and toxicology (see *Index*).

The foreign language requirement, if any, is established on an individual basis by the program-of-study committee appointed to guide the work of the student.

Courses primarily for undergraduate students

An S 101. Working with Animals. (1-3) Cr. 2. F.S. A hands-on introductory course in skills for proper care and management of domestic animals. Husbandry skills including health observation, animal movement, identification, management procedures, and environmental assessment are covered.

An S 110. Orientation in Animal Science and ISU. Cr. R. F.S. Orientation to the university and Department of Animal Science. Challenges and opportunities available to the professional animal agriculturalist. Professional goal setting, portfolio development, and development of interpersonal skills in the context of pursuing a career in animal science.

An S 114. Survey of the Animal Industry. (2-0) Cr. 2. F.S.SS. Ways domestic animals serve the basic needs of humans for food, shelter, protection, fuel, and emotional well-being. Terminology, basic structures of the industries surrounding the production, care, and marketing of domestic animals in the U.S.

An S 115. Horsemanship and Equitation. (0-4) Cr. 1. Repeatable. F.S. An S 115 can be taken for a maximum of three times for credit. Satisfactory-fail only.
A. Beginner Hunt Seat Equitation.
B. Beginner Jumping. Prereq: 115C, or able to walk, trot, and canter.
C. Intermediate Hunt Seat Equitation. Prereq: 115A or be able to walk, trot, and canter.
D. Intermediate Jumping. Prereq: 115C or jumped a course up to 18".
E. Beginner Western Horsemanship.
F. Intermediate Western Horsemanship. Prereq: 115 E or able to walk, jog and lope.

An S 211. Issues Facing Animal Science. (0-2) Cr. 1. F.S. *Prereq: 114, sophomore classification.* Overview of the factors that define contemporary ethical and scientifically based issues facing animal agriculture. Life skill development (including interactive skills, communication ability, organization, information gathering, and leadership skills) emphasized in the context of issues study. Satisfactory-fail only.

An S 214. Domestic Animal Physiology. (3-0) Cr. 3. F.S. *Prereq: Biol 212, Chem 163 or 177.* Introduction to anatomy and physiology of the neural, circulatory, respiratory, immune, endocrine, reproductive, and digestive systems of domestic animals.

An S 214L. Domestic Animal Anatomy and Physiology Lab. (0-2) Cr. 1. F.S. *Prereq: Concurrent enrollment in An S 214.* Basic anatomy of domestic animals.

An S 216. Equine Science. (2-2) Cr. 3. F. *Prereq: 101 or 114; one course in biology.* Introduction to contemporary concepts, and basic practices and decisions necessary when managing horses through stages of their lives.

An S 217. Equine Farm Practicum. (2-2) Cr. 2. F. *Prereq: Student majoring in Animal Science, An S 115 or riding experience, An S 216 or concurrent.* Intensified management of the equine farm. Provide students with experiential learning in all phases of horse production and management. Students assist with general farm management, preparing horses for sale, marketing techniques and web design.

An S 223. Poultry Science. (2-2) Cr. 3. F.S. *Prereq: 101, 114.* Introduction to principles, practices and decisions necessary when raising poultry through their production cycle.

An S 224. Companion Animal Science. (2-2) Cr. 3. S. *Prereq: Course in biology.* Introduction of students to contemporary concepts, and basic practices and decisions necessary when caring for the companion animal through stages of its life.

An S 225. Swine Science. (2-2) Cr. 3. F.S. *Prereq: 101, 114.* Introduction to principles, practices and decisions necessary when raising swine through the vertically integrated production cycle.

An S 226. Beef Cattle Science. (2-2) Cr. 3. F.S. *Prereq: 101, 114.* Introduction to principles, practices and decisions necessary when raising beef cattle through the vertically integrated production cycle.

An S 229. Sheep Science. (2-2) Cr. 3. F.S. *Prereq: 101, 114.* Introduction to principles, practices and decisions necessary when raising sheep through the vertically integrated production cycle.

An S 235. Dairy Cattle Science. (2-2) Cr. 3. F. *Prereq: 101, 114.* Introduction to principles, practices and decisions necessary when raising dairy cattle through the vertically integrated production cycle.

An S 270. Foods of Animal Origin. (2-2) Cr. 3. F. *Prereq: Biol 212, Chem 163 or 177.* Principles, practices and issues impacting the production, processing and preservation of safe, wholesome, nutritious, and palatable meat, dairy, and egg products. Product evaluation, classification, value, and utilization.

An S 305. Livestock Evaluation. (0-6) Cr. 3. F. *Prereq: Junior classification; An S 270 recommended.* Fall semester leads to 475A or D. Breeding animal and market animal evaluation of beef, swine and sheep using contemporary techniques and tools. Communication and decision-making skills are practiced in the context of making selection decisions.

An S 306. Equine Evaluation. (0-6) Cr. 3. S. *Prereq: sophomore classification or permission of instructor.* Detailed visual evaluation of conformation and performance of the equine athlete. Decision-making skills are practiced in the context of making selection choices. Development of written and oral communication skills as students defend their judgments. Industry trends will be addressed.

An S 311. Career Preparation in Animal Science. (0-2) Cr. 1. F.S. *Prereq: Junior classification in An S.* Life skill development emphasized in the context of career preparation. Assist students with career goal clarification, interview skills, resume preparation. Internship development, job shadowing, and exploration of career option. Satisfactory-fail only.

An S 316. Training the Horse. (0-6) Cr. 3. F. *Prereq: 115, or ability to walk, trot and canter.* Modifying the behavior of the horse for performance objectives through bitting, longeing, saddling, and riding.

An S 319. Animal Nutrition. (2-2) Cr. 3. F.S.SS. *Prereq: 214, course in organic chemistry or biochemistry.* Fundamentals of nutrition. Essential nutritive requirements of domestic animals, sources of nutrients, composition and identification of feeds, diet formulation and feeding recommendations. Nonmajor graduate credit.

An S 320. Livestock Feeding Program Design. (0-4) Cr. 2. F.S. *Prereq: 319.* Advanced diet formulation and feeding recommendations. Evaluation of alternate feeding programs and diets in the context of case studies.

An S 325. Biorenewable Systems. (Cross-listed with A E, Agron, BusAd, Econ, TSM). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing.

An S 331. Domestic Animal Reproduction. (3-0) Cr. 3. F.S. *Prereq: Course in physiology.* Comparative anatomy, physiology, and endocrinology of domestic mammalian animal reproduction. Techniques for the control and manipulation of reproductive processes. Nonmajor graduate credit.

An S 332. Laboratory Methods in Animal Reproduction. (0-4) Cr. 2. F.S. *Prereq: Credit or enrollment in 331.* Comparative reproductive anatomy with emphasis on the physiology of normal reproductive function; ways to control and improve reproduction; principles of artificial insemination in farm animals; and selected laboratory exercises with written report.

An S 333. Embryo Transfer and Related Technologies. (2-0) Cr. 2. F.S. *Prereq: 331 or 332.* Application of embryo transfer and related technologies to genetic improvement of mammalian livestock. Techniques for control of female reproduction, embryo collection and transfer, embryo cryopreservation, and embryo manipulation. Gender selection. Economic and genetic aspects of embryo transfer. Nonmajor graduate credit.

An S 334. Embryo Transfer Laboratory. (0-3) Cr. 1. F. *Prereq: Credit or concurrent enrollment in An S 333; An S 332 or VDPAM 416; permission of instructor.* Selected laboratory exercises related to embryo transfer such as synchronization of estrus, superovulation, detection of estrus, artificial insemination, embryo collection, embryo evaluation, microscopy, embryo cryopreservation, in vitro fertilization, and embryo sexing will be demonstrated and/or performed. Nonmajor graduate credit.

An S 335. Dairy Cattle Evaluation. (0-6) Cr. 3. S. *Prereq: Sophomore classification.* Evaluation of breeding animals for dairy herds. Comparative terminology, decision making, and presentation of oral reasons. Trips to dairy cattle farms. Livestock handling.

An S 336. Domestic Animal Behavior and Well-Being. (2-2) Cr. 3. F. *Prereq: One course in physiology.* Principles of behavior relative to animal care, management and environmental design to ensure animal well-being. Examination of basic neural-endocrine mechanisms involved in the animal's response to its environment. Awareness of animal protection, law and legislation. Methods to objectively assess animal well-being.

An S 337. Lactation. (2-0) Cr. 2. S. *Prereq: 214.* The structure, development and evolution of the mammary gland. Mammary metabolism, milk synthesis; neural and endocrine regulation of mammary function. Immune function and health of the mammary gland.

An S 345. Growth and Development of Domestic Animals. (3-0) Cr. 3. S. *Prereq: An S 214; Biol 313 or Gen 320.* Basic principles of animal growth and development covered at the tissue, cellular and molecular level. Emphasis placed on skeletal muscle, adipose, bone, and immune system growth and development. The effects of genetics, nutrition, and pharmaceuticals on growth.

An S 352. Genetic Improvement of Domestic Animals. (2-2) Cr. 3. F.S. *Prereq: One course in statistics, Biol 211, course in genetics.* Principles of qualitative and quantitative genetics applied to creating change in domestic animals. Impact of selection and mating schemes in achieving breeding program goals. Applications and impacts of biotechnological advancements in genetic manipulation. Nonmajor graduate credit.

An S 353. Animal Breeding Programs Design. (0-4) Cr. 2. S. *Prereq: 352.* Evaluation of alternate breeding programs and genetic improvement techniques in the context of case study. Experiential and cooperative learning techniques employed. Nonmajor graduate credit.

An S 360. Fresh Meats. (2-2) Cr. 3. F. *Prereq: 270; a course in organic or biochemistry.* Impact of muscle structure, composition, rigor mortis, inspection, fabrication, handling, packaging and cooking on the palatability, nutritional value, yields, market value, and safety of fresh meat. Nonmajor graduate credit.

An S 399. Animal Science Internship. Cr. arr. Repeatable. F.S.SS.

A. Graded Internship Experience. Cr. 2 to 6. Prereq: Permission of the instructor. Learning experience focused on professional development for a career related to animal science. Journal, presentation, and creative component.
B. Supervised Internship Experience. Cr.
R. Prereq: Permission of internship coordinator. Supervised learning activity consisting of work period in production agriculture or the agriculture-related industry.

An S 411. Addressing Issues in Animal Science. (0-2) Cr. 1. F.S. *Prereq: Senior classification in An S.* Life skill development emphasized in the context of exploring one's perspective of the most pressing moral and scientific issues facing animal agriculture. Clarification and communication of personal conclusions in small and large group settings expected.

An S 415. Equine Systems Management. (2-2) Cr. 3. S. *Prereq: 216, 319, 331.* Application of advanced horse management - nutrition, reproduction, exercise physiology and business. Computer-aided management. Explore topics of current concern in the horse industry. Computer aided study. Nonmajor graduate credit.

An S 417. Equine Reproductive Management. (2-2) Cr. 3. S. *Prereq: 216, 331, 415 or concurrent and permission of instructor.* Practical application of managing a breeding farm including servicing the mare, handling stallions, breeding problems, foaling mares, and marketing techniques.

An S 419. Advanced Animal Nutrition. (2-0) Cr. 2. F. *Prereq: 214, 319.* Detailed consideration of digestion, metabolism, and assimilation of nutrients. Recent advances and developments in basic nutrition. Nonmajor graduate credit.

An S 423. Poultry Systems Management. (2-2) Cr. 3. F. *Prereq: 223, 319, 331, 352.* Decisions facing the administrator of a poultry enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the poultry enterprise. Computer aided study. Nonmajor graduate credit.

An S 424. Companion Animal Systems Management. (2-2) Cr. 3. S. *Prereq: 224, 319, 331, 352.* Decisions facing the administrator of a companion animal enterprise. Financial and business goal identification, problem clarification, and resource allocation to manage the companion animal system. Nonmajor graduate credit.

An S 425. Swine Systems Management. (2-2) Cr. 3. F.S. *Prereq: 225, 270, 319, 331, 352; Econ 330 or equivalent recommended.* Decisions facing the administrator of a swine enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the swine enterprise. Computer aided study. Nonmajor graduate credit.

An S 426. Beef Cattle Systems Management. (2-2) Cr. 3. F.S. *Prereq: 226, 270, 319, 331, 352; Econ 330 or equivalent recommended.* Decisions facing the administrator of a beef cow-calf or feedlot enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the beef enterprise. Computer aided study. Nonmajor graduate credit.

An S 429. Sheep Systems Management. (2-2) Cr. 3. S. *Prereq: 229, 319, 331, 352; Agron 334 recommended; Econ 330 or equivalent recommended.* Decisions facing the administrator of a sheep enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the sheep enterprise. Computer aided study. Nonmajor graduate credit.

An S 434. Dairy Systems Management. (2-2) Cr. 3. F.S. *Prereq: 235, 319, 331, 337, 352; Econ 330 or equivalent recommended.* Decisions facing the administrator of a dairy enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the dairy enterprise. Computer aided study. Nonmajor graduate credit.

An S 435. Applied Dairy Farm Evaluation. (2-2) Cr. 3. S. *Prereq: An S 434; Econ 330.* Evaluate nutrition, reproduction, milk quality, breeding, and related management practices of commercial dairy herds in a case study format. Students will apply knowledge gained in the classroom to commercial dairy farm situations and develop skills in information gathering, decision making, problem solving, and interpersonal communications. Nonmajor graduate credit.

An S 460. Processed Meats. (Dual-listed with 560). (2-2) Cr. 3. S. *Prereq: 270.* Physical, chemical and biological properties of meat important to processed meat product characteristics. Ingredients, technology and equipment used for cured meats, loaf products and fresh, cooked, dry and semi-dry sausages products. Nonmajor graduate credit.

An S 475. Intercollegiate Judging Training and Competition. (0-4) Cr. arr. Repeatable. F.S. *Prereq: permission of instructor.* Specialized training in evaluation and grading of livestock, livestock products, and livestock production management plans. Maximum of 6 credits may be applied toward graduation.
A. Meat Animals
B. Dairy Cattle
C. Meats
D. Meat Animal Evaluation.
E. Horses
F. Management Systems

An S 480. Animal Industry Leadership Fellows. Cr. 1. Repeatable. F.S. *Prereq: A. An S 226; permission of instructor C. An S 225; permission of instructor.* Students broaden their perspective of the livestock industry through site visits, case-study (Fellows) projects, and cooperative learning experiences that capitalize on interaction skills in the context of studying the structure of the U.S. livestock industry. This for-credit offering represents the central academic focus of the Iowa State University Animal Industry Leadership Fellows Program. Study is species specific, and enrollment is limited. Satisfactory-fail only.
A. Beef
C. Pork

An S 489. Issues in Food Safety. (Cross-listed with FS HN, HRI, VDPAM). (1-0) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in FS HN 101 or 272 or HRI 233; FS HN 419 or 420; FS HN 403.* Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

An S 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the instructor.* Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.
A. Animal Science
B. Dairy Science
C. Meat Science
D. Companion Animal Science
E. Equine Science
G. Poultry Science
H. Honors
I. Entrepreneurship

An S 493. Workshop in Animal Science. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Workshop in livestock production. Includes current concepts in breeding, nutrition, reproduction, meats, and technologies that impact the animal industry. Nonmajor graduate credit.

An S 495. Agricultural Travel Course Preparation. Cr. R. Repeatable. F.S. *Prereq: Permission of instructor.* Limited enrollment. Students enrolled in this course will also register for Agron 495 and intend to register in Agron 496 and An S 496 the following term. Topics will include the agricultural industries, climate, crops, culture, history, livestock, marketing, soils, and preparation for travel to locations to be visited. Information normally available 9 months before departure.

An S 496. Agricultural Travel Course. Cr. arr. Repeatable. *Prereq: Permission of instructor, 30 college credits.* Limited enrollment. Students enroll in both An S 496 and Agron 496. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on livestock and crop production. Locations and duration of tours will vary. Summer tour will usually visit a northern location and winter tour will usually visit a southern location. Information usually available 9 months before departure. Tour expenses paid by students.
A. International tour
B. Domestic tour

An S 497. Undergraduate Teaching Experiences in Animal Science. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Development of oral and written communication skills of technical concepts in animal science. Emphasis on organizational skills, conducting activities and interpersonal communication skills. Responsibilities in a class under direct supervision of a faculty member. A maximum of 4 credits of An S 497 may be applied toward graduation.

Courses primarily for graduate students, open to qualified undergraduate students

An S 500. Computer Techniques for Biological Research. (2-0) Cr. 1. F. Introduction to UNIX and SAS for solving research problems, including organization of data files, transfer of files between workstations, developing models, and techniques for analysis of designed experiments. Introduction to matrix algebra for solving animal breeding problems using MATLAB and computer simulation.
A. (1st half of semester) UNIX and SAS
B. (2nd half of semester) Problem solving using matrix algebra

An S 501. Survey of Animal Disciplines. (1-0) Cr. 1. F. Required for Animal Science graduate students. Orientation to departmental and graduate school policies and procedures. Discussion of programs of research and outreach in Animal Science. Issues impacting the animal industry. Satisfactory-fail only.

An S 503. Seminar in Animal Production. (1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor.* Discussion and evaluation of current topics in animal production and management.

An S 511. Applied Ruminant Nutrition. (2-0) Cr. 2. *Prereq: 319.* Procedures and theories in beef, dairy, and sheep nutrition. Feeding programs and requirements for lactation, growth, and reproduction. Designed for master of agriculture program.

An S 515. Integrated Crop and Livestock Production Systems. (Cross-listed with A E, Agron, SusAg). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: SusAg 509.* Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

An S 518. Digestive Physiology and Metabolism of Non Ruminants. (Cross-listed with NutrS). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: An S 419 or NutrS 501.* Digestion and metabolism of nutrients. Nutritional requirements and current research and feeding programs for poultry and swine.

An S 520. Digestive Physiology and Metabolism of Ruminants. (Cross-listed with NutrS). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: An S 419 or NutrS 501.* Digestive physiology and nutrient metabolism in ruminant and preruminant animals.

An S 533. Physiology and Endocrinology of Animal Reproduction. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: General physiology course.* Development of structure and function of the reproductive system. Physiologic and endocrine aspects including puberty, gametogenesis, estrous cycle, pregnancy, parturition, interaction of environment, thyroid and adrenal function, and nutrition with these processes.

An S 536. Perinatology. (2-0) Cr. 2. S. *Prereq: One course in physiology; one course in biochemistry.* Regulation of metabolism and development in the mammalian fetus and neonate is explored in a comparative manner. Emphasis will be on the dynamic changes in these relationships occurring at birth.

An S 537. Topics in Farm Animal Environmental Physiology, Behavior, Stress, and Welfare. (3-0) Cr. 3. Repeatable. F.S. *Prereq: permission of instructor; M.S. or Ph.D. student.* Each semester students focus on different topics related to farm animal environmental physiology, behavior, stress, and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line cooperative course involving instructors at Iowa State University, Texas Tech University, and the University of Illinois. Each topic may be taken only one time.

A. Animal rights and Philosophies
B. Brain mechanisms of stress
C. Measuring behavior and welfare
D. Environmental stressors
E. Stress and the immune system
F. Other related topics

An S 540. Livestock Immunogenetics. (Cross-listed with Micro, V MPM). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: An S 561 or Micro 575 or V MPM 520.* Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

An S 549. Advanced Vertebrate Physiology I. (Cross-listed with B M S, Kin). (3-0) Cr. 3. F. *Prereq: Biol 335; credit or enrollment in BBMB 404 or 420.* Neurophysiology, sensory systems, muscle, neuroendocrinology, endocrinology.

An S 552. Advanced Vertebrate Physiology II. (Cross-listed with B M S, Kin, NutrS). (3-0) Cr. 3. S. *Prereq: Biol 335; credit or enrollment in BBMB 404 or 420.* Cardiovascular, renal, respiratory, and digestive physiology.

An S 552L. Advanced Vertebrate Physiology Laboratory. (Cross-listed with BMS). (0-3) Cr. 1. *Prereq: Credit or enrollment in B M S 552.* Laboratory for cardiovascular, renal, respiratory, and digestive physiology.

An S 556. Current Topics in Genome Analysis. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: BBMB 405 or GDCB 510.* Introduction to principles and methodology of molecular genetics useful in analyzing and modifying large genomes. Survey of Statistical methods and computer programs for bioinformatics, linkage mapping, radiation hybrid mapping, and mapping quantitative trait loci.

An S 560. Processed Meats. (Dual-listed with 460). (2-2) Cr. 3. S. *Prereq: 270.* Physical, chemical and biological properties of meat important to processed meat product characteristics. Ingredients, technology and equipment used for cured meats, loaf products and fresh, cooked, dry and semi-dry sausage products.

An S 561. Population and Quantitative Genetics for Breeding. (Cross-listed with Agron). (4-0) Cr. 4. F. *Prereq: Stat 401.* Population and quantitative genetics for plant and animal genetics. Study of the genetic basis and analysis of variation in quantitative traits in domestic or experimental populations using phenotypic and molecular marker data, including estimation of heritability and other genetic parameters, linkage analysis and mapping of quantitative trait loci, and the impact of inbreeding, heterosis, and genotype-by-environment interaction.

An S 562. Methodologies for Population/Quantitative Genetics. (2-0) Cr. 2. S. *Prereq: 561, Stat 402.* Basic theory for genetic analysis of animal breeding data. Course A (1st half semester) covers linear models, selection index methods, and basic theory for best linear unbiased prediction. Course B (2nd half semester) best linear unbiased prediction, including genetic groups, environmental adjustment, repeated records, multiple trait models, maternal effects models, and theory for maximum likelihood estimation of genetic parameters.
A. Linear Models and Genetic Prediction.
B. Advanced Genetic Prediction and Paramater Estimation.

An S 565. Professional Practice in the Life Sciences. (Cross-listed with PI P, Agron, BCB, Hort, Micro, V MPM). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.

A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

An S 570. Advanced Meat Science and Applied Muscle Biology. (2-2) Cr. 3. S. *Prereq: 470.* Ante and postmortem factors impacting composition, structure, and chemistry of red meat and poultry muscle/meat, the conversion of muscle to meat, and the sensory and nutritional attributes of fresh meats. Oral research reports and a research proposal.

An S 571. Advanced Meat Processing Principles and Technology. (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: An S 470 or 570.* Physical/chemical relationships during processing. Effects of modern technology, nonmeat additives and preservation techniques on quality and safety of processed meat. Laboratory demonstration of principles and technology.

An S 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

A. Animal Breeding
B. Animal Nutrition
C. Meat Animal Production
D. Dairy Production
E. Meat Science
F. Physiology of Reproduction
G. Muscle Biology
H. Poultry Nutrition
I. Poultry Products
J. Experimental Surgery
K. Professional Topics
L. Teaching
M. Molecular Biology
N. Ethology

An S 599. Creative Component. Cr. arr. F.S.SS. *Prereq: Nonthesis M.S.* A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.
A. Animal Breeding and Genetics
B. Animal Nutrition
C. Animal Physiology
D. Animal Science
E. Meat Science

Courses for graduate students

An S 603. Seminar in Animal Nutrition. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.* Discussion of current literature; preparation and submission of abstracts.

An S 619. Advanced Nutrition and Metabolism - Protein. (Cross-listed with NutrS). (2-0) Cr. 2. F. *Prereq: BBMB 405.* Digestion, absorption, and intermediary metabolism of amino acids and protein. Regulation of protein synthesis and degradation. Integration of cellular biochemistry and physiology of mammalian protein metabolism.

An S 620. Advanced Nutrition and Metabolism - Energy. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: BBMB 405.* Energy constituents of feedstuffs and energy needs of animals as related to cellular biochemistry and physiology. Interpretations of classical and current research.

An S 633. Seminar in Animal Reproduction. (1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor.* Discussion of current literature and preparation of reports on selected topics concerning physiology of reproduction.

An S 652. Animal Breeding Strategies. (2-0) Cr. 2. *Prereq: An S 561.* Basic concepts and methods for design and evaluation of genetic improvement programs for livestock. Topic A. (1st half semester) Prediction of response to selection, selection index theory, multiple trait selection, inbreeding, cross-breeding, and marker-assisted selection. Topic B. (2nd half semester) Advanced concepts in design and evaluation of animal breeding programs, including modeling and optimization, derivation of economic values, gene-flow, and predicting rates of inbreeding. Each topic may be taken only one time for academic credit.
A. Breeding Goals and Response to Selection (S.)
B. Design and Evaluation of Animal Breeding Programs (Alt. S., offered 2011)

An S 653. Applied Animal Breeding Strategies. (2-0) Cr. 2. F. *Prereq: 561 recommended.* Industrial applications of breeding systems, selection methods, and new genetic technologies. One or more field trips to an industry breeding company to define a class project.
A. Swine and Poultry (Alt. F., offered 2010)
B. Beef and Dairy (Alt. F., offered 2009)

An S 655. Advanced Computational Methods in Animal Breeding and Genetics. (3-1) Cr. 2. Alt. F., offered 2009. *Prereq: 500, 562, Com S 207.* Computational methods and strategies for analysis of large data sets with animal breeding data for use in research and industry applications. Course A (1st half semester) Strategies for handling large sets and for prediction using best linear unbiased prediction using a formal language and utility programs. Course B (2nd

half semester) Strategies for estimation of genetic parameters and for use of non-linear models for genetic analysis of categorical and survival type data.
A. Computational Strategies for Predicting Breeding Values
B. Computational Strategies for Genetic Parameter Estimation

An S 656. Statistical Methods for Mapping Quantitative Trait Loci. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 562, Stat 447.* Statistical methods for mapping quantitative trait loci in out-bred populations. Methods based on modeling covariances between relatives. Likelihood based methods using half-sib and full-sib families and extended pedigrees. Bayesian methods applied.

An S 658. Seminar in Animal Breeding and Genetics. (1-0) Cr. 1. Repeatable. F.S. Presentation of current research related to animal breeding and genetics.

An S 670. Molecular Biology of Muscle. (Cross-listed with BBMB). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: BBMB 405, 420, or 502.* Ultrastructure of muscle; chemistry, structure, function, and molecular biology of muscle proteins. Molecular aspects of muscle contraction, development and turnover. Cytoskeletal proteins and dynamics.

An S 684. Seminar in Meat Science. (1-0) Cr. 1. Repeatable. S. *Prereq: Permission of instructor.* Discussion and evaluation of current topics in research publications in meat science.

An S 685. Seminar in Muscle Biology. (1-0) Cr. 1. Repeatable. S. *Prereq: Permission of instructor.* Reports and discussion of recent literature and current investigations.

An S 695. Seminar in Animal Science. (1-0) Cr. 1. Repeatable. S. Reports and discussion of current issues and research in animal science. One credit is required for all M.S. degree candidates with graduate majors in the Department of Animal Science, and two credits are required for all Ph.D. candidates with graduate majors in the Department of Animal Science. Satisfactory-fail only.

An S 699. Research. Cr. arr. Repeatable.
A. Animal Breeding
B. Animal Nutrition
C. Meat Animal Production
D. Dairy Production
E. Meat Science F. Physiology of Reproduction
G. Muscle Biology
H. Poultry Nutrition
I. Poultry Products
J. Animal Ethology

Anthropology

http://www.Anthr.iastate.edu/

R. Paul Lasley, Chair of Department

Professors: Lasley, Whiteford

Professors (Emeritus): Bower, Butler, Gradwohl, Huang

Associate Professors: Coinman, Ilahiane, Pruetz

Associate Professors (Emeritus): Wolff

Assistant Professors: Arndt, Dusselier, Hill, Moutsatsos, Viatori

Lecturers: Folinsbee, Johnsen

Undergraduate Study

An undergraduate major in Anthropology can Serve as the nucleus for a general liberal education, or as the prerequisite for graduate training qualifying a person for positions in (1) college and university teaching, (2) research, and (3) administrative and applied positions in government, development organizations, museums, and private businesses or corporations.

Anthropology graduates develop a well-rounded professional education in four fields of anthropology: cultural anthropology, linguistic anthropology, archaeology, and biological anthropology. They learn what it means to be human through the study of culture and social relations, human biology and evolution, languages, music, art, architecture, and through the study of past human communities. Graduates learn the important historical and contemporary issues of our subdisciplines, and they learn what it means to be a "modern" Anthropologist and a citizen in an international and global community. Graduates develop an appreciation of the value of cultural diversity at the local, national and international level. They acquire a particular holistic vision that requires using a repertoire of methods in order to forge a deeper understanding of cultural contexts, both past and present. Undergraduate students may obtain experience in archaeological, ethnological and biological research.

Anthropology majors may choose either a bachelor of arts or a bachelor of science degree, both of which require 33 credits in anthropology. A bachelor of arts degree is obtained by fulfilling the college general education requirements plus 6 additional credits in Groups I, II, and/or IV. A bachelor of science degree is obtained by fulfilling the college general education requirements plus 6 additional credits in Group III.

Undergraduate students with majors in anthropology are required to take the following anthropology core courses: 306, 307, 308, 309 and 450. One course in statistics is required.

Undergraduates majoring in anthropology are required to have a minor or a second major. A minor usually consists of 15 credits minimum. A minor in anthropology consists of at least 15 credits and must include 306 or 309 and 307 or 308, and at least 3 other credits in courses numbered 300 or above.

Communication Proficiency requirement: The department requires that a student earn a grade of C or better in Engl 250 and either English 302 or 309 or 314.

The principal subdisciplines of anthropology are represented by the following:

1. General cultural anthropology and ethnology: 201, 230, 250, 257, 306, 313, 322, 323, 325, 326, 327, 335, 340, 411, 412, 418, 431, 432, 434B, 436, 439, 444, 450, 451B, 490B, 491.

2. Archaeology: 202, 308, 315, 321, 337, 414, 416, 420, 428, 429, 434A, 450, 451A, 427I, 490A.

3. Linguistic Anthropology: 309, 451D, 490D.

4. Biological Anthropology: 202, 307, 319, 424, 434C, 438, 445, 451C, 490C.

Graduate Study

The department offers work for the degree master of arts with a major in anthropology. Graduate courses are offered in the areas of biological anthropology, archaeology, cultural anthropology, linguistic anthropology, history and theory, and methodology. Competence in one foreign language and in statistics must be demonstrated. A thesis, generally based on original fieldwork, is required.

Courses primarily for undergraduate students

Anthr 201. Introduction to Cultural Anthropology. (3-0) Cr. 3. F.S.SS. Comparative study of culture as key to understanding human behaviors in different Societies. Using a global, cross-cultural perspective, patterns of family life, economic and political activities, religious beliefs, and the ways in which cultures change are examined.

Anthr 202. Introduction to Biological Anthropology and Archaeology. (3-0) Cr. 3. F.S. Human biological and cultural evolution; survey of the evidence from fossil forms and archaeology, as well as living primates and traditional cultures; introduction to methods of study in archaeology and biological anthropology.

Anthr 230. Globalization and the Human Condition. (3-0) Cr. 3. F.S. An introduction to understanding key global issues in the contemporary world. Focuses on social relations, cultural practices and political-economic linkages among Africa, the Americas, Asia, Europe and the Pacific.

Anthr 250. Contemporary Muslim Societies. (3-0) Cr. 3. S. An introduction to understanding key local and global issues facing Muslim Society. Focus on cultural, social, political, religious, and ecological forces shaping contemporary Muslim Societies and linkages with the non-Muslim world.

Anthr 306. Cultural Anthropology. (2-2) Cr. 3. S. *Prereq: 201.* Survey of the major theoretical, methodological and empirical foundations of cultural anthropology. Participatory lab: focus on ethnographic methods through individual research projects.

Anthr 307. Biological Anthropology. (2-2) Cr. 3. S. *Prereq: 202.* Human evolution as known from fossil evidence, comparative primate studies, and genetic variations in living populations. Laboratory-tutorial sessions include study and discussion of human osteology, fossil hominids, simple Mendelian traits, and bio-ethics in applied biological anthropology.

Anthr 308. Archaeology. (2-2) Cr. 3. F. *Prereq: 202.* Methods and techniques for the recovery and interpretation of archaeological evidence, its role in reconstructing human behavior and past environments. Laboratory sessions include experience in the interpretation of archaeological evidence, the use of classification systems, and prehistoric technologies such as ceramics and stone tools. Field trips.

Anthr 309. Linguistic Anthropology. (Cross-listed with Ling). (2-2) Cr. 3. F. *Prereq: 201.* Language as a human attribute; language versus animal communication; human communication in cultural context; paralanguage, kinesics, proxemics, artifacts as communication; language and culture; cross-cultural Sociolinguistics; ethnoscience; and language policies. Participatory lab: focus on analysis of a non-Western language and communication system.

Anthr 313. The Family and Kinship in Cross-Cultural Perspective. (Dual-listed with 513). (3-0) Cr. 3. S. *Prereq: 201 recommended.* Comparative and historical overview of family, marriage and kinship crossculturally; discussion of differences in the structure, cycle, and functioning of family and kin relations through ethnographic readings, including Euro-American examples; current critical and theoretical issues in kinship studies, especially integrating work on gender, sexuality and representation.

Anthr 315. Archaeology of North America. (Dual-listed with 515). (Cross-listed with Am In). (3-0) Cr. 3. S. *Prereq: 202 or 308.* Prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; culture-historical sequences of major culture areas; linkages of archaeological traditions with selected ethnohistorically known Native American groups.

Anthr 319. Skeletal Biology. (Dual-listed with 519). (2-2) Cr. 3. F. *Prereq: 307 or college level biology.* Comprehensive study of the skeletal anatomy, physiology, genetics, growth, development and population variation of the human skeleton. Applications to forensic anthropology, paleopathology and bioarchaeology are introduced.

Anthr 321. World Prehistory. (Dual-listed with 521). (3-0) Cr. 3. S. *Prereq: 202 recommended.* An introduction to archaeological sites from around the world including the Near East, Africa, Europe, Mesoamerica, and North and South America. Emphasis is on the interpretation of material cultural remains in reconstructing past Societies.

Anthr 322. Peoples and Cultures of Native North America. (Dual-listed with 522). (Cross-listed with Am In). (3-0) Cr. 3. F.SS. *Prereq: 201 or Am In 210.* Origin, distribution, and traditional life of native peoples of North America. Survey of culture areas; ecology and subsistence, language, kinship, life cycle, political, economic, and religious systems; impact of European contact.

Anthr 323. Topics in Latin American Anthropology. (Dual-listed with 523). (Cross-listed with Am In). (3-0) Cr. 3. Repeatable. S. *Prereq: Anthr 201 or 306 recommended.* Exploration of contemporary Latin American social dynamics within specific historical, political and economic contexts; discussion of current ethnographic approaches to studying key Sociocultural issues in Latin America. Topics vary each time offered.
A. Violence and Memory
B. Social movements and Democracy
C. Race, Class and Gender
D. Regional Focus

Anthr 325. Peoples and Cultures of Africa. (Dual-listed with 525). (Cross-listed with Af Am). (3-0) Cr. 3. S. *Prereq: 201 or 306 recommended.* Origins and distribution of peoples of Africa; geographical characteristics as related to culture types, including early civilizations; a comparative examination of economic, subsistence, language, social and political organization, and religious systems throughout the continent; change processes, the impact of colonialism, and the nature of contemporary African Societies.

Anthr 335. Peoples and Cultures of the Middle East. (Dual-listed with 535). (3-0) Cr. 3. F. *Prereq: 201 or 306 recommended.* Anthropological approaches to the study of Middle East cultures. Survey of major culture areas, discussion of economic, political, and social and religious issues and systems. Examination of contemporary social movements.

Anthr 337. Andean Archaeology. (Dual-listed with 537). (3-0) Cr. 3. F. *Prereq: 202 or 321 recommended.* Survey of prehistoric Andean cultures of Peru, Bolivia and Ecuador; the archaeology of the Incas and their ancestors. Emphasis on prehistoric economic, religious, and political organization, the rich material culture recovered through archaeological records; and the use of ethnohistoric texts and modern ethnographies to reconstruct the prehistory of Andean Societies.

Anthr 340. Magic, Witchcraft, and Religion. (Dual-listed with 540). (Cross-listed with Relig). (3-0) Cr. 3. S. *Prereq: 201 or 306.* Origin and development of indigenous magico-religious systems; myth and ritual; therapeutic aspects; symbols and meanings; religion and Sociocultural change, including acculturation, nativistic, and revitalization movements.

Anthr 350. Primate Behavior. (Dual-listed with 550). (2-2) Cr. 3. F.S.SS. *Prereq: Anthr 202 and/or basic biology course recommended.*. An introduction to the Order Primates with a focus on their behavior. Biological and social adaptations of monkeys, apes, and prosimians; basic evolutionary concepts, current trends and theories in the field of Primatology and issues related to primate conservation.

Anthr 411. Culture Change and Applied Anthropology. (Dual-listed with 511). (3-0) Cr. 3. F. *Prereq: 201 or 306.* Theoretical and practical considerations of human cultural development. Examination of theories of cultural change, culture contact and acculturation. Dynamics of directed change in contemporary world cultures. Principles, theories, and ethics of international development projects from a sociocultural perspective.

Anthr 412. Psychological Anthropology. (Dual-listed with 512). (3-0) Cr. 3. F. *Prereq: 201 or 306.* Relationship of cultural, social and personality factors in human behavior. Cross-cultural comparisons of child rearing practices, cognitive development, mental health, deviancy, ethno-psychiatry, altered states of consciousness, and psychological dimensions of culture change.

Anthr 414. Southwestern Archaeology. (Dual-listed with 514). (3-0) Cr. 3. F. *Prereq: 308 or 315 or 321.* Prehistoric archaeology of the American Southwest, including the Paleo-indian and Archaic periods; the adoption of agriculture; the emergence of pueblo Societies; relationships with contemporary Southwest cultures.

Anthr 418. Global Culture, Consumption and Modernity. (Dual-listed with 518). (3-0) Cr. 3. F. *Prereq: Anthr 201 or 306 recommended.* Cross-cultural study of the impact of globalization, with an emphasis on economic consumption and the movement of goods, ideas, and peoples across cultural and national boundaries.

Anthr 420. Cultural Continuity and Change in the Prairie-Plains. (Dual-listed with 520). (Cross-listed with Am In). (3-0) Cr. 3. F. *Prereq: 315 or 322.* Ecological adaptations, sociocultural changes, and continuities of traditions among Prairie and Plains Indian groups through time; impacts of Euro-American Society and technology on Indians of the Great Plains; perspectives from ecology, archaeology, ethnology, history, and contemporary literary sources.

Anthr 424. Forensic Anthropology. (Dual-listed with 524). (2-2) Cr. 3. S. *Prereq: 319.* Comprehensive study of forensic anthropology, a specialized subfield of biological anthropology. Emphasis is placed on personal identifications from extremely fragmentary, comingled, burnt, cremated and incomplete skeletal remains. All parameters of forensic study are included as they pertain to anthropology, including human variation, taphonomy, entomology, archaeology, pathology, epidemiology; genetics and the non-biological forensic disciplines. An appreciation for the wide range of medicolegal and bioethical issues will also be gained.

Anthr 427I. Archaeology. (Cross-listed with Ia LL). Cr. 4. SS. Nature of cultural and environmental evidence in archaeology and how they are used to model past human behavior and land use; emphasis on Iowa prehistory; basic reconnaissance surveying and excavation techniques. Nonmajor graduate credit.

Anthr 428. Topics in Archaeological Laboratory Methods and Techniques. (Dual-listed with 528). (2-2) Cr. 3. Repeatable. S. *Prereq: 308.* Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition and organization, and computer applications
A. Lithics
B. Ceramics
C. Faunal remains
D. General.

Anthr 429. Archaeological Field School. (Dual-listed with 529). Cr. arr. SS. *Prereq: 202 or 308.* Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence.

Anthr 431. Ethnographic Field School. (Dual-listed with 531). Cr. arr. SS. 4 or 6 weeks. Summer field school for training in ethnographic field methods; students will carry out research projects in social anthropology, learning a variety of investigative research techniques commonly used in social sciences.

Anthr 432. Current Issues in Native North America. (Dual-listed with 532). (Cross-listed with Am In). (3-0) Cr. 3. S. *Prereq: 201 or 306; 322 or Am In 210 recommended.* Conditions and issues of contemporary Native Americans; historical background of eighteenth and nineteenth century Indian-White relationships; examination of legal Status, the reservation system, treaty violations, Indian militancy, education and urbanization, self-determination, social impact of resource development, and other current concerns.

Anthr 434. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior or senior standing.* Supervised practice in government agencies, museums, and business organizations. Not more than 6 credits of internship experience may count towards the major. No credits in Anthr 434 may be used to satisfy anthropology core courses for majors or for the anthropology minor. Satisfactory-fail only.
A. Archaeology
B. Cultural Anthropology
C. Biological Anthropology
D. Linguistic Anthropology

Anthr 436. Development Anthropology. (Dual-listed with 536). (3-0) Cr. 3. S. *Prereq: Anthr 201 or 306.* Historical and theoretical basis of the practices of development, applied and economic anthropology. Covers a wide range of topics such as the role of aid, institutions of development, indigenous knowledge, rural development projects, organization of production, migration, health and environment.

Anthr 438. Primate Evolutionary Ecology and Behavior. (Dual-listed with 538). Cr. 3. S. *Prereq: 202 or 307.* Primate behavior and ecology in evolutionary perspective: biological and social adaptations of prosimians, monkeys, and apes. Introduction to the Order Primates, basic evolutionary concepts, and techniques of behavioral observation. Focus on theory and methods current in Primatology, including applied conservation biology.

Anthr 439. Medical Anthropology. (Dual-listed with 539). (3-0) Cr. 3. S. *Prereq: 201 or 202 or 306.* Study of human health in cultural and environmental context; comparison of health and disease patterns of western and non-western populations; healing systems; use of epidemiological models in understanding illness and disease etiologies cross-culturally; interrelationship between diet and culture.

Anthr 444. Sex and Gender in Cross-cultural Perspective. (Dual-listed with 544). (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: Anthr 201; Anthr 306 recommended.* Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western Societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

Anthr 445. Biological Field School. (Dual-listed with 545). Cr. arr. SS. *Prereq: 202 or Biol 101.* Summer field school for training in behavioral and ecological methods for primatologists. Proposal, data collection and analyses, and presentation of research topic in primatology.

Anthr 450. Historical and Theoretical Approaches in Anthropology. (3-0) Cr. 3. F. *Prereq: 306.* Survey of the historical foundations of anthropology and its interrelated four sub-fields; key figures in 19th and 20th century anthropology with a focus on major theoretical contributions.

Anthr 451. Practicum in Anthropology. Cr. arr. Repeatable. F.S.SS. *Prereq: 201 or 202 or 308.* Application of methods under actual laboratory and field conditions, including basic data management, synthesis, and analysis.
A. Archaeology
B. Cultural Anthropology
C. Biological Anthropology
D. Linguistic Anthropology

Anthr 482. Topics in Biological Anthropology. (Dual-listed with 582). (3-0) Cr. 3. Repeatable. F. *Prereq: Anthr 307.* In-depth study of current topics in biological Anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.
A. Paleoanthropology
B. Primate Cognition
C. Population Conservation
D. Population Genetics and Human Evolution

Anthr 490. Independent Study. Cr. arr. Repeatable. *Prereq: 9 credits in anthropology.* No more than 9 credits of Anthr 490 may be counted toward graduation.
A. Archaeology
B. Cultural Anthropology
C. Biological Anthropology
D. Linguistic Anthropology (Same as Ling 490D)

H. Honors
I. Undergraduate Independent Study (Same as Ia LL 490I)

Courses primarily for graduate students, open to qualified undergraduate students

Anthr 500. Language and Culture. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: Anthr 309 or 510.* Approaches to the study of the relationship between language structure, world view, and cognition; social and structural linguistic variation; cross-cultural aspects of verbal and non-verbal communication; linguistic change; contemporary applications of linguistic anthropology.

Anthr 503. Biological Anthropology. (3-0) Cr. 3. F. *Prereq: 307.* Survey of the history of biological anthropology, current developments and theoretical issues in evolution, human variation and adaptation, population studies, primates and primate behavior, and Paleoanthropology.

Anthr 509. Agroecosystems Analysis. (Cross-listed with Agron, Soc, SusAg). (3-4) Cr. 3. F. *Prereq: Senior or above classification.* Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (Agronomic, economic, ecologic, social, etc.) and scales of operation.

Anthr 510. Theoretical Dimensions of Cultural Anthropology. (3-0) Cr. 3. F. *Prereq: 6 credits in anthropology.* Survey of historical and current developments in topical and theoretical approaches to sociocultural anthropology. Examination and assessment of controversies; new research directions and theoretical approaches.

Anthr 511. Culture Change and Applied Anthropology. (Dual-listed with 411). (3-0) Cr. 3. F. *Prereq: 6 credits in anthropology, 201 or 306.* Theoretical and practical considerations of cultural development. Examination of theories, cultural change, culture contact and acculturation. Dynamics of directed change in contemporary world cultures. Principles, theories, and ethics of international development projects from a sociocultural perspective.

Anthr 512. Psychological Anthropology. (Dual-listed with 412). (3-0) Cr. 3. F. *Prereq: 201 or 306.* Relationship of cultural, social and personality factors in human behavior. Cross-cultural comparisons of child rearing practices, cognitive development, mental health, deviancy, ethno-psychiatry, altered states of consciousness, and psychological dimensions of culture change.

Anthr 513. The Family and Kinship in Cross-Cultural Perspective. (Dual-listed with 313). (3-0) Cr. 3. S. *Prereq: 6 credits in anthropology, 201 recommended.* Comparative and historical overview of family, marriage and kinship crossculturally; discussion of differences in the structure, cycle, and functioning of family and kin relations through ethnographic readings, including Euro-American examples; current critical and theoretical issues in kinship studies, especially integrating work on gender, sexuality and representation.

Anthr 514. Southwestern Archaeology. (Dual-listed with 414). (3-0) Cr. 3. F. *Prereq: 308 or 315 or 321.* Prehistoric archaeology of the American Southwest, including the Paleo-indian and Archaic periods; the adoption of agriculture; the emergence of pueblo Societies; relationships with contemporary Southwest cultures.

Anthr 515. Archaeology of North America. (Dual-listed with 315). (3-0) Cr. 3. S. *Prereq: 202 or 308.* Prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; culture-historical sequences of major culture areas; linkages of archaeological traditions with selected ethnohistorically known Native American groups.

Anthr 518. Global Culture, Consumption and Modernity. (Dual-listed with 418). (3-0) Cr. 3. F. *Prereq: Anthr 201 or 306 recommended.* Cross-cultural study of the impact of globalization, with an emphasis on economic consumption and the movement of goods, ideas, and peoples across cultural and national boundaries.

Anthr 519. Skeletal Biology. (Dual-listed with 319). (2-2) Cr. 3. F. *Prereq: 307 or college level biology recommended.* Comprehensive study of the skeletal anatomy, physiology, genetics, growth, development and population variation of the human Skeleton. Applications to forensic anthropology, paeopathology, and bioarchaeology are introduced.

Anthr 520. Cultural Continuity and Change in the Prairie-Plains. (Dual-listed with 420). (3-0) Cr. 3. F. *Prereq: 315 or 322.* Ecological adaptations, sociocultural changes, and continuities of traditions among Prairie and Plains Indian groups through time; impacts of Euro-American Society and technology on Indians of the Great Plains; perspectives from ecology, archaeology, ethnology, history, and contemporary literary sources.

Anthr 521. World Prehistory. (Dual-listed with 321). (3-0) Cr. 3. S. *Prereq: 202 recommended.* An introduction to archaeological sites from around the world including the Near East, Africa, Europe, Mesoamerica, and North and South America. Emphasis is on the interpretation of material cultural remains in reconstructing past Societies.

Anthr 522. Peoples and Cultures of Native North America. (Dual-listed with 322). (3-0) Cr. 3. F. *Prereq: 201 or Am In 210.* Origin, distribution, and traditional life of native peoples of North America. Survey of culture areas; ecology and subsistence, language, kinship, life cycle; political, economic and religious systems; impact of European contact.

Anthr 523. Topics in Latin American Anthropology. (Dual-listed with 323). (3-0) Cr. 3. Repeatable. S. *Prereq: 6 credits in anthropology, 201 or 306 recommended.* Exploration of contemporary Latin American social dynamics within specific historical, political and economic contexts; discussion of current ethnographic approaches to studying key Sociocultural issues in Latin America. Topics vary each time offered.
A. Violence and Memory
B. Social Movements and Democracy
C. Race, Class and Gender
D. Regional Focus

Anthr 524. Forensic Anthropology. (Dual-listed with 424). (3-0) Cr. 3. S. *Prereq: 319.* Comprehensive study of forensic anthropology, a specialized subfield of biological anthropology. Emphasis is placed on personal identifications from extremely fragmentary, comingled, burnt, cremated and incomplete skeletal remains. All parameters of forensic study are included as they pertain to anthropology, including human variation, taphonomy, entomology archaeology, pathology, epidemiology; genetics and the non-biological forensic disciplines. An appreciation for the wide range of medicolegal and bioethical issues will also be gained.

Anthr 525. Peoples and Cultures of Africa. (Dual-listed with 325). (3-0) Cr. 3. S. *Prereq: 201 or 306 recommended.* Origins and distribution of peoples of Africa; geographical characteristics as related to culture types, including early civilizations; a comparative examination of economic, subsistence, language, social and political organization, and religious systems throughout the continent; change processes, the impact of colonialism, and the nature of contemporary African Societies.

Anthr 528. Topics in Archaeological Laboratory Methods and Techniques. (Dual-listed with 428). (2-2) Cr. 3. Repeatable. S. *Prereq: 308.* Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition organization, and computer applications
A. Lithics
B. Ceramics
C. Faunal remains
D. General.

Anthr 529. Archaeological Field School. (Dual-listed with 429). Cr. arr. SS. *Prereq: 202 or 308.* Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence.

Anthr 530. Ethnographic Field Methods. Cr. 3. F. *Prereq: 6 credits in anthropology, permission of instructor.* Field training experience in ethnography. Problems emphasizing field studies in the contemporary Societies of the world. Focus on techniques of data gathering and analysis.

Anthr 531. Ethnographic Field School. (Dual-listed with 431). Cr. arr. SS. 4 or 6 weeks. Summer field school for training in ethnographic field methods; students will carry out research projects in social anthropology, learning a variety of investigative research techniques commonly used in social sciences.

Anthr 532. Current Issues in Native North America. (Dual-listed with 432). (3-0) Cr. 3. S. *Prereq: 6 credits in anthropology, 201 or 306; 322 or Am In 210 recommended.* Conditions and issues of contemporary Native Americans; historical background of eighteenth and nineteenth century Indian-White relationships; examination of legal Status, the reservation system, treaty violations, Indian militancy, education and urbanization, self-determination, social impact of resource development, and other current concerns.

Anthr 535. Peoples and Cultures of the Middle East. (Dual-listed with 335). (3-0) Cr. 3. F. *Prereq: 201 or 306 recommended.* Anthropological approaches to the study of Middle East cultures. Survey of major culture areas. Discussion of economic, political, and social and religious issues and systems. Examination of contemporary social movements.

Anthr 536. Development Anthropology. (Dual-listed with 436). (3-0) Cr. 3. S. *Prereq: Anthr 201 or 306.* Historical and theoretical basis of the practices of development, applied and economic anthropology. Covers a wide range of topics such as the role of aid, institutions of development, indigenous knowledge, rural development projects, organization of production, migration, health and environment.

Anthr 537. Andean Archaeology. (Dual-listed with 337). (3-0) Cr. 3. F. *Prereq: 202 or 321 recommended.* Survey of prehistoric Andean cultures of Peru, Bolivia and Ecuador; the archaeology of the Incas and their ancestors. Emphasis on prehistoric economics, religious, and political organization, the rich material culture recovered through archaeological records; and the use of ethnohistoric texts and modern ethnographies to reconstruct the prehistory of Andean societies.

Anthr 538. Primate Evolutionary Ecology and Behavior. (Dual-listed with 438). (3-0) Cr. 3. S. *Prereq: 202 or 307.* Primate behavior and ecology in evolutionary perspective; biological and social adaptations of prosimians, monkeys, and apes. Introduction to the Order Primates, basic evolutionary concepts, and techniques of behavioral observation. Focus on theory and methods current in Primatology, including applied conservation biology.

Anthr 539. Medical Anthropology. (Dual-listed with 439). (3-0) Cr. 3. S. *Prereq: 6 credits in anthropology, 201 or 202 or 306 recommended.* Study of human health in cultural and environmental context; comparison of health and disease patterns of western and non-western populations; healing systems; use of epidemiological models in understanding illness and disease etiologies cross-culturally; interrelationship between diet and culture.

Anthr 540. Magic, Witchcraft, and Religion. (Dual-listed with 340). (3-0) Cr. 3. S. *Prereq: 6 credits in anthropology, 201 or 306 recommended.* Origin and development of indigenous magico-religious systems; myth and ritual; therapeutic aspects; symbols and meanings; religion and Socio-cultural change, including acculturation, nativistic, and revitalization movements.

Anthr 544. Sex and Gender in Cross-cultural Perspective. (Dual-listed with 444). (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: 201; 306 recommended.* Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western Societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

Anthr 545. Biological Field School. (Dual-listed with 445). Cr. arr. SS. *Prereq: Anthr 202 or Biol 101 and permission of instructor.* Summer field school for training in behavioral and ecological methods for primatologists. Proposal, data collection and analyses, and presentation of research topic in primatology.

Anthr 550. Primate Behavior. (Dual-listed with 350). (2-2) Cr. 3. F.S.SS. *Prereq: Anthr 202 and/or basic biology course recommended.*. An introduction to the Order Primates with a focus on their behavior. Biological and social adaptations of monkeys, apes, and prosimians; basic evolutionary concepts, current trends and theories in the field of Primatology and issues related to primate conservation.

Anthr 555. Seminar in Archaeology. (3-0) Cr. 3. S. *Prereq: 308 or 429.* Examination of the history of Anthropological archaeology and current issues and debates concerning methods, theories and the ethics of modern archaeology.

Anthr 582. Topics in Biological Anthropology. (Dual-listed with 482). (3-0) Cr. 3. Repeatable. F. *Prereq: Anthr 307.* In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.
A. Paleoanthropology
B. Primate Cognition
C. Population Conservation
D. Population Genetics and Human Evolution

Anthr 590. Graduate Independent Study. (Cross-listed with Ia LL, A Ecl, EEOB). Cr. arr. Repeatable. SS. *Prereq: Graduate classification and permission of instructor.*
I. Iowa Lakeside Laboratory (Same as Ia LL 590I)

Anthr 591. Orientation to Anthropology. (1-0) Cr. 1. F. *Prereq: Admission to the Anthropology Graduate Program.* Introduction to the Anthropology program, including the requirements for successful degree completion, department administrative procedures, ethics in anthropology and current trends in the four subfields of anthropology. Required of graduate students. Satisfactory-fail only.

Courses for graduate students

Anthr 610. Foundations of Sustainable Agriculture. (Cross-listed with Agron, SusAg, Soc, A E). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging systems of agriculture in terms of core concepts of sustainability and their theoretical contexts.

Anthr 699. Research. Cr. arr. Repeatable.
I. Iowa Lakeside Laboratory (Same as Ia LL 699I.)

Apparel, Educational Studies, and Hospitality Management

www.aeshm.hs.iastate.edu/

Robert Bosselman, Chair of Department

Distinguished Professors (Emeritus): Fanslow, Moyer, Winakor

University Professors (Emeritus): Farrell-Beck

Professors: Bosselman, Damhorst, Fiore, Kadolph

Professors (Emeritus): Anderson, Beavers, Brun, Burnet, Cowan, Crabtree, Gilmore, Smith, Stone, Williams

Associate Professors: Baltzer, Hausafus, Niehm, Parsons

Associate Professors (Emeritus): Amos, Brackelsberg, Brown, Ebert, Huss, Kundel, Kunz, Walsh

Associate Professors (Adjunct): Strohbehn

Assistant Professors: Barker, Hurst, Karpova, Keino, Y. Lee, Marcketti, Rajagopal, Wohlsdorf-Arendt, Zheng

Assistant Professors (Adjunct): Glock

Instructors (Adjunct): Fratzke

Lecturers: Ackerman, Burger, Christensen, Fiihr, Fitzpatrick, Kramer, M. Lee, Sanger, Trost, Wirth, Wise

The department offers courses that provide opportunities for students to learn about interdisciplinary areas including aesthetics, leadership, event planning, entrepreneurship, and multi-channel retailing at both undergraduate and graduate levels. AESHM courses serve to complement the student's major area of study whether it be Apparel Merchandising, Design, and Production; Family and Consumer Sciences Education; Hotel and Institutional Management; agriculture, business, design education, engineering, liberal arts and sciences or minor areas of study including entrepreneurial studies, design studies, or international studies.

Students majoring in Apparel Merchandising, Design, and Production are required to earn a C- or better in all AESHM courses applied to the degree, including transfer courses.

For additional courses of interest, see the listings for Family and Consumer Sciences Education and Studies; Hotel, Restaurant, and Institution Management; and Textiles and Clothing.

Courses primarily for undergraduate students

AESHM 111. Professional Development for AESHM. (2-2) Cr. 3. F.S. Career exploration, presentation and professional skills, teamwork and leadership, creativity, critical thinking, technology, and service learning components. Some WWW lectures.

AESHM 271. Public Relations and Event Management I. (2-2) Cr. arr. Repeatable. S. *Prereq: Permission of instructor.* Overview of public relations and event management in the apparel and hospitality industries. Production of an event including developing budgets, publicity, advertising, fund raising, choreography, staging, lighting, and food. Course must be taken for 3 credits first time, can be repeated for 1 credit.

AESHM 275. Merchandising. (3-0) Cr. 3. F.S. *Prereq: 3 credits in Math*. Principles of merchandising as applied to human science-related businesses, such as retailing, service, hospitality, and manufacturing. Study of planning, development, and presentation of apparel- and hospitality-related product lines.

AESHM 287. Principles of Management in Human Sciences. (3-0) Cr. 3. F.S. Introduction to management concepts and principles with application to the human Sciences organizations. Includes service quality management, professionalism, and social responsibility.

AESHM 311. Seminar on Careers and Internships. (1-0) Cr. 1. F.S. *Prereq: Sophomore classification. Good academic standing.* Internship and career planning, professional expectations and responsibilities. Resume development, cover letters, portfolio planning, interviewing techniques, and business etiquette.

AESHM 340. Hospitality and Apparel Marketing Strategies. (3-0) Cr. 3. F. *Prereq: Econ 101.* Application of marketing principles to the hospitality, apparel and retail industries. Emphasis on development of organizational strategies, marketing plans, service and social marketing principles within human sciences-related businesses.

AESHM 342. Aesthetics of Everyday Experience. (3-0) Cr. 3. F.S. Design principles, aesthetic concepts, and Philosophies applied to multi-sensory consumer environments. Influence of individual differences and cultural patterns on aesthetic preferences.

AESHM 379. Community Leadership: Examination of social Issues. (3-0) Cr. 3. F. Study of family and community social issues from diverse perspectives. Application of critical thinking and reflection to issues with a focus on leadership within the community.

AESHM 421. Developing Global Leadership: Maximizing Human Potential. (3-0) Cr. 3. S. Development of leadership in a global environment. Focus on the contributions of women in enhancing the well-being of others. Strategies for working with individuals, families and communities in other countries and cultures. Taking local action on global issues. Student participation in cultural activities.

AESHM 424. International Study Abroad Seminar. Cr. arr. Repeatable. F.S.SS. Orientation to study abroad program considering topics related to country and location; travel arrangements and preparation for study abroad; on-site fieldwork and academic experiences in an international setting.

AESHM 438. Human Resource Management. (3-0) Cr. 3. S. *Prereq: HRI 193, AESHM 275 or 287; junior classification.* Principles and practices of human resource management relevant to human Science-related organizations. Emphasis on the entry-level manager's role.

AESHM 471. Public Relations and Event Management II. (2-2) Cr. arr. Repeatable. S. *Prereq: Permission of instructor.* Advanced application of public relations and event management in the apparel and hospitality industries. Provide leadership and communicate direction for production of an event including developing budgets, publicity, advertising, fund raising, choreography, staging, lighting, and food. Course must be taken for 3 credits first time, can be repeated for 1 credit.

AESHM 474. Entrepreneurship in Human Sciences. (Dual-listed with 574). (3-0) Cr. 3. S. *Prereq: junior or senior Status.* Entrepreneurship concepts of innovation, creativity, opportunity assessment, business planning. Focus on human Sciences-related businesses: retail, service, hospitality, family, home-based, rural, women and minority-owned businesses. Project applications include market research, feasibility analysis, and new business proposals.

AESHM 477. Multi-channel Retailing. (3-0) Cr. 3. F. *Prereq: 3 credits in marketing or AESHM 275 or 287.* Strategies used by retailers to market products through store formats, e-commerce, catalog, TV, mobile, direct sales. Emphasis on integration of e-commerce with other channels.

Courses primarily for graduate students, open to qualified undergraduate students

AESHM 545. Consumer Aesthetics and Retail Branding. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: One course in design elements and principles, psychology, consumer behavior, or marketing.* Examination of hedonic nature of consumer experience and its application to experiential design and branding of retail/hospitality establishments. Emphasis on consumer behavior, design, environmental psychology, and marketing literature.

AESHM 574. Entrepreneurship in Human Sciences. (Dual-listed with 474). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: One course in marketing or permission of instructor.* Entrepreneurship concepts of innovation, creativity, opportunity assessment, business planning. Focus on human Sciences-related businesses: retail, service, hospitality, family, home-based, rural, women and minority-owned businesses. Project applications include market research, feasibility analysis, and business proposals.

AESHM 577. E-Commerce for Apparel and Hospitality Companies. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: Course in marketing or permission of instructor.* Technology and consumer trends, industry practices, and marketing strategies for e-commerce. Evaluation and development of apparel or hospitality

company websites. Theory application to development of multi-channel business strategies.

Architecture

www.arch.iastate.edu

Calvin Lewis, Chair of Department

Professors: Block, Chan, Engelbrecht, Lewis, Osterberg, Palermo, Schwennsen, Shao

Professors (Emeritus): Findlay, Heemstra, Kitzman, Mckeown, Mukerjea, Shank, Stone

Associate Professors: Alread, Bassler, Bermann, Cardinal-Pett, Ghandour, Horwitz, Leslie, Muecke, Naegele, Paxson, Squire

Associate Professor (Adjunct): Masterson

Assistant Professors: Call, Campbell, Maves, Passe, Sobiech-Munson, Zarecor

Assistant Professor (Collaborator): Schneider

Lecturers: Anderson, Fisher, Goche, Jackson, Julien, Kalaher, Lueth, Whitehead, Zhao

Undergraduate Study

The undergraduate program in architecture is a five-year curriculum leading to the bachelor of architecture degree. The program provides opportunities for general education as well as preparation for professional practice and/or graduate study. An optional one-semester foreign study program is offered to fourth year students.

The undergraduate curriculum includes one year of preprofessional coursework and four years of professional coursework. Admission to the professional degree program is based on the applicant's performance in the completed preprofessional curriculum; previous high school record (or transfer record where applicable); portfolio and essay evaluations; and on available departmental resources.

Objectives of the Bachelor of Architecture program:
The Department is committed to the study of architecture as a cultural discipline in which issues of practice, of the multiplicity of social formations in which buildings exist, and of environmental effect are enfolded with the subject matter of building design - construction, space, material, form and use. Architecture arises from the aspirations that diverse individuals and groups have for their physical environment, and from the social enterprise of designing and fabricating the landscape we inhabit. It involves individual and multiple buildings, the spaces within them, and the exterior landscape.

It is our intent: that our students develop the skills with which to critically assess and research architectural questions and to invent architectural designs that address those questions; that they develop a working method for designing and that they have the communication, graphic, modeling and computational skills to support design exploration and to represent their design ideas to others; that they gain knowledge of architectural technologies through which buildings are given form, of which they are constructed and by which they are environmentally tempered; that they understand architectural history, that they understand the theoretical and diverse cultural underpinnings of the discipline of architecture, that they are able to reference architectural precedents and know how to utilize all of these in the development of their ideas; and that they have grounding in the ethical and practical aspects of the architectural profession in Society.

For students entering the professional program, the department highly recommends purchase or lease of a laptop/notebook computer and appropriate software. See the *Undergraduate Academic Advising Handbook* in the departmental office or the departmental web pages for hardware and software specifications.

For a more complete undergraduate program description, see *College of Design, Curricula*.

Graduate Study

The Department of Architecture offers professional, post-professional and research-oriented degrees for graduate students. The M.Arch. I and M. Arch. II emphasize the relationship between professional education and research. The M.S.A.S. is for students with non-professional degrees who want to pursue graduate-level research on the built environment. All the programs encourage interdisciplinary work within the College of Design and across related fields within the university.

Objectives:
The graduate program assumes the following: the built environment is an active agent in a global ecosystem and the setting for most forms of cultural exchange; the built environment can make positive and negative contributions to the vitality of local and global communities; understanding the dynamics of social production, material consumption and cultural exchange is a prerequisite to meaningful architectural design. For the most part, the built environment is designed by people who do not consider the consequences of their actions broadly. Therefore, our program demands engagement with contemporary issues and a commitment to lifelong learning. We encourage students to examine the relationships between local, regional and global contexts with a particular emphasis on the dynamics of the contemporary American Midwest. The domain of the architect's action is limited, but the range of information needed to make intelligent and responsible design decisions is vast. We expect our graduates to value the necessity of research, interdisciplinary collaboration and teamwork.

The M.Arch. I is an accredited first professional degree in architecture. Students with an undergraduate degree other than architecture enroll in a 100-credit, seven semester program. The curriculum starts with an intensive three-semester course sequence that places equal emphasis on architectural design, science and technology, and social and historical seminars on the built environment. The remaining four semesters have an open structure that allows students to explore architecture within an interdisciplinary context. These four semesters include a series of thematic and option studios, as well as various elective offerings. Students with a B.A. or B.S. in architecture or other affiliated design fields are considered for advanced standing based on a review of their academic record.

The M.Arch. II is a 30-credit post-professional degree in architecture for students with a B.Arch. or equivalent professional degree in architecture. The program is not subject to NAAB accreditation. The M.Arch. II program offers designers with a professional degree an opportunity to pursue advanced research in design. The program of study is expected to explore architectural design within interdisciplinary fields and requires completion of a creative component. As a precondition for acceptance, applicants are required to submit a statement of purpose that defines the research they want to pursue in architectural design. Upon admission, students partner with a faculty member to select courses from across the university to determine their program of study. A minimum of two semesters should be devoted to the program; due to teaching assistantship and research needs, students often take longer to finish.

The M.S.A.S. is a 30-credit interdisciplinary research degree in architectural studies. This degree is for students with bachelor degrees in various fields and interests in graduate-level research on the built environment. The M.S.A.S program is not subject to NAAB accreditation and is not intended, on its own, to lead to a career as a licensed architect. The program of study is expected to explore architecture within interdisciplinary fields and requires completion of a thesis project. As a precondition for acceptance, applicants are required to submit a thesis proposal. Upon admission, students partner with a faculty member to serve as a thesis adviser and to determine their program of study. A minimum of two semesters should be devoted to the program; due to teaching assistantship and research needs, students often take longer to finish. Areas of specialization include, but are not limited to: accessibility, architectural education, architectural history, building technology, energy and sustainability, environmental and social change, globalization and the built environment, historic preservation, housing, light and sound, politics and architecture and professional ethics.

Double-degree programs are currently offered with the Department of Community and Regional Planning (M.Arch./M.C.R.P.) and the College of Business (M.Arch./M.B.A.).

Financial support in the form of teaching and research assistantships is available.

Contact the department office for specific curricula.

Courses primarily for undergraduate students

Arch 102. Pre-Architecture Design. (1-6) Cr. 4. F.S. Three-dimensional design and drawing, with emphasis on creative conceptualization, exploration of materials, and analytical thinking. Includes study of architectural precedents and exercises to develop ability to communicate about form and space.

Arch 132. Two-Dimensional Studio. (0-6) Cr. 2. F.S. *Prereq: Enrollment in the preprofessional program.* Introduction to free-hand drawing concepts and practices. Exploration of the sketch as a means of inquiry, conceptualization and representation of form and space. Exercises focus on acquiring proficiency in the perceptual and experiential aspects of drawing. Various media, subjects and environmental contexts.

Arch 182. An Introduction to Architecture. (3-0) Cr. 3. S. *Prereq: Open to non-majors.* Through the study of architects, buildings, and theories, an introduction to the discipline of architecture, presenting architectural process and architectural works as culturally grounded events and artifacts.

Arch 201. Architectural Design I. (1-15) Cr. 6. F. *Prereq: Completion of the preprofessional program and admission into the professional program.* Introduction to architectural design. Introduction to architectural design, including precedent research, drawing conventions, model making, and diagramming. Studio projects focus on investigating the impact of specific site conditions on design, threshold conditions, and small-scale domestic space. Students will learn skills in problem solving, visualization, and written, oral, and graphic communication. Field trips to relevant architectural sites.

Arch 202. Architectural Design II. (1-15) Cr. 6. S. *Prereq: 201; Math 142; Phys 111.* Continuation of fundamental architectural design exploration. Studio projects focus on the generation of ideas based on experience and an understanding of urban Spaces. Emphasis on systematic analysis of urban culture, scale, materiality, and networks. Students work in

groups and individually. Representational methods expand on architectural conventions through experimentation. Fieldtrips to relevant architectural sites.

Arch 221. History of Western Architecture I. (Cross-listed with Dsn S). (3-0) Cr. 3. F. Introductory survey with emphasis on the cultural, visual, natural, and constructed context. Ancient through Renaissance.

Arch 222. History of Western Architecture II. (Cross-listed with Dsn S). (3-0) Cr. 3. S. Introductory survey with emphasis on the cultural, visual, natural, and constructed context. Renaissance to present.

Arch 230. Design Communications I. (2-2) Cr. 3. F. *Prereq: Admission to the professional program.* Investigations of various design media–including computer graphics and freehand drawing–and their applications to design, specifically to the course work in 201. Exercises to develop manual skill and perceptual sensitivity.

Arch 240. Materials and Assemblies I. (3-0) Cr. 3. F. *Prereq: Completion of the preprofessional program and admission into the professional program.* Introduction to common architectural materials, their physical properties, and integration into light construction subsystems. Model building codes, gravitational and climactic forces, and simplified methods of analysis for the preliminary design of building systems.

Arch 242. Architectural Structures I. (3-1) Cr. 3. S. *Prereq: 240; Math 142; Phys 111.* Structural performance and preliminary design of residential scale wood frame members and systems; principles of equilibrium and material behavior.

Arch 271. Human Behavior and Environmental Theory. (3-0) Cr. 3. F. *Prereq: Completion of the preprofessional program and admission into the professional program.* Exploration of theories that describe social structure and order and the manner in which individuals and Societies organize themselves and structure their environment.

Arch 301. Architectural Design III. (1-15) Cr. 6. F. *Prereq: 202.* Consideration of landscape as a constructed, cultural artifact. Projects address the perceptual aspects and strategies of situation and location; examination of environmental phenomena and patterns of use and settlement as revealed and affected by the architectural artifact. Development of a critical design process is stressed.

Arch 302. Architectural Design IV. (1-15) Cr. 6. S. *Prereq: 301 and minimum 2.0 GPA in previous studio courses.* Continuation of 301, examining housing in the urban Situation; diverse scales of use and occupation within the city as shaped by cultural tendencies. Projects examine collective and individual identities related by the condition of adjacency, the ability to consider varieties of scale within a project, and a further development of critical and technical methods.

Arch 310. Practical Experience. Cr. R. *Prereq: Permission of department chair.* Students must register for this course prior to commencing each term. Available only to students taking course loads of eleven credits or less.

Arch 334. Computer Applications in Architecture. (2-2) Cr. 3. F.S.SS. *Prereq: 201; 230.* Current and potential applications of digital computers in architecture. Projects employing computer graphics and modeling methods. Awareness of programming languages related to applications.

Arch 335. Three-Dimensional Studio. (Cross-listed with ArtIS). (0-5) Cr. 2. Repeatable. F.S. This course deals with three dimensional problems in visual invention, organization, and expression emphasizing creative manipulation of tools, materials, and techniques as means for three dimensional thinking. Projects cover the additive (modeling), subtractive (carving), substitutional (casting) as well as constructive techniques.

Arch 344. Architectural Structures II. (3-0) Cr. 3. F. *Prereq: 242.* Structural performance and preliminary design of low to medium rise steel frame members and systems, long span steel systems, and masonry walls and systems. Principles of equilibrium and material behavior.

Arch 346. Architectural Structures III. (3-0) Cr. 3. S. *Prereq: 344.* Structural performance and preliminary design of low- to medium- rise reinforced concrete and prestressed concrete members and systems. Wind and seismic lateral forces and the principles of equilibrium and material behavior.

Arch 351. Solar Home Design. (Cross-listed with Dsn S). (3-0) Cr. 3. S. *Prereq: 202.* Architectural design and technical analysis of residential structures with emphasis on energy construction and solar energy utilization.

Arch 357. Environmental Forces in Architecture. (3-0) Cr. 3. S. *Prereq: Completion of the preprofessional program and admission into the professional program; Math 142; Phys 111.* Introduction to environmental forces that describe the function of buildings in terms of human comfort and patterns of occupancy. Emphasis on analytical rules of thumb and calculation methods that contribute to design synthesis. A design process is developed utilizing building climatology, control of thermal, luminous, and acoustic environments.

Arch 401. Architectural Design V. (1-15) Cr. 6. F. *Prereq: 302.* A rigorous examination of architecture's relationship with culture and technology. Studio projects stress the interpretation and integration of contextual and historical considerations, as well as structural, environmental, and communication systems, in a comprehensive design proposal.

Arch 402. Architectural Design VI. (1-15) Cr. 6. S. *Prereq: 401 and minimum 2.0 GPA in previous studio courses.* An examination of the relationship between architecture and the city. Studio projects stress analysis and interpretation of the diverse forces and conditions that impact and inform architecture in the urban environment. Urban design project. Study abroad option.

Arch 403. Architectural Design VII. (1-15) Cr. 6. F. *Prereq: 402.* Advanced forum for architectural research and/or design. Choice of thematic studios or student initiated research and design. Experimentation and innovation are encouraged. Dsn S 446/546, for 6 cr. each time taken, can be substituted for this class and be taken up to a maximum of 12 credits.

Arch 404. Architectural Design VIII. (1-15) Cr. 6. S. *Prereq: 403.* Advanced forum for architectural research and/or design. Choice of thematic studios or student initiated research and design. Experimentation and innovation are encouraged. Dsn S 446/546, for 6 cr. each time taken, can be substituted for this class and be taken up to a maximum of 12 credits.

Arch 420. Topics in American Architecture. (3-0) Cr. 3. Repeatable. F.S. *Prereq: Junior classification.* History, theory, and principles of American architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 420 may be applied to degree program. Nonmajor graduate credit.

Arch 422. Topics in Medieval Architecture. (3-0) Cr. 3. Repeatable. S. *Prereq: Junior classification.* History, theory, and principles of medieval architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 422 may be applied to degree program. Nonmajor graduate credit.

Arch 423. Topics in Renaissance to Mid-Eighteenth Century Architecture. (3-0) Cr. 3. Repeatable. S. *Prereq: Junior classification.* History, theory, and principles of renaissance to mid-eighteenth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 423 may be applied to degree program. Nonmajor graduate credit.

Arch 424. Topics in Nineteenth Century Architecture. (3-0) Cr. 3. Repeatable. F. *Prereq: Junior classification.* History, theory, and principles of nineteenth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 424 may be applied to degree program. Nonmajor graduate credit.

Arch 425. Topics in Twentieth Century Architecture. (3-0) Cr. 3. Repeatable. F.S. *Prereq: Junior classification.* History, theory, and principles of twentieth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 425 may be applied to degree program. Nonmajor graduate credit.

Arch 426. Topics in Native American Architecture. (Cross-listed with Am In, Dsn S). (3-0) Cr. 3. Repeatable. F.S. *Prereq: Junior classification.* History, theory, and principles of Native American/American Indian architecture, landscape architecture and planning considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 426 may be applied to degree program. Nonmajor graduate credit.

Arch 427. History, Theory, and Criticism of Chinese Architecture. (Dual-listed with 527). (3-0) Cr. 3. F. *Prereq: Junior classification.* Survey of the history and theoretical concept of Chinese built environment with emphasis on the morphology of built form and its relation to art, landscape design, and urban Structure. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. Nonmajor graduate credit.

Arch 431. Analytical Drawing. (1-6) Cr. 3. Repeatable. F.S. *Prereq: 232, 302.* Exploration of 2- and 3-dimensional representations. Emphasis on on-site freehand sketching, perspective and orthographic drawing, rendering of shadows and textures, and use of diverse media.

Arch 432. Advanced Computer Lighting and Rendering. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 230, 301.* Exploration of the computer as a design and communication tool. Emphasis on lighting and rendering techniques.

Arch 433. File to Fabrication. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 230, 301.* Exploration of the computer as a design and manufacturing tool. Emphasis on fabrication techniques and rapid prototyping including laser-cutting, 3-D printing and CNC routing.

Arch 434. Computer-aided Architectural and Environmental Design. (1-4) Cr. 3. S. *Prereq: 334.* Emphasis on application of the computer as a design tool, topical applications and computer graphic methods, development of computer software for architectural and environmental problem solving. Nonmajor graduate credit.

Arch 436. Advanced Design Media. (2-2) Cr. 3. Repeatable. F.SS. *Prereq: 230.* Special topics in design media applications.

Arch 437. Architectural Photography. (3-0) Cr. 3. F. *Prereq: 202.* Emphasis on use of the camera and lighting in photographing drawings and interior and exterior building environments. Nonmajor graduate credit.

Arch 448. Materials and Assemblies II. (3-0) Cr. 3. S. *Prereq: 346.* Investigation of the materials and integrated systems found in complex construction assemblies. Emphasis on determination and utilization of appropriate forms of material assemblies and structural systems for large scale construction.

Arch 458. Environmental Control Systems. (3-0) Cr. 3. F. *Prereq: 357.* Overview of architectural environmental control systems in response to occupant comfort, patterns of use, health, and safety regulations. Emphasis on the analytical rules of thumb and calculation methods necessary to provide integrated

design synthesis of technical systems within architecture. Understanding the use and design of mechanical, electrical, plumbing, fire safety, transportation, and conveying systems and subsystems.

Arch 482. Professional Practice. (Dual-listed with 582). (3-0) Cr. 3. F. *Prereq: 202.* Emphasis on the circumstances and opportunities of the professional practice of architecture: practice as profession, process, organization, business, and evolving models of practice.

Arch 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on required form.* Independent investigation.
A. Design Communications.
B. Design
C. Technical Systems.
D. Architectural History
E. Behavioral Studies
F. Practice
H. Honors

Courses primarily for graduate students, open to qualified undergraduate students

Arch 505. Architectural Design I. (0-10) Cr. 5. F. *Prereq: Admission to the M Arch program. Concurrent enrollment in 595; 541.* An introduction to comprehensive architectural design projects (individual and collaborative) with coordinated studies in design media, history, theory, culture, science, and technology. Projects establish a framework for designing buildings as aspects of dynamic circumstances such as environmental forces, construction methods, economic and political regulations, social relationships, and cultural values. Course content and assignments coordinated with 506 and 596.

Arch 506. Architectural Design II. (0-10) Cr. 5. S. *Prereq: 505; 583; 541. Coreq: 596; 542.* Continuation of 505. More challenging comprehensive architectural design projects (individual and collaborative) with coordinated studies in design media, history, theory, culture, science and technology. Projects establish a framework for designing buildings as aspects of dynamic circumstances such as environmental forces, construction methods, economic and political regulations, social relationships and cultural values.

Arch 507. Architectural Design and Media III. (0-10) Cr. 5. SS. *Prereq: 506, 596, 542. Coreq: Arch 543.* Design projects that examine the relationship between architectural concepts and the reality of built form. Emphasis is placed on the multi-faceted role of the architectural detail in the design process. Assignments involve the study of contemporary and historic construction documentation, research into architectural materials and the use of representational media appropriate to the scale of the detail. Projects also demand engagement with the cultural and technological issues explored in previous and concurrent courses.

Arch 510. Practical Experience. Cr. R. Repeatable. F.S.SS. *Prereq: Graduate standing and permission of department DOGE.* Students must register for this course prior to commencing each period. Available only to students taking course loads of 8 credits or less.

Arch 519. Middle Eastern Cities. (3-0) Cr. 3. F. *Prereq: Graduate or senior standing.* Middle Eastern cities introduce a particular continuity between history and contemporary life where in some cases the latter is about re-defining the former. Introduction to basic academic writings on Middle Eastern cities in addition to other contemporary cultural productions of the region. Study of various aspects of Middle Eastern life and the built environments that this life produces.

Arch 527. History, Theory, and Criticism of Chinese Architecture. (Dual-listed with 427). (3-0) Cr. 3. F. *Prereq: Senior classification or graduate standing.* The history and theoretical concept of Chinese built environment with emphasis on the morphology of built form and its relationship to art, landscape design, and urban structure. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Arch 528. Topical Studies in Architecture. (Cross-listed with Dsn S). (3-0) Cr. arr. Repeatable. F.S.SS. *Prereq: Arch 221, 222 or senior classification or graduate standing.*
A. Studies in Architecture and Culture
B. Technology
C. Communications
D. Design
E. Practice

Arch 529. Spatial Dialectics in the American Midwest. (3-0) Cr. 3. S. *Prereq: Graduate or senior standing.* The American Midwest has witnessed dramatic transformation during the last two centuries which impacted its physical, environmental, economic and social characteristics. This course is an interdisciplinary study of the evolution and sustainability of Midwestern space in relationship to forces of flow shaped by the mobility of bodies, products, meanings, and symbols that are enforced, incorporated, reproduced or destroyed.

Arch 534. Advanced Computer-aided Architectural Design. (1-4) Cr. 3. Repeatable. F. *Prereq: 434, permission of instructor.* Emphasis on concepts, algorithms, data structures, advanced modeling, rendering, animation, and virtual reality applications in architectural design.

Arch 535. Advanced Three-Dimensional Studio. (0-5) Cr. 2. Repeatable. F.S. *Prereq: 335 or graduate standing.* Advanced investigation of sculptural expression with emphasis on individual projects.

Arch 541. Science and Technology for Architects I. (4-2) Cr. 5. F. *Prereq: Admission to the M.Arch I program. Coreq: 505; 595.* First of a four-course series in building science and technologies. Introduction to Human Factors, Descriptive Geometry, Basic Building Materials, and Small-Scale Building Envelopes. Theory and case studies, stressing the connectivity of technical issues to broader formal, social, and cultural spheres. Course content and assignments coordinated with 505 and 595.

Arch 542. Science and Technology for Architects II. (4-2) Cr. 5. S. *Prereq: 505; 541; 595. Coreq: 506; 596.* Second of a four-course series in building science and technologies. Elementary Statics and Beam Theory, Basic Construction Materials, and Site and Building Circulation. Theory and case studies stressing the connectivity of technical issues to broader formal, social, and cultural spheres. Course content and assignments coordinated with 506 and 596.

Arch 558. Sustainability and Green Architecture. (Cross-listed with Dsn S). (3-0) Cr. 3. F. *Prereq: Graduate standing.* Issues of Sustainability as related to living patterns and city design, population, pollution and use and availability of natural resources for the built environment; Issues of Green Architecture as it relates to building material selection, systems of building materials, the environment of the United States and the World, architects and examples of buildings with green or sustainable designations.

Arch 567. Preservation, Restoration, and Rehabilitation. (Cross-listed with Dsn S). (3-0) Cr. 3. S. *Prereq: Senior classification.* Construction standards and procedures for preserving, restoring, reconstructing, and rehabilitating existing buildings following the guidelines of the National Park Service and the National Trust for Historic Preservation. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Arch 571. Design for All People. (Cross-listed with Dsn S, Geron). (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Principles and procedures of universal design in response to the varying ability level of users. Assessment and analysis of existing buildings and sites with respect to standards and details of accessibility for all people, including visually impaired, mentally impaired, and mobility restricted users. Design is neither a prerequisite nor a required part of the course. Enrollment open to students majoring in related disciplines. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Arch 575. Contemporary Urban Design Theory. (Cross-listed with Dsn S). (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Current urban design theory and its application to urban problems. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Arch 576. Study Abroad Options. (3-0) Cr. 3. Repeatable. SS. Special topics in environmental design, architectural history and contemporary practice. Travel to relevant countries. General cultural and historical studies, topical projects and individual inquiry. Courses may be taught by departmental faculty or faculty from approved Iowa State Study Abroad programs. See current offerings for detailed syllabus.

Arch 581. Service Learning. (1-12) Cr. 5. SS. *Prereq: 506, 596, 542.* Planning and construction of a full-scale project serving a community need. Learning occurs through both theory and active involvement in constructed work. Projects connect previous coursework to practical applications and community involvement.

Arch 582. Professional Practice. (Dual-listed with 482). (3-0) Cr. 3. F. *Prereq: Graduate standing.* Emphasis on the circumstances and opportunities of the professional practice of architecture: practice as profession, process, organization, business, and evolving models of practice.

Arch 583. Research in Practice. (3-0) Cr. 3. S. *Prereq: Senior or graduate standing.* Foundational course in the methods and conceptual tools of design research in the context of practice. Through team and individual guided projects, students generate, analyze and represent knowledge in design-related communications and contexts. Alternative models of practice, client groups and communities are addressed within projects that precede, feed, follow, or overlap with architectural contracts.

Arch 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on approved form.* Investigation of architectural issues having a specialized nature.

Arch 595. Seminar on the Built Environment I: History. (5-0) Cr. 5. F. *Prereq: Admission to the MArch I program. Coreq: 505; 541.* Introduction to architectural history and its role in shaping the contemporary practice of architecture. Students learn skills in critical thinking, visual analysis, and research methods. Course sessions develop thematically with interdisciplinary readings, group discussions, student presentations, and research projects. Course content and assignments coordinated with 505 and 541.

Arch 596. Seminar on the Built Environment II: Landscape and Society. (5-0) Cr. 5. S. *Prereq: 505; 541; 595. Coreq: 506; 542.* Introduction to landscape as artifact and multi-disciplinary knowledge-base for design thinking. Literatures and methods of environmental psychology, cultural geography, landscape and architectural history and theory, site and circulation design as intersection of built infrastructural, natural, and social systems. Emphasis on sensory perception, and human movement; investigations of climate, environmental conditions, and values toward consumption and sustainability in everyday experience of the built environment. Course content and assignments coordinated with 506 and 542.

Arch 597. Seminar on the Built Environment III: Theory. (3-0) Cr. 3. F. *Prereq: Senior classification or graduate standing.* Multidisciplinary overview of contemporary theories concerned with the production of the built environment. Particular attention to urbanism as a discourse that relates social interactions and power structures to material space. Coursework includes readings, seminar discussion and a research paper.

Arch 598. Seminar in the Built Environment IV: Topical Study. (3-0) Cr. 3. S. *Prereq: senior or graduate standing.* A research seminar that takes an in-depth look at a topic within contemporary discourses on architecture and urbanism. The topic will be considered from multiple points of view including its historical, theoretical, behavioral and cultural aspects.

Courses for graduate students

Arch 601. Architecture and Landscape Design. (0-12) Cr. 6. F. *Prereq: 507; 542; 596. Coreq: 643.* Design projects that explore the relationships among architecture, cultural landscapes, and biological issues. Emphasis on regional sites and Socio-economic conditions. Projects stress engagement with local circumstances and stakeholders, and the application of interdisciplinary research, new materials and systems. Course content and assignments coordinated with 643.

Arch 602. Design Studio Options. (0-12) Cr. 6. Repeatable. S. *Prereq: 601.* Design studio electives include, but are not limited to: independent and interdisciplinary projects, study abroad, and design-build. Dsn S 446/546, for 6 cr. each time taken, can be substituted for this class and be taken up to a maximum of 12 credits.

Arch 603. Comprehensive Design. (0-12) Cr. 6. F. *Prereq: 601.* Rigorous examination of architecture's relationship with culture and technology. Studio projects stress the interpretation of contextual and historical considerations, as well as structural, environmental, mechanical, electrical and plumbing systems, in a comprehensive design proposal. This course fulfills the Graduate College Creative Component Requirement.

Arch 643. Science and Technology for Architects III. (2-2) Cr. 3. F. *Prereq: 507, 542, 596, 581 or graduate standing. Coreq: 601.* Third in a four-course series in building science and technologies. Structural Elements and Systems, and Building Services. Theory and case studies stressing the connectivity of technical issues to broader formal, social and cultural spheres. Course content and assignments coordinated with 601.

Arch 644. Science and Technology for Architects IV. (2-2) Cr. 3. S. *Prereq: 643 or graduate standing.* Fourth of a four-course series in building science and technologies. Building Enclosures, Interior Construction and Sensory Qualities, Fabrication and Construction. Theory and case studies stressing the connectivity of technical issues to broader formal, social and cultural spheres. Summative Student Project.

Arch 690. Independent Design Study. (1-15) Cr. 6. Repeatable. F.S.SS. *Prereq: Admission to MSAS or M Arch 30 credit program.* Independent architectural design projects commensurate with student interests requiring approval of Architecture Graduate Advisory Committee.

Arch 698. Graduate Seminar. Cr. R. Repeatable. F.S. *Prereq: Graduate standing.* Special topics and guest speakers.

Arch 699. Research. (1-18) Cr. arr. Repeatable. F.S.SS.

Art and Design

Roger Baer, Chair of Department

Distinguished Professors (Emeritus): Heggen, Miller

Professors: Baer, Herrnstadt, Lilligren

Professors (Emeritus): Allen, Bro, Dake, Evans, Fowles, Held, Pickett, Singer, Smith, Sontag, Stieglitz, Tartakov

Associate Professors: Akkurt, Caldwell, Chidister, Croyle, Cunnally, Curran, Fontaine, Gibbs, Gould, Jones, Kang, Katz, Malven, Martin, Mickelson, Muench, Paschke, Richards, Satterfield, Stout, Walton, Warme

Associate Professors (Emeritus): Bruene, Lehner, Mcilrath, Polster, Sage, Sreenivasam

Associate Professors (Adjunct): Demartino, Pohlman

Associate Professor (Collaborator): Sandor

Assistant Professors: Brunner, Bruski, Call, Campbell, Eisman, Faber, Godbey, Golec, Holland, Iasevoli, Sobiech-Munson, Song

Assistant Professor (Collaborator): Schneider

Senior Lecturers: Boehmer, Harris, Mikovec, Pappenheimer, Ure

Lecturers: Biechler, Morgan

Undergraduate Study

The department offers the degree Bachelor of Fine Arts (B.F.A.) in three curricular areas: Graphic Design, Integrated Studio Arts, and Interior Design. The department also offers the degree Bachelor of Arts (B.A.) in Art and Design. Each of these curricula affords excellent preparation for a variety of career opportunities or as a foundation for graduate study.

B.F.A. Graphic Design. Emphasis is on creative problem solving, design process, and the visual organization of communication media. Graphic design graduates effectively integrate abstract thinking skills; communication design theory, history, and methodology; and technology. Components of visual communication including typography, symbology, and image creation are integrated with an understanding of professional practice.

B.F.A. Integrated Studio Arts. Students select from a variety of studio options in order to build a portfolio and prepare for a professional practice in the visual arts. This concentration emphasizes aesthetics, visual problem solving, critical thinking, and skill development in a variety of media employing contemporary, historical, and cultural theory and practices.

B.F.A. Interior Design. Emphasis is on the student's application of design processes to creatively solve problems of the interior environment based on knowledge of human Safety, functional utility, physical, psychological, and contextual fit. Graduates in interior design are competent in visual communication (sketching, drafting and computer aided design), design problem solving, space planning, lighting and color specification for interiors, finish and furniture selection, detailing interior construction and application of human factors. The curriculum is accredited by the Foundation for Interior Design Education Research (FIDER) as providing professional level education.

Students entering the Graphic Design, Interior Design, or Integrated Studio Arts programs involving computeraided design or animation are strongly encouraged to purchase or lease of a laptop/notebook computer and appropriate software. Contact the department or see the College of Design web site for hardware and software specification.

B.A. Art and Design. This curriculum offers two concentrations: Art and Culture, and Visual Cultural

Culture Studies. Art and Culture has a greater emphasis on studio components, and Visual Culture Studies on humanities and liberal arts components.

Both concentrations are combined with an applied career minor or approved program.

Transfer students with studio credits from other colleges and universities must present a portfolio of work done in those courses to determine if these credits can be applied toward specific studio requirements. Students are required to present this portfolio upon admission and prior to registration for classes. Arrangements for this process must be made with department advisers.

The department offers no minor but participates in the undergraduate minor in design studies.

Graduate Study

The department offers the degrees of Master of Fine Arts (M.F.A.) in Graphic Design, Integrated Visual Arts, and Interior Design, and Master of Arts (M.A.) in Art and Design, with degree specialization in interior design, graphic design, and environmental graphic design. Graduates have a broad understanding of visual communication, problem solving, and interdisciplinary studies.

The M.F.A. curricula in Graphic Design and Interior Design require a minimum of 60 credits. The M.F.A curriculum in Integrated Visual Arts requires a minimum of 61. These programs include an art and design seminar, a studio concentration, history and criticism courses, a teaching seminar, elective courses outside the department or area of study, and the completion of a thesis-exhibition or thesis.

M.F.A. graduates in Graphic Design are skilled in communication design, problem solving, and are adept in the use of visual language and symbology. Graduates are proficient in the design of communications and the use of technologies that incorporate human interaction with environments, objects, and electronic and traditional publications. The M.F.A. is recognized as the terminal degree in the graphic design field. The degree requires completion of a written thesis integrating theory, research, and design problem solving.

M.F.A graduates in Interior Design are proficient in visual communication skills, design theory, human factors, and space planning. The M.F.A. degree is considered a terminal degree in the interior design field. The degree requires completion of a written thesis comprised of original research.

M.F.A. graduates in Integrated Visual Arts have skills that link traditional studio disciplines with emerging technologies. Graduates are prepared as visual artists to enter studio research, business, higher education or new interdisciplinary fields. The MFA is recognized as the terminal degree. A required thesis-exhibition is composed of two parts, a substantial exhibition and a written statement that describes the development of the work in the exhibition, its objectives, and its historical and cultural points of reference. A thesis may be an appropriate alternative, but some portion of the work should entail an element of design problem-solving in the form of a visual product.

The M.A. in Art and Design with specialization in interior design requires a minimum of 34 credits including a studio concentration and work in research methods and human factors. Candidates focus on research in an area of specialization culminating in a written thesis comprised of original research. Graduates have a broad understanding of current interior design issues and design research, preparing them for special analytical aspects of design practice and further studies leading to the PhD. Applicants without a degree in interior design may be required to complete up to 40 additional credits of course work.

The M.A. in Art and Design with a specialization in graphic design requires a minimum of 30 credits including seminar courses in art and design, a studio concentration, a history course, a business practice course, courses outside of graphic design, and the completion of a capstone course in graphic design. Graduate students selecting the M.A. in graphic design will focus on a first professional degree. Applicants without a degree in graphic design may be required to complete up to 17 additional credits of coursework.

The M.A. in Art and Design with a specialization in environmental graphic design requires a minimum of 34 credits including a seminar course in art and

design, a studio concentration, a history courses, courses in design methods, and the completion of a capstone course in environmental graphic design.

Graduate students selecting the M.A. in environmental graphic design will focus on a first professional degree. Applicants without a degree in background in environmental graphic design may be required to complete up to 15 additional credits of coursework.

Credit earned at Iowa State University or other institution for the Master of Arts degree may be applied toward the master of fine arts degree at the discretion of the program of study committee.

Applicants to the graduate program should have an undergraduate major in an art or design area and demonstrate the ability to do technically competent and original work through the presentation of a slide or digital portfolio for faculty review. Past academic performance and the quality of studio work are critical in the admission process. A minimum 3.0 GPA in the student's undergraduate major is the standard for full admission to the graduate program. Admission is also determined by studio space available within the program area, which changes yearly due to graduate students' progress in their programs of study.

Graduate students who have not completed an undergraduate program of study substantially equivalent to that required of undergraduates in the department can expect that additional supporting coursework, determined by the graduate faculty, will be required.

Prospective students are advised to contact the graduate coordinator with specific questions about admission procedures and portfolio review. Application and additional program information may be obtained from the Department of Art and Design, College of Design, Iowa State University, Ames, Iowa 50011-3092.

Art (Art)

Courses primarily for undergraduate students

Art 108. Visual Foundations I. (0-6) Cr. 3. F.S.SS. Exploring visual order, creative process, and interaction of two- and three-dimensional design. Introduction to color.

Art 109. Visual Foundations II. (0-6) Cr. 3. F.S.SS. *Prereq: 108.* Continued exploration of visual order, creative process, and interaction of two- and three-dimensional design and color.

Art 110. Orientation to Artand Design. Cr. R. F.S. Overview of the department and university with special emphasis on curricula, program planning, and study skills. Advising, policy and procedures, student services.

Art 130. Drawing I. (1-6) Cr. 3. F.S.SS. The introductory course in drawing, focusing on the fundamentals of drawing from observation. Subject matter may include working from the still life, architectural settings, landscape and the human figure. Line, shape, perspective and value studies are explored through a variety of drawing media.

Art 230. Drawing II. (0-6) Cr. 3. F.S. *Prereq: Art 108 or Dsn S 102, 183, and 131.* A continuation of Dsn S 131 (Design Representation). Further development of perceptual drawing skills from a variety of subject matter. Continued practice with drawing materials and techniques with emphasis on tonal and color media.

Art 292. Introduction to Visual Culture Studies. (Cross-listed with Dsn S). (3-0) Cr. 3. F.S. *Prereq: Open to all majors.* An introduction to various topics in visual culture studies. The lecture course will provide students with a creative and intellectual context in which to study historical and contemporary instances of the visual in culture. Individual lectures examine significant trends in the visual arts, mass media, scientific imagery, visual communications, and other areas related to visual literacy and visual representation in local and global contexts. Cross cultural viewpoints and issues of diversity will be presented in relation to visual culture and related fields.

Art 494. Art and Design in Europe Seminar. (1-0) Cr. 1. *Prereq: Permission of instructor and planned enrollment in 495.* Cultural and historical aspects of art and design in Western Europe in preparation for study abroad. Area of study varies each time offered. Satisfactory-fail only.
A. Fine Arts
G. Graphic Design
I. Interior Design
N. Art History

Art 495. Art and Design in Europe. (Dual-listed with 595). Cr. 3. F.S.SS. *Prereq: 494, permission of instructor.* International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities. Related activities depending on specific area of study which may vary each time offered. Travel and tour expenses to be paid by the student.
A. Fine Arts
G. Graphic Design
I. Interior Design
N. Art History

Art 496. Art and Design Field Study. Cr. R. Repeatable. *Prereq: Enrollment in an art and design studio or art history course, permission of instructor.* Study and tours of museums, galleries, artist and/or designer studios and other areas of interest within art and design. Satisfactory-fail only.

Art 497. Studio Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Advanced classification in a department curriculum.* Written approval of supervising instructor and department chair on required form in advance of semester of enrollment. Supervised experience with a cooperating artist or studio. Satisfactory-fail only.

Art 498. Museum/Gallery Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Advanced classification in a department curriculum.* Written approval of supervising instructor on required form in advance of semester of enrollment. Supervised experience with a cooperating museum or gallery or art center. Satisfactory-fail only.

Art 501. Issues in Visual and Material Culture Seminar. (3-0) Cr. 3. *Prereq: Permission of instructor.* Issues and debates that pertain to the study of visual objects and material artifacts in their cultural context. Examination of the role of visual and material culture studies as both relate to allied disciplines including, but not limited to: anthropology, art history, design history, design studies, and new media studies.

Art 511. Seminar in Teaching. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Readings and discussion of university level design education issues, studio/classroom observation, development of a teaching Philosophy, lesson planning and presentation.

Art 595. Art and Design in Europe. (Dual-listed with 495). Cr. 3. *Prereq: Graduate classification, 494 or equivalent, permission of instructor.* International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities. Related activities depending on specific area of study which may vary each time offered. Tour and travel expenses to be paid by the student.
A. Fine Arts
G. Graphic Design
I. Interior Design
N. Art History

Art 598. Museum/Gallery Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification and permission of instructor.* Written approval in advance of semester of enrollment. Supervised experience with a cooperating museum or gallery or art center. Satisfactory-fail only.

Courses for graduate students

Art 605. Research Methods. (3-0) Cr. 3. *Prereq: Permission of instructor.* Research strategies related to fine art and technology. Application of selected methods to specific issues.

Art 697. Studio Internship. Cr. arr. F.S.SS. *Prereq: Graduate classification and approval of POS committee.* Supervised off-campus learning experience with a prominent artist, designer, or firm.

Art 699. Research. Cr. arr. Repeatable.
A. Thesis
B. Thesis-exhibition museum or gallery or art center.
Satisfactory-fail only.

Art Education (ArtEd)

Courses primarily for undergraduate students

ArtEd 211. Introduction to Art Education. (0-6) Cr. 3. F.S. Design experiences for the K-12 classroom. Hands-on discipline-specific and integrated art activities; emphasis on creativity and thinking skills.

Graphic Design (ArtGr)

Courses primarily for undergraduate students

ArtGr 270. Graphic Design Studio I. (0-6) Cr. 3. F. *Prereq: Dsn S 102 and Dsn S 131, enrollment in 275; admission to the graphic design program through department review.* Basic design concepts and color principles used for visual communication.

ArtGr 271. Graphic Design Studio II. (0-6) Cr. 3. S. *Prereq: Art 230, ArtGr 270, 275, enrollment in 276.* Principles of typographic composition, structure and hierarchy. Formal and conceptual principles of symbology.

ArtGr 275. GraphicTechnology I. (0-4) Cr. 2. F. *Prereq: enrollment in 270.* Basic computer skills for graphic design.

ArtGr 276. GraphicTechnology II. (1-2) Cr. 2. S. *Prereq: 275, enrollment in 271.* Color management, color theory and applications skills for graphic design.

ArtGr 291. Theories and Principles of Graphic Design. (1-0) Cr. 1. F. *Prereq: Enrollment in 270.* Historical, cultural, and social issues related to the practice of visual communication.

ArtGr 370. Graphic Design Studio III. (0-6) Cr. 3. F. *Prereq: 271, 276, enrollment in a 2-credit option; credit or enrollment in 387.* Creation and design of images and symbols for communication. Application and integration of typography with images and symbols.

ArtGr 371. Graphic Design Studio IV. (0-6) Cr. 3. S. *Prereq: 370, 387, enrollment in a 2-credit option.* Development and preparation of design concepts for application to the printing and electronic publishing process. Creative problem-solving skills, introduction to systems design.

ArtGr 372. Graphic Design Materials and Processes. (2-0) Cr. 2. S. *Prereq: Credit or enrollment in 371.* Lecture about the processes and materials involved in graphic design arts reproduction. Course covers prepress, paper selection and specification, ink systems, type systems and fonts, output technology, printing presses and bindery operations.

ArtGr 377. Graphic Design Internship Seminar. (1-0) Cr. 1. F. *Prereq: Credit or enrollment in 370 or 371.* Procedural and ethical concerns related to the graphic design internship. Personal goals, preparation of resume and plans for internship. Study and tours of areas of interest within the graphic design profession.

ArtGr 378. Critical Issues in Graphic Design. (2-0) Cr. 2. *Prereq: Credit or enrollment in 370.* Lecture, discussion and writing about the critical issues facing the communications field today and in the future.

ArtGr 387. Graphic Design History/Theory/ Criticism I. (Dual-listed with 587). (3-0) Cr. 3. F. *Prereq: Art H 280, 281, Dsn S 183.* Late nineteenth century to the 1990s. This course will explore the cultural, social,

political, industrial, and technological forces that have influenced the practice of graphic design in Britain, Europe, and the United States. Students will study the historical issues and problems facing designers, their clients, and their publics. Nonmajor graduate credit.

ArtGr 388. Graphic Design History/Theory/ Criticism II. (Dual-listed with 588). (3-0) Cr. 3. S. *Prereq: Art H 281, Dsn S 183, or ArtGr 387.* Critical issues that affect the contemporary practice of graphic design as it relates to the United States. Students will study a variety of issues that include, but are not exclusive to, new media, gender, class, design and the public sphere, design as social action, postmodern design theory, sustainability, and ethical practice. Nonmajor graduate credit.

ArtGr 391. Graphic Design Field Study. (0-1) Cr. 1. Repeatable. *Prereq: Enrollment in 300 or 400 level graphic design studio course.* Travel, study, and tours of areas of interest within the graphic design profession such as print production companies, design studios, and museums. Satisfactory-fail only.

ArtGr 470. Graphic Design Studio V. (0-6) Cr. 3. F. *Prereq: 371, enrollment in a 2-credit option.* Advanced design systems as applied to corporate identity and environmental graphic design. Symbology as an integrated component of communication systems.

ArtGr 472. Photographic Art Direction. (Dual-listed with 572). (0-6) Cr. 3. *Prereq: 471, 482, enrollment in 370 or 371, or 470 or 471.* Photography as a graphic design component. Compositional and conceptual elements in photographic images. Must have a camera with adjustable shutter speeds and lens openings.

ArtGr 473. Time Based Multi-Media. (Dual-listed with 573). (0-6) Cr. 3. *Prereq: Enrollment in 370 or 371, or 470 or 482.* The design of visual, aural and written communication for electronic media.

ArtGr 474. Exhibition Design. (Dual-listed with 574). (0-6) Cr. 3. F.S. *Prereq: Enrollment in 370 or 371 or 470 or 482.* Visual communication applied to exhibition design focusing on educational or interactive museum exhibitions, trade show booth design, and modular unit design for traveling exhibitions. Translation of graphic information to a three-dimensional space.

ArtGr 475. Advanced Typography. (Dual-listed with 575). (0-6) Cr. 3. F.S. *Prereq: Enrollment in 370 or 371 or 470 or 482.* Typographic theory exploring traditional and non-traditional forms, both historical and contemporary typographic achievements.

ArtGr 476. Graphic Design Methodology. (Dual-listed with 576). (0-6) Cr. 3. F.S. *Prereq: Enrollment in 370 or 371 or 470 or 482.* Analysis and application of scientific, systematic, and non-traditional problem-solving and problem-seeking techniques.

ArtGr 477. Graphic Design Practicum. (0-6) Cr. 3. F.S. *Prereq: Enrollment in 370 or 371 or 470 or 482, portfolio review and permission of instructor.* Graphic design outreach and problem solving. Individual and group projects for non-profit clients selected by the instructor.

ArtGr 478. Web Design for E-Commerce/Graphic Applications. (Dual-listed with 578). (0-6) Cr. 3. S. *Prereq: Enrollment in 370 or 371 or 470 or 482.* The development of advanced and experimental web design for the applications of e-commerce, education and the communication of visual information.

ArtGr 479. Wayfinding Design. (Dual-listed with 579). (0-6) Cr. 3. *Prereq: Enrollment in 370 or 371 or 470 or 482.* Study of the navigational challenges of built environments and outdoor spaces, including site analysis, development of navigational plans, and design of wayfinding sign systems. Issues of function, accessibility, legibility, and fabrication are considered.

ArtGr 480. Graphic Design Internship. (3-0) Cr. 3. SS. *Prereq: 377, 12 credits in graphic design; permission of instructor, registration in advance of enrollment.* Graphic design experience in an off-campus professional environment.

ArtGr 481. Graphic Design Professional Practices. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 470.* Professional design management: ethics, setting up a new business, client/designer relationships, contractual options, billing practices, and effective operating procedures.

ArtGr 482. Professional Presentation. (0-6) Cr. 3. S. *Prereq: 470, enrollment in a 2-credit option.* Exploration and development of the graphic design portfolio and resume in electronic, print, and photographic form.

ArtGr 484. Selected Studies in Graphic Design. (Dual-listed with 584). Cr. arr. Repeatable. *Prereq: Permission of instructor.* Special issues related to graphic design. Topics vary each time offered.

ArtGr 490. Independent Study. Cr. arr. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed related graphic design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.
A. Theory, Criticism, and Methodology
B. Two-Dimensional Design
C. Three-Dimensional Design
H. Honors
I. Internship/Cooperative (in-depth experience other than ArtGr 480)

ArtGr 491. Publication Design: Magazines. (Dual-listed with 591). (0-6) Cr. 3. F. *Prereq: Credit or enrollment in 370.* The Philosophy, concepts and structures of magazine design.

ArtGr 492. Publication Design: Books. (Dual-listed with 592). (0-6) Cr. 3. S. *Prereq: Credit or enrollment in 370 or 371.* The Philosophy, concepts and structures of book design.

ArtGr 493. Workshop. Cr. arr. Repeatable. *Prereq: Evidence of satisfactory experience in area of specialization.* Intensive 2 to 4 week studio exploration. Topics vary each time offered.

Courses primarily for graduate students, open to qualified undergraduate students

ArtGr 570. Advanced Studies in Visual Communication. (0-6) Cr. 3. F. *Prereq: Graduate classification in College of Design.* Theory and investigation of systems, structures, principles of visual organization, and typography for communication. Studio problems will be influenced by social, cultural, environmental, or technological factors.

ArtGr 571. Signs, Symbols, Images. (0-6) Cr. 3. S. *Prereq: Graduate Classification in College of Design.* Investigation and application of signs, symbols and semiotic theory for communication. Studio problems influenced by social, cultural, environmental, or technological factors.

ArtGr 572. Photographic Art Direction. (Dual-listed with 472). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* Photography as a graphic design component. Compositional and conceptual elements in photographic images. Must have a camera with adjustable shutter speeds and lens openings.

ArtGr 573. Time Based Multi-Media. (Dual-listed with 473). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* The design of visual, aural and written communication for electronic media.

ArtGr 574. Exhibition Design. (Dual-listed with 474). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* Visual communication applied to exhibition design focusing on educational or interactive museum exhibitions, trade show booth design, and modular unit design for traveling exhibitions. Translation of graphic information to a three-dimensional space.

ArtGr 575. Advanced Typography. (Dual-listed with 475). (0-6) Cr. 3. *Prereq: Graduate classification in College of Design.* Typographic theory exploring traditional and non-traditional forms.

ArtGr 576. Graphic Design Methodology. (Dual-listed with 476). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* Analysis and application of scientific, systematic, and non-traditional problem-solving and problem-seeking techniques.

ArtGr 578. Design for E-Commerce/Graphic Applications. (Dual-listed with 478). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* The development of advanced and experimental web design for the applications of e-commerce, education and the communication of visual information.

ArtGr 579. Wayfinding Design. (Dual-listed with 479). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design.* Study of the navigational challenges of built environments and outdoor spaces, including site analysis, development of navigational plans, and design of wayfinding sign systems. Issues of function, accessibility, legibility, and fabrication are considered.

ArtGr 584. Selected Studies in Graphic Design. (Dual-listed with 484). Cr. arr. Repeatable. *Prereq: Graduate classification in the College of Design.* Special issues related to graphic design. Topics vary each time offered.

ArtGr 587. Graphic Design History/Theory/ Criticism I. (Dual-listed with 387). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Late nineteenth century to the 1990's, this course will explore the cultural social, political, industrial, and technological forces that have influenced the practice of graphic design in Britain, Europe, and the United States. Students will study the historical issues and problems facing designers, their clients, and their publics.

ArtGr 588. Graphic Design History/Theory/ Criticism II. (Dual-listed with 388). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Critical issues that affect the contemporary practice of graphic design as it relates to the United States. Students will study a variety of issues that include, but are not exclusive to, new media, gender, class, design and the public sphere, design as social action, postmodern design theory, sustainability, and ethical practice.

ArtGr 590. Special Topics. Cr. arr. *Prereq: Bachelor's degree in graphic design, or evidence of satisfactory equivalency in specialized area.* Written approval of instructor and department chair on required form in advance of semester of enrollment.
A. Theory, Criticism, and Methodology
B. Two-Dimensional Design
C. Three-Dimensional Design

ArtGr 591. Publication Design: Magazines. (Dual-listed with 491). (0-6) Cr. 3. F. *Prereq: Graduate enrollment in College of Design.* The Philosophy, concepts and structures of magazine design.

ArtGr 592. Publication Design: Books. (Dual-listed with 492). (0-6) Cr. 3. S. *Prereq: Graduate enrollment in College of Design.* The Philosophy, concepts and structures of book design.

ArtGr 593. Workshop. Cr. arr. Repeatable. *Prereq: Graduate classification; evidence of satisfactory experience in area of specialization.* Intensive 2 to 4 week studio exploration. Topics vary each time offered.

ArtGr 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

ArtGr 672. Graphic Design and Human Interaction. (0-6) Cr. 3. F.S. *Prereq: 570, 571, and graduate enrollment in College of Design or permission of instructor.* The theory and investigation of experience design as it applies to human interactions in contemporary society and culture. Studio problems may involve such areas as: exhibition design, electronic interface design, wayfinding, package design, and publication design.
A) Usability. The exploration and design of interface/interaction with products, systems, and technologies
B) Design for Behavioral Change. The exploration and design of educational experiences and artifacts as they relate to the social, emotional, and behavioral aspects of society.
C) Consumer Experience Design and Branding. The exploration and design of identity systems and consumer brand experiences..

ArtGr 690. Advanced Topics. Cr. arr. Repeatable.

ArtGr 698. Current Issues in Graphic Design. Cr. arr. Repeatable. *Prereq: Graduate enrollment in College of Design or permission of instructor.* Selected issues in contemporary graphic design. Topics and readings vary each time offered.

ArtGr 699. Research-Thesis. Cr. arr. Repeatable.

Art History (Art H)

Courses primarily for undergraduate students

Art H 181. Origins and Evolution of Modern Design. (Cross-listed with Dsn S). (3-0) Cr. 3. F.S. History of designed artifacts, their creators, and their cultural environments in Western Europe and America from the beginning of the Industrial Revolution to the present.

Art H 280. History of Art I. (Cross-listed with Dsn S). (3-0) Cr. 3. F. Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts; from prehistoric through Gothic. H. Honors. Cr. 4.

Art H 281. History of Art II. (Cross-listed with Dsn S). (3-0) Cr. 3. S. Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts; from the Renaissance to the twentieth century.
H. Honors. Cr. 4

Art H 378. Popes and Caesars: 2000 Years of Art History in Rome. (3-0) Cr. 3. SS. *Prereq: Permission of instructor.* Survey of Italian art and architecture from the Etruscans to Bernini, including lectures and tours of museums and historical sites. Study abroad course taught in Rome, with travel to other Italian cities. Tour and travel expenses to be paid by student.

Art H 382. Art and Architecture of Asia. (Dual-listed with 582). (Cross-listed with Dsn S). (3-0) Cr. 3. Introduction to the history of art and architecture in China, Korea, and Japan before the modern era. Visual materials selected based on important themes that are critical in understanding Asian culture and art tradition. Museum field trip expenses to be paid by students. Nonmajor graduate credit.

Art H 383. Greek and Roman Art. (Dual-listed with 583). (Cross-listed with Dsn S, Cl St). (3-0) Cr. 3. Greek art from Neolithic and Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West. Nonmajor graduate credit.

Art H 384. Art of Islam. (3-0) Cr. 3. Historical survey of the painting, sculpture, crafts, and architecture of the various civilizations of the Islamic world.

Art H 385. Renaissance Art. (Dual-listed with 585). (Cross-listed with Dsn S). (3-0) Cr. 3. European art including painting, sculpture, architecture, and crafts; thirteenth through sixteenth centuries. Nonmajor graduate credit.

Art H 394. Women/Gender in Art. (Dual-listed with 594). (Cross-listed with Dsn S). (3-0) Cr. 3. Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture. Nonmajor graduate credit.

Art H 481. Art and Architecture of India. (Dual-listed with 581). (Cross-listed with Dsn S). (3-0) Cr. 3. Survey of Indian-style art and architecture through history. Examine how art and architecture developed in the Indian world has come to define the Indian identity religiously, culturally, socially, and politically. Nonmajor graduate credit.

Art H 487. Nineteenth Century Art. (Dual-listed with 587). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. European and American art and architecture from 1780 to 1900 focusing on the major movements of western Europe: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism. Nonmajor graduate credit.

Art H 488. Modern and Contemporary Art and Theory I. (Dual-listed with 588). (Cross-listed with Dsn S). (3-0) Cr. 3. F. Visual arts and critical theory from Impressionism to Abstract Expressionism Nonmajor graduate credit.

Art H 489. Sequential Art. (Dual-listed with 589). (Cross-listed with Dsn S). Cr. 3. An art-historical survey of comic strips, comic books, and graphic novels from their origins in the 19th century to present. Nonmajor graduate credit.

Art H 490. Independent Study. Cr. arr. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed Art History coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.
H. Honors

Art H 495. Modern and Contemporary Art and Theory II. (Dual-listed with 595). (Cross-listed with Dsn S). (3-0) Cr. 3. Visual arts and critical theory from Abstract Expressionism to the present. Nonmajor graduate credit.

Art H 496. History of Photography. (Dual-listed with 596). (Cross-listed with Dsn S). (3-0) Cr. 3. Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an Art Historical perspective, emphasizing causative factors, cultural influences, and major masters and schools. Nonmajor graduate credit.

Art H 498. Selected Topics in Art History. (Dual-listed with 598). (Cross-listed with Dsn S). (3-0) Cr. 3. Repeatable. Specialized study in the history or criticism of art and design. Course primarily for graduate students open to qualified undergraduate students.

Courses primarily for graduate students, open to qualified undergraduate students

Art H 581. Art and Architecture of India. (Dual-listed with 481). (Cross-listed with Dsn S). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Survey of Indian-style art and architecture through history. Examine how art and architecture developed in the Indian world has come to define the Indian identity religiously, culturally, socially, and politically.

Art H 582. Art and Architecture of Asia. (Dual-listed with 382). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Introduction to the history of art and architecture in China, Korea, and Japan before the modern era. Visual materials selected based on important themes that are critical in understanding Asian culture and art tradition. Museum field trip expenses to be paid by students.

Art H 583. Greek and Roman Art. (Dual-listed with 383). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Greek art from Neolithic and Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West.

Art H 585. Renaissance Art. (Dual-listed with 385). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* European art including painting, sculpture, architecture, and crafts; thirteenth through sixteenth centuries.

Art H 587. Nineteenth Century Art. (Dual-listed with 487). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* European and American art and architecture from 1780 to 1900, focusing on the major movements of western Europe: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism.

Art H 588. Modern and Contemporary Art and Theory I. (Dual-listed with 488). (Cross-listed with Dsn S). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Visual arts and critical theory from Impressionism to Abstract Expressionism.

Art H 589. Sequential Art. (Dual-listed with 489). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* An Art History survey of comic strips, comic books, and graphic novels from their origins in the 19th century to the present.

Art H 590. Special Topics. Cr. arr. *Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area.* Written approval of instructor and department chair on required form in advance of semester of enrollment.

Art H 594. Women/Gender in Art. (Dual-listed with 394). (Cross-listed with Dsn S, W S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture.

Art H 595. Modern and Contemporary Art and Theory II. (Dual-listed with 495). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Visual arts and critical theory from Abstract Expressionism to the present.

Art H 596. History of Photography. (Dual-listed with 496). (Cross-listed with Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an Art Historical perspective, emphasizing causative factors, cultural influences, and major masters and schools.

Art H 598. Selected Topics in Art History. (Dual-listed with 498). (Cross-listed with Dsn S). (3-0) Cr. 3. Repeatable. *Prereq: Graduate classification, permission of instructor.* Specialized study in the history or criticism of art and/or design.

Interior Design (ArtID)

Courses primarily for undergraduate students

ArtID 250. Fundamentals of Interior Design. (2-0) Cr. 2. F. The profession, issues, and the role of interior design.

ArtID 251. Human Factors in Interior Design. (2-0) Cr. 2. S. Overview of issues related to health and safety, ergonomics, Anthropometrics, perception, psycho-behavioral response, physiology, physical ability and universal design. Emphasis on application of human factors to analysis and solution of interior design problems.

ArtID 255. Forces That Shape Interior Space. (3-0) Cr. 3. F. *Prereq: Open to non-majors.* A survey of variables influencing the form and function of interior environments. Review of professional, geo-political, utilitarian, social-cultural, economic, humanistic, historical, technological, and other factors as generators of form.

ArtID 259. Sophomore Field Study. Cr. R. *Prereq: Enrollment in interior design studio course.* Study and tours of areas of interest within the interior design profession such as manufacturers, design studios, showrooms and museums. Satisfactory-fail only.

ArtID 261. Graphic Communication for Interior Design I. (0-4) Cr. 2. F. *Prereq: Admission to the interior design program through program review and enrollment in 265.* Proficiency in the development of technical conventions, and design drawing with drafting instruments. Emphasis on drawing layout, line quality, and lettering. Site and structure measurements, dimensioning, single and multi-view drawings, sections and axonometrics.

ArtID 262. Graphic Communication for Interior Design II. (0-4) Cr. 2. F. *Prereq: Admission to the interior design program through program review and enrollment in 265.* Perspective drawing, design sketching, presentation drawings, shades, shadows, and reflections. Use of various rendering media and techniques.

ArtID 263. Graphic Communication for Interior Design III. (0-4) Cr. 2. S. *Prereq: 261, enrollment in 267.* Computer visualization techniques and applications; projects employing computer graphic methods.

ArtID 265. Interior Design Studio I. (1-6) Cr. 4. F. *Prereq: Credit or enrollment in 250, 261, 262, and 350; admission to the interior design program through program review.* Enhanced creative interior design problem solving. Emphasis on research, spatial composition theories and graphic ideation and communication as applied to the interior design of small scale environments. Modeling and manual visualization techniques.

ArtID 267. Interior Design Studio II. (1-6) Cr. 4. S. *Prereq: 250, 261, 262, 265, 350, enrollment in 251, 259, and 351.* Human factors issues including ergonomics, human behavior and the requirements of special groups. Color theories related to interior spaces. Residential interior design and medium scale projects. Detail drawings, and expansion of visualization techniques.

ArtID 350. Interior Materials Systems and Details I. (2-2) Cr. 3. F. *Prereq: Admission to the interior design program through program review.* Exploration of concepts, materials, and assemblies associated with development of planar interior elements including floors, walls, ceiling, windows, and finishes. Fiber, plastic, sheet metal, and other materials. Emphasis on human factors, testing, codes, detailing, specifications, and other issues related to design and end use.

ArtID 351. Interior Materials Systems and Details II. (2-2) Cr. 3. S. *Prereq: 265, 350 and enrollment in 267.* Exploration of concepts, materials, and assemblies associated with development of furnishings, furniture-scale interior elements. Discussion of materials and fabrication, focusing on wood and metal. Emphasis on human factors, testing, codes, detailing, specifications and other issues related to design and end use.

ArtID 352. Interior Materials Systems and Details III. (2-2) Cr. 3. S. *Prereq: 267, 351 and enrollment in 367.* Exploration of concepts, materials, and components associated with the use of light as an element in interior spaces. Lighting principles, and techniques. Emphasis on human factors, testing, codes, detailing, specifications, and other issues related to design and end use. Teamwork.

ArtID 353. Interior Materials Systems and Details IV. (2-2) Cr. 3. F. *Prereq: 351 and enrollment in 365.* Exploration of concepts, materials, and assemblies associated with development of building construction. Discussion of common building materials and methods. Overview of electrical, mechanical, acoustical, and other building systems. Emphasis on human factors, codes, detailing, and other interior design issues related to buildings.

ArtID 355. Interior Design History/Theory/Criticism I. (3-0) Cr. 3. F. Theoretical approaches to evaluation of interior finishes, furnishings, and decorative arts in relation to parallel developments in art and architecture, from a critical, historical and multicultural perspective. Focus on pre-1850. Nonmajor graduate credit.

ArtID 356. Interior Design History/Theory/Criticism II. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 355 or permission of instructor.* Advanced theoretical approaches to evaluation of interior finishes, furnishings, and decorative arts in relation to parallel developments in art and architecture from a critical, historical, and multicultural perspective. Focus on mid-nineteenth and twentieth century. Nonmajor graduate credit.

ArtID 357. Made in Italy. (2-0) Cr. 2. F. *Prereq: Participation in Study Abroad Rome program.* An investigation of the 20th century roots of modern Italian design and its contemporary form. Lectures and seminar presentations highlight major Italian designers and internationally significant design in the 20th century. Focus is on innovative design that exhibits a synthesis of formal and social functions.

ArtID 359. Junior Field Study. Cr. R. F. *Prereq: Enrollment in third year interior design studio course.* Study and tours of areas of interest within the interior design profession such as manufacturers, design studios, showrooms, and museums. Satisfactory-fail only.

ArtID 360. Interior Design Internship Seminar. (0-1) Cr. 0.5. Repeatable. F.S. *Prereq: Enrollment in third year studio course.* Procedural and ethical concerns relating to interior design internship. Preparation of placement credentials and formulation of personal goals. Internship plans and agreements. Satisfactory-fail only.

ArtID 365. Interior Design Studio III. (1-6) Cr. 4. F. *Prereq: 263, 267, 351 credit or enrollment in 353.* Refined methods of problem identification design programming and problem solving, including theoretically-based concept development and refinement. Emphasis on optimized design work environments and compliance with codes and standards. Produce small and large scale projects. Alternative manual and computer-based visualization methods. Teamwork.

ArtID 367. Interior Design Studio IV. (1-6) Cr. 4. S. *Prereq: 365, credit or enrollment in 352 and 369.* Emphasis on three-dimensional spatial development in large scale, multiple scale unit institutional projects. Inclusion of extensive design documentation. Expansion of alternative manual and computer-based visualization methods. Teamwork.

ArtID 368. International Study Orientation Seminar. (1-0) Cr. 1. *Prereq: 365, permission of instructor and planned enrollment in Rome study option.* Historic and contemporary architecture and interior design, customs and traditions of Rome and related travel itinerary locations. Required of students participating in the interior design international study option.

ArtID 459. Senior Field Study. Cr. R. *Prereq: Enrollment in fourth year interior design studio course.* Study and tours of areas of interest within the interior design profession such as manufacturers, design studios, showrooms and museums. Satisfactory-fail only.

ArtID 460. Interior Design Internship. Cr. 3. SS. *Prereq: Completion of 350, 365.* Professional interior design off-campus experience.

ArtID 461. Interior Design Professional Practices. (3-0) Cr. 3. S. *Prereq: 460.* Organization and general management of the interior design office: agreements, business procedures, and professional ethics. Professional interior design issues and concerns.

ArtID 463. Environments for the Aging. (Cross-listed with HD FS, Geron). (3-0) Cr. 3. S. *Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies.* Emphasis on independent living within residential settings including specialized shelter, supportive services, and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities.

ArtID 465. Interior Design Studio V. (Dual-listed with 565). (1-6) Cr. 4. F. *Prereq: 460.* Design research and refined problem solving methods including functional analysis, programming and detailing. Multi-cultural, study abroad option. Nonmajor graduate credit.

ArtID 467. Interior Design Studio VI. (Dual-listed with 567). (1-6) Cr. 4. S. *Prereq: 465, credit in 469 and all required interior systems and history/theory/criticism courses or permission of instructor.* Refinement of technical, analytical and theoretical problem-solving methods and comprehensive design documentation. In-depth development of interior design projects. Current issues in interior design. Nonmajor graduate credit.

ArtID 468. Interior Design in an Urban Setting. (1-4) Cr. 3. S. *Prereq: Enrollment or credit in third year studio courses.* Study of selected interior design projects and designers practicing in an urban Setting. Studio project examining issues related to interior design in an urban context.

ArtID 469. Advanced Studies in Interior Design. (Dual-listed with 569). Cr. 3. Repeatable. *Prereq: 12 credits in interior design related courses or permission of instructor.* Examination of special issues with emphasis on their translation into design application. Topics vary each time offered. Nonmajor graduate credit.

ArtID 490. Independent Study. Cr. arr. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed related interior design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.
H. Honors

ArtID 493. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: Evidence of satisfactory experience in area of specialization.* Intensive 2 to 4 week studio exploration. Topics vary each time offered.

Courses primarily for graduate students, open to qualified undergraduate students

ArtID 550. Creative Integration. (1-2) Cr. 2. Repeatable. F.S. *Prereq: Permission of instructor.* Analysis and expansion of technical, theoretical and procedural sources of design insight and their application to design problem-solving. Emphasis on the refinement and communication of clear, logical bases for design decisions.

ArtID 551. Design Humanics. (3-0) Cr. 3. Repeatable. F.S. *Prereq: Instructor permission.* An exploration of human nature as broadly defined and as applied to design of the built environment. Consideration of human characteristics, responses and performance, at varying scales, as sources of design insight. Topics vary each time offered.
A: Micro-Scale Humanics- Issues related to the nature, performance and accommodation of the individual organism, including sensation and perception, physical requirement, individual Anthropometrics, personal safety and other issues connecting human needs and built environmental responses.
B: Meso-Scale Humanics- Issues related to human performance in small to moderate scale settings, including psychological and behavioral dimensions, social factors, interpersonal safety, etc. C: Macro-Scale Humanics- Cultural and Societal influences on human performance and well being in the moderate to large scale built environment, including the impact of political, economic, cultural, geographic, design cultural and other Societal factors.

ArtID 552. Design Methods. (2-0) Cr. 2. Repeatable. F.S. *Prereq: Permission of instructor.* Survey of methodologies and methodological tools for varied end uses and drawn from wide ranging sources. Emphasis on their organization and application to design of the human environment. Topics vary each time offered.
A. Investigation & Analysis - Methods of design research, analysis, programming and theory formulation.
B. Synthesis - Methods of synthesizing design concepts and solutions
C. Communication - Methods of managing, translating, communicating and otherwise utilizing text, image, abstract and other forms of information.
D. Procedural Alternatives - New and specialized methodological trends, including subject or setting-specific methods.

ArtID 554. Interior Design Teaching Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Completion of ArtId 667 or permission of instructor.* Supervised practical application of interior design theory, materials, and practice to the educational process.

ArtID 559. Graduate Interior Design Field Study. Cr. R. Repeatable. *Prereq: Graduate enrollment or permission of instructor.* Study and tours of places of interior design-related interest such as manufacturers, design studios, related professional offices, showrooms, museums, and historical sites.

ArtID 560. Interior Design Internship. (3-0) Cr. 3. *Prereq: Completion of a graduate interior design studio or permission of instructor.* Applied, off campus, professional interior design-related experience

ArtID 565. Interior Design Studio V. (Dual-listed with 465). (1-6) Cr. 4. F. *Prereq: Graduate classification and concurrent enrollment in 598.* Design research and refined problem-solving methods including functional analysis, programming and detailing. Multi-cultural, hospitality and retail. Study abroad option.

ArtID 567. Interior Design Studio VI. (Dual-listed with 467). (1-6) Cr. 4. S. *Prereq: Graduate classification and concurrent enrollment in 598 or permission of instructor.* Refinement of technical, analytical and theoretical problem-solving methods and comprehensive design documentation. In-depth development of interior design projects. Current issues in interior design. Nonmajor graduate credit.

ArtID 569. Advanced Studies in Interior Design. (Dual-listed with 469). Cr. 3. Repeatable. *Prereq: Graduate classification, permission of instructor.* Examination of special issues with emphasis on their translation into design application. Topics vary each time offered.

ArtID 590. Special Topics. Cr. arr. *Prereq: Bachelor's degree in interior design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment.*

ArtID 593. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification; evidence of satisfactory experience in area of specialization.* Intensive 2 to 4 week studio exploration. Topics vary each time offered.

ArtID 598. Research Forum. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Concurrent enrollment in 565, 567, 665, or 667, or permission of instructor.* Presentation and discussion of cross-disciplinary design research theory, methods, and application. Focus on the investigation, application, and communication of types of design research.

Courses for graduate students

ArtID 660. Research Methods. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Research strategies related to design. Application of selected methods to specific issues.

ArtID 665. Advanced Interior Design Studio. (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification, concurrent enrollment in 598.* Interior design problem-solving with emphasis on special issues. Project types will include but not be restricted to hospitality, health care, institutional, industrial, residential, historic preservation and commercial environments.

ArtID 667. Experimental Interior Design. (0-6) Cr. 3. Repeatable. F.S. *Prereq: Concurrent enrollment in 598, permission of instructor.* Application of alternative design methods and sources of insight to the solution of human environmental design problems. Focus on the identification, formulation, refinement and application of theory to the design process. Emphasis on the pursuit of new discovery and innovative problem solving. Approaches, settings and scales vary each time offered.

ArtID 690. Advanced Topics. Cr. arr. Repeatable. *Prereq: M.F.A classification, permission of instructor.*

ArtID 697. Design Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Approval of POS committee.* Supervised off-campus learning experience with a prominent designer or firm. (Credit not to be applied to MA degree program of study).

ArtID 698. Current Issues in Interior Design. Cr. 3. Repeatable. *Prereq: Graduate classification.* Selected issues in contemporary design. Topics and readings vary each time offered.

ArtID 699. Research. Cr. arr. Repeatable.
A. Thesis
B. Thesis-Exhibition

Integrated Studio Arts (ArtIS)

Courses primarily for undergraduate students

ArtIS 201. Foundations of Visual Literacy. (0-6) Cr. 3. F.S. *Prereq: Dsn S 102 and 131.* Exploration through the World Wide Web of the nature of visual perception in relation to issues of visual communication and problem solving, envisioning information, scientific visualization and visual thinking. Studio assignments to be digitized and sent to instructor electronically for evaluation and critique.

ArtIS 205. Studio Fundamentals I. (0-6) Cr. 3. F.S. *Prereq: Acceptance into the BFA ISA program..* Introduction to studio fundamentals and crossover between media. Emphasis on ceramics and fibers as tools of expression and communication. Required of all ISA BFA students. Must register for both sections.

ArtIS 207. Studio Fundamentals II. (0-6) Cr. 3. F.S. *Prereq: Acceptance into the BFA ISA program.* Introduction to studio fundamentals and crossover between media. Emphasis on metals and wet darkroom photography as tools of expression and communication. Required of all ISA BFA students. Must register for both sections.

ArtIS 208. Color. (0-6) Cr. 3. F.S. *Prereq: Dsn S 102, 131, and 183.* Required of all ISA BFA students. The impact of changing visual relationships emphasizing physical and psychological color concepts. Additive and subtractive mixing and color interaction exercises using various color media.

ArtIS 209. Studio Fundamentals III. (0-6) Cr. 3. F.S. *Prereq: Acceptance into the ISA BFA program.* Introduction to studio fundamentals and crossover between media. Emphasis on printmaking and wood as tools of expression and communication. Required of all ISA BFA students. Must register for both sections.

ArtIS 211. Studio Fundamentals IV. (0-6) Cr. 3. F.S. *Prereq: Acceptance into the ISA BFA program..* Introduction to studio fundamentals and crossover between media. Emphasis on computers and painting as tools of expression and communication. Required of all ISA BFA students. Must register for both sections.

ArtIS 227. Introduction to Creative Digital Photography. (0-6) Cr. 3. F.S. *Prereq: Dsn S 102, 131, and 183.* The course will include camera operation, scanning, image manipulation, color management and printing. Must have access to 35 mm camera or 4 megapixel (minimum resolution) digital camera. Cameras must have manual override. Digital photography as a medium of design, expression and communication.

ArtIS 229. Introduction to Darkroom Photography. (0-6) Cr. 3. F.S. *Prereq: Dsn S 102, 131 and 183.* Photography as a creative medium of design, expression and communication. Camera techniques and black and white wet lab processing taught. Alternative processes explored as time permits. 35 mm camera with manual exposure controls is required.

ArtIS 233. Watercolor Painting. (0-6) Cr. 3. F.S. *Prereq: Art 230.* Fundamentals of painting using water-based media applied to observation-based painting. Subject matter may include working from actual or two-dimensional references of still life, landscape, architectural space, and the human form.

ArtIS 238. Painting I. (0-6) Cr. 3. F.S. *Prereq: Art 230.* Fundamentals of painting using acrylic and oil media applied to observation-based painting. Subject matter may include working from actual or two-dimensional references of still life, landscape, and the human form.

ArtIS 305. Integrative Media. (Dual-listed with 505). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Dsn S 102, 131 and 183 and 6 credits of additional ISA studio at 200+ level.* Exploration and application of materials and methods that combine and integrate traditional approaches, alternative/new materials and alternative approaches, and new media.

ArtIS 308. Computer Modeling, Rendering and Virtual Photography. (0-6) Cr. 3. F.S. *Prereq: Art 230 or permission of instructor.* Introduction to 3D modeling using computer and available software. Modeling, texturing, lighting, and rendering with respect to 3D object and still scene creation.

ArtIS 310. Sources of Visual Design. (0-6) Cr. 3. F.S. *Prereq: Art 230.* Required of all ISA BFA students. Studio exercises to develop awareness of external and internal sources for design.

ArtIS 311. Contemporary Issues in Studio Art. (0-6) Cr. 3. F.S. *Prereq: 310.* Studio based exploration of issues and directions in current art. Readings, discussions, and studio research projects to build an experimental and applied knowledge base for understanding each student's place in the contemporary art world.

ArtIS 320. Introduction to Furniture Design. (0-6) Cr. 3. F.S. *Prereq: ArtIS 209 or permission of instructor.* Design and creation of basic furniture forms in wood. Introduction to power tools. Develop an individual design process including an understanding of scale and proportion. Develop sensitivity to wood and the social and environmental implications of materials used for furniture design and production.

ArtIS 322. Ceramics II. (0-6) Cr. 3. F.S. *Prereq: 222 or 205.* Further investigation of concepts and techniques in ceramics; introduction to glaze research and kiln firing.

ArtIS 323. Scientific Illustration Principles and Techniques. (Cross-listed with BPM I). (0-6) Cr. 3. Repeatable. F. *Prereq: 6 credits in art and design and 3 credits in biological sciences.* Studio basics and professional techniques in black & white, continuous tone, and color. Emphasis on tools, materials, and rendering.

ArtIS 324. Jewelry/Metalsmithing II. (0-6) Cr. 3. F.S. *Prereq: 207 or permission of instructor.* Continued study of traditional and contemporary metal fabrication techniques applicable to jewelry and object construction, including container forms. Emphasis on design, modeling and rendering techniques and progressive skill development. Basic stone setting and lost wax casting introduced.

ArtIS 325. Integrated Studio Arts Seminar. (2-0) Cr. 2. Repeatable. *Prereq: Any 3-D studio.* Contemporary issues in studio arts explored through lectures and presentations.

ArtIS 326. Illustration and Illustration Software. (Cross-listed with BPM I). (0-6) Cr. 3. Repeatable. S. *Prereq: 323.* Application of painting, drawing, and image making techniques to communication. Development of technical abilities using illustration software. Digital and print production techniques.

ArtIS 327. Illustration as Communication. (Cross-listed with BPM I). (0-6) Cr. 3. F. *Prereq: 326.* Studio problems in illustration emphasizing composition and communication. Problem solving methodologies.

ArtIS 329. Creative Photography. (0-6) Cr. 3. Repeatable. F.S. *Prereq: 207 or 229.* Continuation and expansion of concepts and processes covered in ArtIS 207 and ArtIS 229. Individual thematic expression further enhanced through photographic history and criticism.

ArtIS 330. Drawing III: Life Drawing. (0-6) Cr. 3. Repeatable. F.S. *Prereq: Art 230.* Drawing from the human figure.

ArtIS 335. Three-Dimensional Studio. (Cross-listed with Arch). (0-5) Cr. 2. Repeatable. F.S. This course deals with three dimensional problems in visual invention, organization, and expression emphasizing creative manipulation of tools, materials, and techniques as means for three dimensional thinking. Projects cover the additive (modeling), subtractive (carving), substitutional (casting) as well as constructive techniques.

ArtIS 337. Application of Scientific Illustration Techniques. (Cross-listed with BPM I). (0-6) Cr. 3. S. *Prereq: 323.* Rendering techniques applied to different types of biological and scientific subjects emphasizing communication. The use of traditional and digital media. Term project required.

ArtIS 338. Painting II. (0-6) Cr. 3. Repeatable. F.S. *Prereq: 238.* Painting using acrylic and oil media; composition and expression.

ArtIS 345. Woven Structures. (0-6) Cr. 3. Repeatable. *Prereq: DsnS 102, 131, 183, and ArtIS 205 or equivalent.* Introduction to a variety of textile techniques including on-loom and off-loom woven construction using both traditional and non-traditional materials and approaches. Techniques may include basketry, tapestry weaving, papermaking, and 4-harness

weaving. Emphasis placed on technical development, exploration and experimentation with a variety of fiber media, development of problem solving and critical thinking skills.

ArtIS 346. Textile Surface Design. (0-6) Cr. 3. Repeatable. *Prereq: Dsn S 102, 131, 183 and ArtIS 205, or equivalent.* Introduction to surface design using dyes and discharging agents, as well as mechanical and liquid resists to create complex surfaces. Other surface embellishment techniques, such as direct application of pigments and stitching, will be explored. Emphasis on technical skill development and research, as well as conceptual exploration and visual problem solving.

ArtIS 347. Printed Textile Design. (0-6) Cr. 3. Repeatable. *Prereq: Dsn S 102,131, 183, and ArtIS 205 or equivalent, or permission of instructor.* Textile printing methods; block, stencil, screen-printing using dyes, discharging agents, and pigments. Digital printing on fabric will be introduced. Experimental printing methods will also be explored. Research and development of surface design techniques as a means for personal expression.

ArtIS 356. Relief Printmaking. (Dual-listed with 556). (0-6) Cr. 3. Repeatable. F. *Prereq: Art 230.* Examine the techniques and aesthetic qualities of black and white and color relief printmaking primarily through woodcuts and photopolymer plates. Emphasis is on experimental and creative use of printmaking for artistic expression.

ArtIS 357. Intaglio and Monotype Printmaking. (Dual-listed with 557). (0-6) Cr. 3. Repeatable. F. *Prereq: Art 230.* Examine the techniques and aesthetic qualities of black and white and color intaglio printmaking primarily through etching, aquatint, photographic intaglio and collagraph processes. Unique, one-of-a-kind black and white and color prints from Plexiglas will also be introduced. Emphasis is on experimental and creative use of printmaking for artistic expression.

ArtIS 358. Lithography. (Dual-listed with 558). (0-6) Cr. 3. Repeatable. S. *Prereq: Credit or enrollment in Art 230.* Examine the techniques and aesthetic qualities of lithography primarily through hand-drawn and photographic plates. Emphasis is on experimental and creative use of printmaking for artistic expression. For those taking the course for a second semester, focus is on stone lithography and increased work with color.

ArtIS 399. BFA Professional Practice. (2-0) Cr. 2. S. *Prereq: Junior classification in Art and Design BFA curriculum. Required of all ISA BFA students.* Introduction to professional practices including development of portfolio (visual and written components). Lecture and presentation topics include applying to graduate school, grants/funding opportunities, professional networking, exhibition opportunities, and best practices for studio artists. Half semester course.

ArtIS 407. Principles of 3D Character Animation. (Dual-listed with 507). (Cross-listed with HCI). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 308.* Animation techniques using the computer and available software. Principles of character animation. Prior knowledge of modeling, lighting, texturing and rendering with available software is assumed. Nonmajor graduate credit.

ArtIS 408. Principles of 3D Animation. (0-6) Cr. 3. Repeatable. F.S. *Prereq: 308.* Animation techniques using the computer and available software. Principles of animation. Prior knowledge of modeling, lighting, texturing, animation and rendering with computer and available software is assumed. Nonmajor graduate credit.

ArtIS 409. Computer/Video Game Design and Development. (Dual-listed with 509). (Cross-listed with HCI). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Permission of instructor. Programming emphasis: Com S 227, 228, 229 or equivalent in Engineering; art or graphics emphasis: Art 230 and ArtIS 308; writing emphasis: an English course in creative writing or writing screen plays; business or marketing students: junior classification.* Independent project based creation and development of "frivolous and non-frivolous" computer games in a cross-disciplinary team. Projects require cross-disciplinary teams. Aspects of Indie development and computer/video game history will be discussed. Nonmajor graduate credit.

ArtIS 420. Advanced Furniture Design. (Dual-listed with 520). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 320.* Design and creation of advanced furniture forms in wood with consideration of precedents and innovative approaches. Develop a unique personal approach to the design and making of furniture. Refine sensitivity to wood and the social and environmental implications of materials used for furniture design and production. Nonmajor graduate credit.

ArtIS 422. Ceramics Studio. (Dual-listed with 522). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 322.* In-depth investigation of ceramic forms and surfaces with an emphasis on personal art expression in the medium of ceramics. Kiln firings, research into contemporary artists and development of a body of work are emphasized. Nonmajor graduate credit.

ArtIS 424. Jewelry/Metalsmithing III. (Dual-listed with 524). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 324 or permission of instructor.* Emphasis on metal fabrication and hollow construction techniques applicable to jewelry, functional objects and sculpural art forms. As students advance, they learn sheet metal processes including raising, forming, and anticlastic shell forming techniques. Introduction to mechanisms and tool making. Advanced students are encouraged to integrate these topics with alternative materials and technologies. A focus is placed on independent research, professional engagement and portfolio development. Nonmajor graduate credit.

ArtIS 429. Advanced Photography. (Dual-listed with 529). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 329.* Independent, advanced work in traditional alternative and/or digital photographic processes. Emphasis is on development of a unified body of work and research into contemporary photographers and aesthetic concerns. Nonmajor graduate credit.

ArtIS 430. Drawing IV. (Dual-listed with 530). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Art 330.* Figurative and/or non-figurative drawing with advanced work in media, composition, and theory. Nonmajor graduate credit.

ArtIS 438. Painting III. (Dual-listed with 538). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 338.* Figurative and non-figurative painting with advanced work in media, composition, and theory. Nonmajor graduate credit.

ArtIS 447. Advanced Printed Textile Design. (Dual-listed with 547). (0-6) Cr. 3. Repeatable. *Prereq: 346 or 347.* Advanced textile printing techniques that include screen-printing with dyes, discharging agents, and pigments, and digital printing on fabric. Experimental printing methods will also be explored. Emphasis is on research and development of surface design techniques as a means for personal expression. Nonmajor graduate credit.

ArtIS 458. Advanced Printmaking. (0-6) Cr. 3. Repeatable. F.S. *Prereq: 356, 357, or 358, and permission of instructor.* Independent, advanced work in printmaking processes. Emphasis is on development of a unified body of work and research into contemporary artists.

ArtIS 482. Selected Topics in Studio Art. (Dual-listed with 582). Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Special issues related to studio art. Topics vary each time offered.

ArtIS 490. Independent Study. Cr. arr. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed craft design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.
B. Ceramics
C. Computer Art and Design
D. Drawing
E. Textiles
F. Illustration
G. Metals
H. Honors
I. Painting
J. Photography
K. Printmaking
L. Furniture
M. Mixed Media

ArtIS 493. Workshop. Cr. arr. Repeatable. SS. *Prereq: Permission of instructor.* Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.
B. Ceramics
C. Computer Art and Design
D. Drawing
E. Textiles
F. Illustration
G. Metals
H. Honors
I. Painting
J. Photography
K. Printmaking
L. Furniture
M. Mixed Media

ArtIS 499. BFA Exhibition. (1-0) Cr. 1. S. *Prereq: 399 and senior classification in the Art and Design BFA Curriculum.* Capstone experience for the BFA degree; includes the creation and refinement of a final portfolio both visual and written components. Students give a portfolio presentation to the ISA faculty. Course culminates in the planning and installation of the BFA group exhibition in a formal gallery setting. Required of all ISA BFA students. Half semester course.

Courses primarily for graduate students, open to qualified undergraduate students

ArtIS 505. Integrative Media. (Dual-listed with 305). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.* Exploration and application of materials and methods that combine and integrate traditional approaches, alternative/new materials, alternative approaches and new media.

ArtIS 507. Principles of 3D Character Animation. (Dual-listed with 407). (Cross-listed with HCI). (0-6) Cr. 3. F.S. *Prereq: 308.* Advanced, 3D computer-generated animation concepts and techniques.

ArtIS 508. Computer Aided Animation and Visualization. (0-6) Cr. 3. Repeatable. S. *Prereq: 408 or graduate Status and permission of instructor.* Further investigations begun in ArtIS 408. Attention given to the workflow and management of creating animation and visualizations.

ArtIS 509. Computer/Video Game Design and Development. (Dual-listed with 409). (Cross-listed with HCI). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Permission of instructor..* Independent project based creation and development of "frivolous and non-frivolous" computer games in a cross-disciplinary team. Projects require cross-disciplinary teams. Aspects of Indie development and computer/video game history will be discussed.

ArtIS 520. Advanced Furniture Design. (Dual-listed with 420). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor..* Design and creation of advanced furniture forms in wood with consideration of precedents and innovative approaches. Develop a unique personal approach to the design and making of furniture. Refine sensitivity to wood and the social and environmental implications of materials used for furniture design and production.

ArtIS 522. Ceramics Studio. (Dual-listed with 422). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.* In-depth investigation of ceramic forms and surfaces with an emphasis on personal art expression in the medium of ceramics, kiln firings, research into contemporary artists and development of a body of work are emphasized.

ArtIS 524. Jewelry and Decorative Metalsmithing III. (Dual-listed with 424). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.* Emphasis on metal fabrication and hollow construction techniques applicable to jewelry, functional objects and sculptural art forms. As students advance, they learn sheet metal processes including

raising, forming, and anticlastic shell forming techniques. Introduction to mechanisms and tool making. Advanced students are encouraged to integrate these topics with alternative materials and technologies. A focus is placed on independent research, professional engagement and portfolio development.

ArtIS 529. Advanced Photography. (Dual-listed with 429). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.* Independent, advanced work in traditional, alternative and/or digital photographic processes. Emphasis is on development of a unified body of work and research into contemporary photographers and aesthetic concerns.

ArtIS 530. Drawing. (Dual-listed with 430). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.* Figurative and non-figurative drawing with advanced work in media, composition, and theory.

ArtIS 538. Advanced Painting. (Dual-listed with 438). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Graduate classification and permission of instructor.*. Figurative and non-figurative painting with advanced work in media, composition, and theory.

ArtIS 547. Advanced Printed Textile Design. (Dual-listed with 447). (0-6) Cr. 3. Repeatable. *Prereq: Graduate classification.* Advanced textile printing techniques that include screen-printing with dyes, discharging agents, and pigments, and digital printing on fabric. Experimental printing methods will also be explored. Emphasis is on research and development of surface design techniques as a means for personal expression.

ArtIS 556. Relief Printmaking. (Dual-listed with 356). (0-6) Cr. 3. Repeatable. F. *Prereq: Graduate classification and permission of instructor.* Examine the techniques and aesthetic qualities of black and white and color relief printmaking primarily through woodcuts and photopolymer plates. Emphasis is on experimental and creative use of printmaking for artistic expression.

ArtIS 557. Intaglio and Monotype Printmaking. (Dual-listed with 357). (0-6) Cr. 3. Repeatable. F. *Prereq: Graduate classification and permission of instructor.* Examine the techniques and aesthetic qualities of black and white and color intaglio printmaking primarily through etching, aquatint, photographic intaglio and collagraph processes. Unique, one-of-a-kind black and white and color prints from Plexiglas will also be introduced. Emphasis is on experimental and creative use of printmaking for artistic expression.

ArtIS 558. Lithography. (Dual-listed with 358). (0-6) Cr. 3. Repeatable. F. *Prereq: Graduate classification and permission of instructor.* Examine the techniques and aesthetic qualities of lithography primarily through hand-drawn and photographic plates. Emphasis is on experimental and creative use of printmaking for artistic expression. Experienced lithography students may focus on stone lithography and increased work with color.

ArtIS 582. Selected Topics in Studio Art. (Dual-listed with 482). Cr. arr. Repeatable. F.S. *Prereq: Permission of Instructor.* Special issues related to studio art. Topics vary each time offered.

ArtIS 590. Special Topics. Cr. arr. *Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area.* Written approval of instructor and department chair on required form in advance of semester of enrollment.
B. Ceramics
C. Computer Art and Design
D. Drawing
E. Textiles
F. Illustration
G. Metals
I. Painting
J. Photography
K. Printmaking
L. Furniture
M. Mixed Media

ArtIS 593. Workshop. Cr. arr. Repeatable. SS. *Prereq: Graduate classification and permission of instructor.* Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.
B. Ceramics
C. Computer Art and Design
D. Drawing
E. Textiles
F. Illustration
G. Metals
I. Painting
J. Photography
K. Printmaking
L. Furniture
M. Mixed Media

Courses for graduate students

ArtIS 607. Intermedia. (0-6) Cr. 3. Exploration and application of media with various materials, methods and ideas.

ArtIS 698. Current Issues in Studio Arts. Cr. arr. Repeatable. *Prereq: Graduate classification.* Selected issues in contemporary studio arts. Topics and readings vary each time offered.

Astronomy and Astrophysics

See *Physics*.

Biochemistry, Biophysics, and Molecular Biology

http://www.bbmb.iastate.edu

Aragula Gururaj Rao, Chair of Department

Distinguished Professors: Beitz, Fromm

Distinguished Professors (Emeritus): Graves, Metzler

University Professor: Girton

University Professors (Emeritus): Hammond, Horowitz, White

Professors: Andreotti, Honzatko, Jernigan, R. Johansen, K. Johansen, Miller, Myers, Nikolau, Nilsen-Hamilton, Rao, Robson, Robyt, Shin, Thornburg

Professors (Emeritus): Applequist, Atherly, Buss, Stromer, Thomas, Tipton

Professor (Collaborator): Meyer, Tabatabai

Associate Professors: Ambrosio, Bobik, Dispirito, Hargrove, Huiatt, Peters

Associate Professors (Adjunct): James

Assistant Professors: Amarasinghe, Macintosh, Shogren-Knaak, Yu, Zabotina

Lecturer: Fulton, Girton

Undergraduate Study

The department offers majors in biochemistry or biophysics in the College of Liberal Arts and Sciences and a major in agricultural biochemistry in the College of Agriculture.

Biochemists and biophysicists seek to understand life processes in terms of chemical and physical principles. They conduct research in the frontiers of biology such as metabolic networking; structure and function of enzymes, membranes, and hormones; computational approaches; genomic and proteomic technology; protein engineering; plant biotechnology; muscle structure and function; and the design and evaluation of drugs for the treatment of disease. Biochemistry, biophysics and molecular biology provide the basis for much of modern biotechnology. Graduates have opportunities in industry, especially the biotechnology sector, in universities, veterinary medical, and medical schools, and government laboratories. Students who meet the necessary high scholastic standards have the opportunity to continue their studies in graduate school, medical school, or veterinary medical school.

Graduates of biochemistry, agricultural biochemistry and biophysics understand the chemical principles of biological systems including molecular biology. They have developed laboratory expertise in modern biochemical techniques, including the ability to analyze data and prepare scientific reports. Most have participated in undergraduate research and have developed the skills necessary for both written and oral presentations at a level that will serve the student both within the university and in postgraduate professional life. Graduates have the experience of interacting with persons of different disciplines and cultures. Students have the training in mathematics and physics to solve problems of broad scope in biological, biomedical and environmental sciences and to provide leadership in diverse scientific and technological arenas.

Agricultural Biochemistry Major in the College of Agriculture

For the undergraduate curriculum leading to the degree bachelor of science, see *College of Agriculture, Curricula*. Agricultural biochemistry is recommended to students interested in the areas of agriculture requiring strong preparation in biochemistry, chemistry, physics, and mathematics, or in preparation for the study of veterinary medicine. Employment opportunities exist in agrochemical industries, and animal and plant biotechnology.

Biochemistry or Biophysics Majors in the College of Liberal Arts and Sciences

For the undergraduate curriculum leading to the degree of bachelor of science, see Liberal Arts and Sciences, Curriculum. Biochemistry and biophysics are recommended to students whose career interests involve advanced study or employment in biochemistry or biophysics, or in related areas of the biological or medical sciences.

Undergraduate majors in the College of Liberal Arts and Sciences in biochemistry usually have the following basic courses or their equivalents in their programs: BBMB 101, 102, 201, 404 (or 501), 405 (or 502), 411, 461 (or 551); Chem 201 (or 177, 178), 201L (or 177N or 177L), 211, 211L, 322L, 324, 325, 331, 332, 333L (or 331L), 334L (or 332L); Math 165, 166, 265 (or 266 or 267); Phys 221, 222; Biol 211, 211L (or 212L or 313L or 314), 212, 313, 314, and a minimum of 4 additional credits of biological science courses from biology, genetics, and microbiology. Undergraduate research, BBMB 499, is strongly recommended.

Undergraduate majors in biophysics usually include the following basic courses in their programs: BBMB 101, 102, 404, 411, 461 (or 551); Chem 201 (or 177, 178), 177N (or 177L), 322L, 324, 325, 331, 332; Math 165, 166, 265, 266, 307 (or 317), 471; Phys 221, 222; Com S 207; Stat 305 or 231; Biol 211, 211L (or 212L), 212; Chem 211 and 211L; and 9 additional credits in 300 or higher level courses in biochemistry, biophysics, biological sciences, chemistry, or physics.

These lists of courses should not be regarded as statements of fixed requirements or as complete outlines of the work necessary for the major. They are given solely for the convenience of students or advisers who wish to estimate the amount of basic study that may be needed.

Biochemistry and biophysics majors are advised to meet the College of Liberal Arts and Sciences foreign language requirement with courses in French, German, or Russian.

See also the B.S./M.S. program under Graduate Study.

The department offers minors in biochemistry in both the College of Agriculture and the College of Liberal Arts and Sciences, which may be earned by credit in BBMB 404, 405, 311 (or 411), and 451 (or Chem 325), plus additional supporting 300 level courses in chemistry or biochemistry for a total of 15 credits.

Communication Proficiency requirement: Majors in agricultural biochemistry must complete Engl 150 and 250 and one course in speech fundamentals with a grade of C or better in each of these courses. Majors in the College of Liberal Arts and Sciences must complete Engl 150 and 250 and one of the following with a grade of C- or better: (a) Engl 305, 309, or 314; (b) a written report in BBMB 411, or 499.

Interdepartmental Majors

The department participates along with other biological science departments including GDCB and EEOB in offering interdepartmental majors in Biology and Genetics. Biology courses that are staffed in part by department faculty members include Biol 101, 313, 314, and 313L (See Biology).

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in biochemistry and biophysics and with interdepartmental majors in genetics, immunobiology, MCDB (molecular, cellular, and developmental biology), plant physiology, and toxicology. Minor work is offered to students taking major work in other departments.

Prerequisite to graduate work is a sound undergraduate background in biology, chemistry, mathematics, and physics.

All graduate students are required by the department to teach as part of their training for an advanced degree.

The department offers a B.S./M.S. program in biochemistry that allows students to obtain both the B.S. and M.S. degrees in five years. The program is open to students in the College of Liberal Arts and Sciences and in the College of Agriculture. Students interested in this program should contact the department office for details. Application for admission to the Graduate College should be made near the end of the junior undergraduate (third) year. Students would begin research for the M.S. thesis during the summer semester after their junior year and are eligible for research assistantships.

Courses primarily for undergraduate students

BBMB 101. Introduction to Biochemistry. (1-0) Cr. 1. F. Research activities, career opportunities in biochemistry and biophysics, and an introduction to the structure of biologically important compounds. For students majoring in biochemistry, agricultural biochemistry or biophysics or considering one of these majors.

BBMB 102. Introduction to Biochemistry Laboratory. (0-2) Cr. 1. S. *Prereq: Credit or enrollment in Chem 177 and 177L*. Topics in the scientific background of biochemistry, such as macromolecules, metabolism, and catalysis. May include laboratory experiments as well as literature readings and discussion. A significant component is practice in scientific communication. For students majoring in biochemistry, agricultural biochemistry or biophysics or considering one of these majors.

BBMB 201. Chemical Principles in Biological Systems. (2-0) Cr. 2. S. *Prereq: Credit or enrollment in Chem 331.* Survey of chemical principles as they apply in biological systems including: water, organic chemistry of functional groups in biomolecules and biochemical cofactors, weak bonds and their contribution to biomolecular structure, oxidation-reduction reactions and redox potential, thermodynamic laws and bioenergetics, chemical equilibria and kinetics, inorganic chemistry in biological systems, data presentation. The subjects will be taught using molecules from biological systems as examples. Intended for majors in biochemistry, biophysics, or agricultural biochemistry.

BBMB 221. Structure and Reactions in Biochemical Processes. (3-0) Cr. 3. F. *Prereq: Chem 163, 167, or 177.* Fundamentals necessary for an understanding of biochemical processes. Primarily for students in agriculture. Not acceptable for credit toward a major in biochemistry or biophysics. Credit for both BBMB 221 and Chem 231 may not be applied toward graduation.

BBMB 301. Survey of Biochemistry. (3-0) Cr. 3. F.S.SS. *Prereq: Chem 231 or 331.* A survey of biochemistry: structure and function of amino acids, proteins, carbohydrates, lipids, and nucleic acids; enzymology; metabolism; biosynthesis; and selected topics. Not acceptable for credit toward a major in biochemistry, biophysics, or agricultural biochemistry.

BBMB 311. Biochemistry Laboratory. (1-3) Cr. 2. S. *Prereq: Credit or enrollment in 301 or Biol 314.* Emphasis on isolation, characterization, and quantification of biological substances. Only one of BBMB 311 or Biol 314L can be counted toward graduation. Not acceptable for credit toward a major in biochemistry, biophysics, or agricultural biochemistry.

BBMB 403. Microbial Biochemistry and Biotechnology. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Chem 332, BBMB 301.* Fundamental principles of microbial biochemistry, physiology, and genetics, and their application to microbial biotechnology. Topics will include biorenewable resources, metabolic pathway engineering, enzyme engineering, bioremediation, microbial diversity genomics, metagenomics. Nonmajor graduate credit.

BBMB 404. Biochemistry I. (3-0) Cr. 3. F. *Prereq: Chem 332*. A general overview for graduate and advanced undergraduate students in agricultural, biological, chemical and nutritional sciences. Chemistry of amino acids, proteins, carbohydrates, and lipids, vitamins; protein structure; enzymology; carbohydrate metabolism. Credit for both BBMB 420 and the 404, 405 sequence may not be applied toward graduation. Nonmajor graduate credit.

BBMB 405. Biochemistry II. (3-0) Cr. 3. S. *Prereq: 404.* A general overview for graduate and advanced undergraduate students in agricultural, biological, chemical, and nutritional sciences. Metabolism of carbohydrates, amino acids, nucleotides and lipids; formation, turnover, and molecular relationships among DNA, RNA, and proteins; genetic code; regulation of gene expression; selected topics in the molecular physiology of plants and animals. Credit for both BBMB 420 and the 404, 405 sequence may not be applied toward graduation. Nonmajor graduate credit.

BBMB 411. Techniques in Biochemical Research. (1-8) Cr. 3. F. *Prereq: Credit or enrollment in 404 or 501, Chem 210 or 211.* Introduction to laboratory techniques for studying biochemistry, including: chromatographic methods; electrophoresis; spectrophotometry; enzyme purification; enzyme kinetics; and characterization of carbohydrates, proteins, lipids, and nucleic acids. Nonmajor graduate credit.

BBMB 420. Physiological Chemistry. (3-0) Cr. 3. F. *Prereq: Chem 332, BBMB 301 or Biol 314.* Structure and function of proteins; enzymology; biological oxidation; chemistry and metabolism of carbohydrates, lipids, amino acids and nucleic acids; protein synthesis and the genetic code; relationship of biochemistry to selected animal diseases. Biochemistry of higher animals emphasized. Not acceptable for credit toward a major in agricultural biochemistry, biochemistry or biophysics. Credit for both BBMB 420 and the 404, 405 sequence may not be applied toward graduation. Nonmajor graduate credit.

BBMB 430. Procaryotic Diversity and Ecology. (Dual-listed with 530). (Cross-listed with Micro). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Micro 302, Micro 302L*. Survey of the diverse groups of procaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

BBMB 440. Laboratory in Microbial Physiology, Diversity, and Genetics. (Cross-listed with Micro). (1-7) Cr. 3. F. *Prereq: Micro 302, 302L, Chem 332, Biol 313L*. Study of the fundamental techniques and theory of studying the diversity of microbial life. Experimental techniques will include isolation and physiological characterization of bacteria that inhabit different environments. Also included are techniques for the phylogenetic characterization, and genetic manipulation of diverse species of bacteria.

BBMB 451. Physical Biochemistry. (2-0) Cr. 2. F. *Prereq: Chem 331, Phys 112 or 222; a previous course in calculus is helpful but not required.* Selected topics in physical chemistry in the context of applications to problems in biology, biochemistry and food sciences. Not acceptable for credit toward a major in biochemistry or biophysics. Nonmajor graduate credit.

BBMB 461. Topics in Biophysics. (2-0) Cr. 2. S. *Prereq: 451 or Chem 321 or Phys 304.* Biological phenomena viewed as problems in physics, with a focus on structure determinations and macromolecular characterization. Nonmajor graduate credit.

BBMB 490. Independent Study. Cr. arr. F.S.SS. *Prereq: College of Agriculture: junior or senior classification and permission of instructor; College of Liberal Arts and Sciences: permission of instructor.* College of Agriculture: a maximum of 9 credits of 490 may be applied toward graduation.
H. Honors

BBMB 499. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of staff member with whom student proposes to work.* Research under senior staff guidance.

Courses primarily for graduate students, open to qualified undergraduate students

BBMB 501. Comprehensive Biochemistry I. (4-0) Cr. 4. F. *Prereq: Chem 210 or 211, 322, and 332; a previous course in biochemistry is strongly recommended.* Chemical composition of living matter and the chemistry of life processes. Chemical characterization of amino acids, proteins, carbohydrates and lipids; enzymology and co-enzymes; metabolism of carbohydrates; biological oxidations.

BBMB 502. Comprehensive Biochemistry II. (4-0) Cr. 4. S. *Prereq: 501.* Chemical composition of living matter and the chemistry of life processes. Metabolism of lipids, amino acids, and nucleotides; membrane biochemistry; biosynthesis of DNA, RNA, and proteins; gene regulation; selected topics.

BBMB 503. Bioinorganic Chemistry. (Cross-listed with Chem). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Chem 402 or BBMB 405.* Essential elements: transport and storage of ions and of oxygen; metalloenzymes and metallocoenzymes; electron-transfer processes in respiration and photosynthesis; metabolism of nonmetals and redox processes involved in it; medicinal aspects of inorganic chemistry.

BBMB 520. Genetic Engineering. (Cross-listed with GDCB, MCDB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Gen 411 or BBMB 405.* Strategies and methods of gene cloning, restriction endonuclease mapping, southern hybridization, isolation and manipulation of plasmid DNA, and detection of specific genes in bacteria.

BBMB 530. Procaryotic Diversity and Ecology. (Dual-listed with 430). (Cross-listed with Micro). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Micro 302, Micro 302L*. Survey of the diverse groups of procaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

BBMB 531. Structure and Reactivity of Biomolecules. (3-0) Cr. 1. F. *Prereq: Chem 332.* Five weeks. Special properties of reactive groups prevalent in biomolecules and reactions commonly encountered in biochemical studies. A study of reaction types and mechanisms in biochemistry.

BBMB 541. Computational Biochemistry. (1-0) Cr. 1. F. *Prereq: A previous course in biochemistry is recommended.* Computer applications in biochemical research.

BBMB 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BCB, B M S, FS HN, Hort, NutrS, VDPAM, EEOB, NREM, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

BBMB 551. Molecular Biophysics. (3-0) Cr. 3. F. *Prereq: Chem 322.* An examination of physical methods for the study of molecular structure and organization of biological materials, with emphasis on applications. Spectroscopy, hydrodynamic methods, nuclear magnetic resonance, and X-ray diffraction.

BBMB 552. Biomolecular NMR Spectroscopy. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Chem 325 or permission of instructor.* Advanced solution state Nuclear Magnetic Resonance spectroscopy as applied to biological systems. Topics include theoretical principles of NMR, practical aspects of experimental NMR, methodologies for protein structure determination, NMR relaxation, recent advances in NMR spectroscopy.

BBMB 569. Bioinformatics III (Structural Genome Informatics). (Cross-listed with BCB, Com S, Cpr E, Math). (3-0) Cr. 3. F. *Prereq: BCB 567, Gen 411, Stat 430.* Algorithmic and Statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

BBMB 581. Seminar. (1-0) Cr. 1. F. *Prereq: Permission of instructor.* Short presentations by students and discussion on assigned topics. For entering graduate students.

BBMB 590. Special Topics. Cr. arr.

BBMB 593. Workshop in Biochemistry and Biophysics. Cr. 1. Repeatable. *Prereq: Permission of instructor.* Graduate workshops in selected topics in biochemistry and biophysics. Credit in this course does not meet the requirement for advanced graduate electives in Biochemistry.

Courses for graduate students

BBMB 607. Plant Biochemistry. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: 405 or 502.* Description of unique aspects of plant biochemistry including lipid metabolism, cell wall structure, secondary metabolism, phytoalexin biosynthesis, and plant defenses.

BBMB 615. Molecular Immunology. (Cross-listed with Micro, V MPM). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: BBMB 405 or 502.* Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signalling pathways leading to expression of genes that control and activate immune function.

BBMB 622. Carbohydrate Chemistry. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 404 or 501.* Structure, occurrence, properties, function, and chemical and enzymatic modifications of monosaccharides, oligosaccharides, polysaccharides, and glycoproteins.

BBMB 632. Kinetics of Enzyme Action. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 501.* Fundamental and advanced enzyme kinetics. Topics include integrated rate equations, methods for deriving initial-rate equations, inhibition, product effects, methods for verifying kinetic mechanisms, allostery, hysteresis, isotope effects, and complex kinetic mechanisms.

BBMB 640. Signal Transduction. (Cross-listed with GDCB, MCDB). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: GDCB 528, BBMB 404.* Mechanisms and components of cellular signal transduction including receptors, G-proteins, second messengers, protein phosphorylation, other post-translational protein modications, and transcriptional regulation.

BBMB 642. Mechanisms of Enzymatic Catalysis. (2-0) Cr. 1. Alt. F., offered 2010. *Prereq: 404, 420, or 501.* First 8 weeks. The chemical basis of enzymatic catalysis with emphasis on mechanisms of substrate recognition, general acid-base catalysis and stereoelectronic factors.

BBMB 645. Molecular Signaling. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 405, 420, or 502.* Molecular mechanisms of cellular signaling including receptor activation, desensitization and cross talk, signal transduction pathways, and nuclear receptors. Discussion includes a variety of cell surface receptors and their hormone; growth factor and extracellular matrix activators; protein kinases; caspase and transcription factor downstream signals; lipids, gases and cyclic nucleotides as regulators of cell signaling. Course content includes current literature, student and instructor presentations and research proposal writing.

BBMB 652. Protein Chemistry - Chemical Methods. (2-0) Cr. 1. Alt. S., offered 2010. *Prereq: 404 or 501.* First 8 weeks. Chemical reactions as a means of determining protein structure and biological function.

BBMB 653. Protein Chemistry - Physical Methods. (2-0) Cr. 1. Alt. S., offered 2010. *Prereq: 404 or 501.* Second 8 weeks. Protein structure determination as a means of understanding biological function.

BBMB 660. Membrane Biochemistry. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: 405 or 502.* Protein and lipid constituents of biological membranes. Structure and topography of membrane proteins. Selected topics concerning the membrane proteins involved in diverse biochemical processes, such as energy transduction transport across membranes, neurotransmission and signal transduction.

BBMB 661. Current Topics in Neurobiology. (Cross-listed with Neuro, GDCB). Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics may include communication, hormones and behavior, neural integration, membrane biophysics, molecular and cellular neuroscience, developmental neurobiology, neuroanatomy and ultrastructure, sensory biology, social behavior, techniques in neurobiology and behavior.

BBMB 670. Molecular Biology of Muscle. (Cross-listed with An S). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: BBMB 405, 420, or 502.* Ultrastructure of muscle; chemistry, structure, function, and molecular biology of muscle proteins. Molecular aspects of muscle contraction, development, and turnover. Cytoskeletal proteins and dynamics.

BBMB 675. Nucleic Acid Structure and Function. (2-0) Cr. 2. F. *Prereq: 405 or 502.* In-depth discussion of nucleic acid properties, structures and structure/function relationships. Interactions between nucleic acids and proteins will be emphasized.

BBMB 676. Biochemistry of Gene Expression in Eucaryotes. (Cross-listed with MCDB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 404 or 501, 405 or 502 or GDCB 511.* Analysis of the biochemical processes involved in expression of eucaryotic genes and the regulation thereof, including RNA polymerase, transcriptional regulatory proteins, enhancers and silencers, chromosome structure, termination, RNA processing, RNA transport, RNA turnover, small RNAs translational regulation, protein turnover.

BBMB 681. Advanced Seminar. Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.* Student presentations.

BBMB 682. Departmental Seminar. Cr. R. F.S. *Prereq: Permission of instructor.* Staff and visitor research.

BBMB 696. Research Seminar. (Cross-listed with Agron, GDCB, PlBio, Hort, For). Cr. 1. Repeatable. Research seminars by faculty and graduate students. Satisfactory-fail only.

BBMB 698. Seminar in Molecular, Cellular, and Developmental Biology. (Cross-listed with MCDB, GDCB, Micro, V MPM). (2-0) Cr. arr. Repeatable. F.S. Student and faculty presentations.

BBMB 699. Research. Cr. arr. *Prereq: Permission of instructor.*

Bioengineering

http://www.eng.iastate.edu/bioengineering/

Minor administered by the College of Engineering

Supervisory Committee: P. Reilly (Chair), A. Bastawros, T. Kim, H. van Leeuwen, S. Pandey, G. Mirka, L. Genalo, P. Shrotriya

The bioengineering minor at Iowa State University is an interdisciplinary program that complements a student's major discipline by providing additional insight into the interactions between various engineering disciplines and biological systems, emphasizing new ways of solving biological problems. The program provides students with unique educational experiences to apply engineering skills and create new biobased products and devices.

Undergraduate Study

The program is open to all undergraduate engineering students at Iowa State University. This minor will provide students with a foundation of core Bioengineering knowledge, on which tracks will be superimposed to provide in-depth exposure to targeted areas of specialization. In addition to the core courses—BioE 201 and 202—students will complete coursework identified in the following tracks:

Bioinformatics and Systems Biology: BioE 325, BCB 211, 401, 402, and 442.

Biomaterials and Biomechanics: BioE 352, Ch E 440, Ex Sp 355, and Mat E 456.

Biomicrosystems: BioE 341, 341L, 450, 450L, and 428.

Biosystems and Environmental Engineering: A E 216 and 480, BioE 411/511, Ch E 415 and 427, and C E 421/521.

Courses primarily for undergraduate students

Undergraduate engineering students can satisfy the minor in bioengineering by completing a total of 15 credits: 6 from the core curriculum and 9 from the specialized tracks. Students can either choose to specialize in a particular track shown above or use courses from all tracks from which to draw their set of courses. The minor must include at least nine credits which are beyond the total used to meet curriculum requirements for the bachelors of science degree in engineering.

Students are strongly encouraged to consult either their undergraduate academic advisor or a member of the supervisory committee for assistance during the application process.

BioE 201. Introduction to Bioengineering I. (3-0) Cr. 3. *Prereq: Chem 167.* An exploration of cell structure and function, cellular metabolism, types of life forms, energy transport and use, biomolecule structure and function, and enzyme structure, function, and kinetics, with strong Mathematical emphasis.

BioE 202. Introduction to Bioengineering II. (3-0) Cr. 3. *Prereq: BioE 201.* Feedback loops in biological systems, cell and microbial growth patterns, fermentation kinetics. Biotechnology in diseases, wastewater treatment, genetic engineering of bacteria, fungi, plants, and animals, and biosensor operation. Strong Mathematical emphasis.

BioE 325. Systems Biology for Engineering. (3-0) Cr. 3. *Prereq: 202, Math 267.* Review of systems approaches for modeling. Introduction or review of methods for gene regulation in cells and how to model them. Auto regulation of gene networks. Feedforward modeling, timing considerations. Feedback mechanisms. Kinetic and rate-limiting steps.

BioE 341. BioMEMs and Nanotechnology. (3-0) Cr. 3. *Prereq: 202.* Overview of Micro-Electro-Mechanical-System (MEMS) technologies for bioengineering, fundamentals of microfluidic device design, fabrication, and characterization, survey of microfluidic functional building blocks for lab-on-a-chip applications including mixers, valves, channels, and chambers. Topics of nanotechnology in bioengineering, nanoscale building block technologies for bioengineering including self-assembling, surface chemical treatment, nano-imprinting, nano-particles, nano-tubes, nanowires, and stimuli-responsive biomaterials.

BioE 341L. BioMEMS and Nanotechnology Laboratory. (0-3) Cr. 1. *Prereq: 202, concurrent enrollment in 341.* Introductory laboratory course accompanying BioE 341. Design, fabrication, and characterization of BioMEMS lab-on-a-chip devices and nanoscale techniques for bioengineering. Student group projects. BioE341L not a necessary corequisite with BioE341.

BioE 352. Molecular, Cellular and Tissue Biomechanics. (3-0) Cr. 3. *Prereq: 201, E M 324, Mat E 272.* Introduction to the anatomy of the musculoskeletal system and connective tissue. Range of movement, joint dislocation, bone deformity and fracture. Application of continuum mechanics to both living and nonliving systems. Laws of motion, free-body diagrams and simple force analysis of musculoskeletal system. biomechanical response of soft and hard tissues with emphasis on microstructure and mechanical properties. Applications to bioengineering design.

BioE 411. Bioprocessing and Bioproducts. (Cross-listed with A E, BSE, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, Bionergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, Bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

BioE 428. Image Processing with Biomedical Applications. (3-0) Cr. 3. *Prereq: E E 324.* Review of signal processing, linear algebra, probability. Image sampling and quantization. Image transforms, image enhancement, image denoising/restoration. Tomographic reconstruction, segmentation and registration, recognition and shape analysis and applications in Computer Aided disease Detection (CAD).

BioE 450. Biosensing. (3-0) Cr. 3. *Prereq: 202.* Overview of biosensors and bioanalytical challenges; designing for performance including various analytical problems, ion-selective membranes, characteristics of enzymes and basics of bioaffinity sensing; fundamentals of bioselective layers including depositing films and membranes, surfaces for immobilization and bioselective agents; survey of different biosensing technologies including electroanalytical, biomembrane, optical, and acoustic-wave based sensors.

BioE 450L. Biosensing Laboratory. (0-3) Cr. 1. *Prereq: 202, concurrent enrollment in BioE 450.* Laboratory course accompanying BioE 450. Design, fabrication, and characterization of various electrical, chemical, polymer, optical and acoustic sensors. Lab is not a necessary corequisite with BioE 450..

Bioinformatics and Computational Biology – Undergraduate

www.las.iastate.edu/bcb/

Chair: S. Willson

Supervisory Committee: V. Brendel, K. Dorman, D. Fernandez-Baca, F. Honavar, M. Smiley

Undergraduate study

Undergraduate study in BCBio is jointly administered by the Department of Computer Science, the Department of Genetics, Development, and Cell Biology, and the Department of Mathematics. The undergraduate B.S. degree is offered through the College of Liberal Arts and Sciences.

Bioinformatics and Computational Biology is an interdisciplinary science at the interfaces of the biological, informational and computational sciences. The science focuses on a variety of topics. These include gene identification, expression, and evolution; RNA, protein, and genome structure; and molecular and cellular systems and networks. The large group of participating faculty provides students with a multidimensional perspective on bioinformatics and computational biology and presents them with broad range of possibilities to get involved in research.

This major will prepare students for careers at the interfaces of biological, informational and computational sciences. BCBio graduates with a B.S. seeking direct employment will find ready markets for their talents in agricultural and medical biotechnology industries, as well as in academia, national laboratories, and clinics. Although some students find employment directly after their baccalaureate training, many students will continue their education in one of the many excellent graduate programs in bioinformatics and computational biology that now exist.

Participation in this field requires that students achieve a high level of competence not only in biology, but also in mathematics, computer science, and statistics. As a result, the program includes required courses from many different disciplines. Graduates demonstrate an above-average ability to synthesize methods from these different disciplines to solve problems.

In addition to basic degree requirements listed in the Curriculum in Liberal Arts and Sciences (www.las.iastate.edu/academics/generaleducation/), BCBio majors must satisfy the following requirements:

A. Complementary Courses for the BCBio Major (37 cr)
   1. Chem (177, 177L, 178) or (201, 201L); 331.
   2. Phys 221.
   3. Stat 330, 341 and 430.
   4. Biol 211, 211L, 212, 212L and 314.

B. Core Courses Within the BCBio Major (48 cr)
   1. Gen 313, 313L and 411.
   2. Com S 227, 228, 363, and 330 (or Cpr E 310).
   3. Math 165, 166, 265 and (307 or 317).
   4. BCBio 110, 211, 401, 402.
   5. BCBio 490 or 491 (3 cr)

C. Support Electives
3-9 credits to be chosen from the following list:

BCB 495, 539, 542, 548, 549, 550, 551, 593, 594, 596, 597; Phys 222; BBMB 404, 405; Biol 315, 423, 462, 465, 472; Gen 340, 410; Stat 342, 402, 416, 432; Com S and Cpr E courses at the 300 level and above; Math (266 or 267), 304, 314, 385, 471, 481.

D. The communications and English proficiency requirements of the LAS college are met by Engl 150, 250 or 250H, and an additional English writing course chosen from Engl 309 or Engl 314. The lowest grade acceptable in Engl 150, 250 or 250H is C-.

Courses primarily for undergraduate students

BCBio 110. BCBio Orientation. (1-0) Cr. 0.5. F. First 8 weeks. Orientation to the area of bioinformatics and computational biology. For students considering a major in BCBio. Specializations and career opportunities. Satisfactory-fail only.

BCBio 211. Introduction to Bioinformatics and Computational Biology. (3-0) Cr. 3. S. Overview of bioinformatics and computational biology. Database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics.

BCBio 401. Fundamentals of Bioinformatics and Computational Biology I. (3-0) Cr. 3. F. *Prereq: BCBio 211, Com S 228.* Biology as an information science. Generative models for sequences. String algorithms. Sequence alignment. Algorithmic and Statistical aspects of database search. Basic methods in molecular phylogeny/phylogenomics. Genome sequence assembly.

BCBio 402. Fundamentals of Bioinformatics and Computational Biology II. (3-0) Cr. 3. S. *Prereq: BCBio 401.* Genome annotation. DNA and protein motifs. DNA microarrays. Introduction to gene expression studies. Protein, DNA and RNA structure. Structure representation, comparison and visualization. Biological networks and systems.

BCBio 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: BCBio 211, junior or senior classification, permission of instructor.* Students in the College of Liberal Arts and Sciences may use no more than 9 credits of BCBio 490 and 491 toward graduation.

BCBio 491. Team Research Projects.. Cr. arr. Repeatable. *Prereq: BCBio 211, junior or senior classification, permission of instructor.* Research projects in bioinformatics and computational biology done by teams of students. Students in the College of Liberal Arts and Sciences may use no more than 9 credits of BCBio 490 and 491 toward graduation.

Bioinformatics and Computational Biology

www.bcb.iastate.edu

bcb@iastate.edu

Interdepartmental Graduate Major

Chair: C. Tuggle

Associate Chair: V. Brendel

Supervisory Committee: C. Tuggle, V. Brendel, J. Dickerson, D. Dobbs, X. Huang, Z. Wu, R. Jernigan (ex-officio), S. Aluru (former chair)

Participating Faculty: D. Adams, S. Aluru, A. Andreotti, L. Bartholomay, W. Beavis, M. Bhattacharyya, A. Bogdanove, V. Brendel, A. Bronikowski, S. Cannon, H. Chou, D. Cook, J. Dekkers, J. Dickerson, P. Dixon, D. Dobbs, K. Dorman, O. Eulenstein, R. Fernando, H. Greenlee, X. Gu, K. Ho, V. Honavar, R. Honzatko, X. Huang, F. Janzen, R. Jernigan, D. Jones, S. Lamont, D. Lavrov, C. Lawrence, H. Levine, P. Liu, G. Macintosh, A. Miller, L. Miller, C. Minion, K. Moloney, D. Nettleton, B. Nikolau, M. Nilsen-Hamilton,

T. Peterson, G. Phillips, K. Rajan, J. Reecy, P. Reilly, S. Rodermel, M. Rothschild, D. Sakaguchi , P. Schnable, T. Sen, J. Shanks , M. Smiley, J. Smith, G. Song, X. Song, A. Travesset, C. Tuggle, N. Valenzuela, J. Wendel, S. Whitham, S. Willson, R. Wise, Z. Wu, E. Wurtele, E. Yu

Undergraduate Study

Undergraduates seeking a B.S. in Bioinformatics and Computational Biology should enroll in the undergraduate major BCBio, which is described in a separate section of this catalog. *See Index, BCBio.*

Undergraduates wishing to prepare for graduate study in Bioinformatics and Computational Biology should consider the undergraduate major in BCBio. Alternatively, they should obtain solid undergraduate training in at least one of the foundation disciplines: molecular biology, computer science, mathematics, statistics, and physics. They should also elect courses in basic biology, basic transmission and molecular genetics, chemistry, physics, mathematics at least through calculus, statistics, and computer programming.

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in Bioinformatics and Computational Biology (BCB). Faculty are drawn from several departments: Agronomy; Animal Science; Astronomy and Physics; Biochemistry, Biophysics and Molecular Biology; Biomedical Sciences; Chemical and Biological Engineering; Chemistry; Computer Science; Ecology, Evolution, and Organismal Biology; Electrical and Computer Engineering; Genetics, Development and Cell Biology; Industrial Manufacturing and Systems Engineering; Materials Science and Engineering; Mathematics; Plant Pathology; Statistics; Veterinary Microbiology and Preventive Medicine; and Veterinary Pathology.

The BCB program emphasizes interdisciplinary training in nine related areas of focus: Bioinformatics, Computational Molecular Biology, Structural and Functional Genomics, Macromolecular Structure and Function, Metabolic and Developmental Networks, Integrative Systems Biology, information Integration and Data Mining, Biological Statistics, and Mathematical Biology. Additional information about research areas and individual faculty members is available at: www.bcb.iastate.edu.

BCB students are trained to develop an independent and creative approach to science through an integrative curriculum and thesis research projects that include both computational and biological components. First year students are appointed as research assistants and participate in BCB 697 (Graduate Research Rotation), working with three or more different research groups to gain experience in both "wet" (biological) and "dry" (computer) laboratory environments. In the second year, students initiate a thesis research project under the joint mentorship of two BCB faculty mentors, one from the biological sciences and one from the quantitative/computational sciences. The M.S. and Ph.D. degrees are usually completed in two and five years, respectively.

Before entering the graduate BCB program, prospective BCB students should have taken courses in mathematics, statistics, computer science, biology, and chemistry. A well-prepared student will have taken calculus (through multivariable calculus, such as Math 265), a calculus-based introduction to probability and Statistics (like Stat 341), two semesters of computer programming (like Com S 207 and 208), one semester of discrete structures (like Com S 330 or Cpr E 310), some physical and organic chemistry (like Chem 163 and 231), biochemistry (like BBMB 301), genetics (like Biol 313), and evolution (like Biol 315).

During the first year, BCB students are required to address any background deficiencies in calculus, molecular genetics, computer science, statistics and discrete structures, with specific courses determined by prior training. Among the total course requirements for Ph.D. students are four core courses in Bioinformatics (BCB 567, 568, 569, and 570), one core course in Molecular Genetics (GDCB 511), and background courses in statistics and computer science. Students make research presentations (BCB 690), attend faculty research seminars (BCB 691), and participate in workshops/symposia (BCB 593). M.S. students take the above background and core courses, take at least 12 credits of advanced coursework, and may elect to participate in fewer seminars and workshops. Additional coursework may be selected to satisfy individual interests or recommendations of the Program of Study Committee. All graduate students are encouraged to teach as part of their training for an advanced degree. (For curriculum details and sample programs of study, see: www.bcb.iastate.edu.)

Courses primarily for undergraduate students

BCB 444. Introduction to Bioinformatics. (Dual-listed with 544). (Cross-listed with Com S, Cpr E, Gen, Biol). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics. Nonmajor graduate credit.

BCB 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*

BCB 495. Molecular Biology for Computational Scientists. (Cross-listed with Gen). (3-0) Cr. 3. F. Survey of molecular cell biology and molecular genetics for nonbiologists, especially those interested in bioinformatics/computational biology. Basic cell structure and function; principles of molecular genetics; biosynthesis, structure, and function of DNA, RNA, and proteins; regulation of gene expression; selected topics. Provides biological background for BCB 594. Credit for graduation will not be allowed for more than one of Gen 411 and Gen/BCB 495. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students.

BCB 538. Computational Genomics and Evolution. (Cross-listed with GDCB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 313.* Introduction to evolutionary sequence analysis at the genome level. Topics include sequence alignment, phylogenetic inference, molecular clock analysis, ancestral state inference, sequence/structure relation, functional divergence and prediction, evolutionary development, genome duplication, and comparative genomics. Focus will be on data analysis and biological interpretation.

BCB 539. Statistical Methods for Computational Biology. (Cross-listed with GDCB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: BCB 568.* Gu. Advanced discussion about Statistical modeling of DNA and amino acid sequences, microarray expression profiles and other genome-wide data interpretation.

BCB 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BBMB, B M S, FS HN, Hort, NutrS, VDPAM, EEOB, NREM, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

BCB 544. Introduction to Bioinformatics. (Dual-listed with 444). (Cross-listed with Com S, Cpr E, GDCB). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics.

BCB 549. Advanced Algorithms in Computational Biology. (Cross-listed with Cpr E, Com S). (3-0) Cr. 3. S. *Prereq: Com S 311 and either 208 or 228.* Design and analysis of algorithms for applications in computational biology, pairwise and multiple sequence alignments, approximation algorithms, string algorithms including in-depth coverage of suffix trees, seminumerical string algorithms, algorithms for selected problems in fragment assembly, phylogenetic trees and protein folding. No background in biology is assumed. Also useful as an advanced algorithms course in string processing.

BCB 550. Evolutionary Problems for Computational Biologists. (Cross-listed with Com S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Com S 311 and some knowledge of programming.* Discussion and analysis of basic evolutionary principles and the necessary knowledge in computational biology to solve real world problems. Topics include character and distance based methods, phylogenetic tree distances, and consensus methods, and approaches to extract the necessary information from sequence-databases to build phylogenetic trees.

BCB 551. Computational Techniques for Genome Assembly and Analysis. (Cross-listed with Com S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Com S 311 and some knowledge of programming.* Huang. Introduction to practical sequence assembly and comparison techniques. Topics include global alignment, local alignment, overlapping alignment, banded alignment, linear-space alignment, word hashing, DNA-protein alignment, DNA-cDNA alignment, comparison of two sets of sequences, construction of contigs, and generation of consensus sequences. Focus on development of sequence assembly and comparison programs.

BCB 565. Professional Practice in the Life Sciences. (Cross-listed with Pl P, Agron, An S, Hort, Micro, V MPM). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.
A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

BCB 567. Bioinformatics I (Fundamentals of Genome Informatics). (Cross-listed with Com S, Cpr E). (3-0) Cr. 3. F. *Prereq: Com S 208; Com S 330; Stat 341; credit or enrollment in Biol 315, Stat 430.* Biology as an information science. Review of algorithms and information processing. Generative models for sequences. String algorithms. Pairwise sequence alignment. Multiple sequence alignment. Searching sequence databases. Genome sequence assembly.

BCB 568. Bioinformatics II (Advanced Genome Informatics). (Cross-listed with GDCB, Stat, Com S). (3-0) Cr. 3. S. *Prereq: BCB 567, BBMB 301, Biol 315, Stat 430, credit or enrollment in Gen 411.* Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

BCB 569. Bioinformatics III (Structural Genome Informatics). (Cross-listed with BBMB, Com S, Math, Cpr E). (3-0) Cr. 3. F. *Prereq: BCB 567, Gen 411, Stat 430.* Algorithmic and Statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

BCB 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology). (Cross-listed with Com S, GDCB, Stat, Cpr E). (3-0) Cr. 3. S. *Prereq: BCB 567, Biol 315, Com S 311 and either 208 or 228, Gen 411, Stat 430.* Algorithmic and Statistical approaches in computational functional genomics and systems biology. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Ontology-driven, network based, and probabilistic approaches to information integration.

BCB 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

BCB 593. Workshop in Bioinformatics and Computational Biology. (1-0) Cr. 1. Repeatable. F.S. Current topics in bioinformatics and computational biology research. Lectures by off-campus experts. Students read background literature, attend preparatory seminars, attend all lectures, meet with lecturers.

BCB 596. Genomic Data Processing. (Cross-listed with Com S, GDCB). (3-0) Cr. 3. F. *Prereq: Some knowledge of programming.* Study the practical aspects of genomic data processing with an emphasis on hand-on projects. Students will carry out major data processing steps using bioinformatics tools. Topics include base-calling, raw sequence cleaning and contaminant removal; shotgun assembly procedures and EST clustering methods; genome closure strategies and practices; sequence homology search and function prediction; annotation and submission of GenBank reports; and data collection and dissemination through the Internet. Useful post-genomic topics like microarray design and data analysis will also be covered.

BCB 597. Introductory Computational Structural Biology. (Cross-listed with Math). (3-0) Cr. 3. S. *Prereq: Math 561 and 562.* Mathematical and computational approaches to protein structure prediction and determination. Topics include molecular distance geometry, potential energy minimization, and molecular dynamics simulation.

BCB 599. Creative Component. Cr. arr.

Courses for graduate students

BCB 690. Student Seminar in Bioinformatics and Computational Biology. Cr. 1. Repeatable. S. Student research presentations.

BCB 691H. Faculty Seminar in Bioinformatics and Computational Biology. (Cross-listed with GDCB). (1-0) Cr. 1. Repeatable. Faculty research series.

H. Bioinformatics and Computational Biology. (Same as GDCB 691H).

BCB 697. Graduate Research Rotation. Cr. arr. F.S.SS. Graduate research projects performed under the supervision of selected faculty members in the Bioinformatics and Computational Biology major.

BCB 699. Research. Cr. arr. Repeatable.

Biological/ Premedical Illustration

www.bpmi.iastate.edu

(Interdepartmental Undergraduate Program)

Program Committee: Lynn G. Clark, Chair; Dean Biechler, John Dorn, Stanley W. Harpole, Steven M. Herrnstadt, Harry Horner, Don Sakaguchi.

Undergraduate Study

The interdepartmental undergraduate BPM I major is designed for students who want to combine their interests and aptitudes in science and art. Based on the theme of "communicating science through art," the major prepares students for careers in biological illustration or for graduate education in medical illustration elsewhere. Graduates enter fields such as biocommunications, environmental display design, free-lance illustration, museum display design, and various careers in the publishing industry.

Entrance into the BPM I program is by application to the BPM I Advisory Committee. Eligibility is based on an academic standard of at least 2.00 CGPA on 30 credits of university level work and a consideration of artistic ability as demonstrated through submission of a portfolio of representative drawings or other art work. Freshman and transfer students usually declare pre-BPM I as their major while satisfying the conditions for entrance into the major, although other majors can be declared.

To earn the B.A. degree offered by the College of Liberal Arts and Sciences, students must complete the general education requirements in that college and take at least 41 credits in design and 32 credits in the biological sciences. Design courses include: Dsn S 131 and Art 230, ArtIS 233, 308, and 330, BPM I 323, 326, 327, 337, and 497 plus 12 credits chosen from a list of approved upper level courses in art and design. Biological science courses include: LAS 101, Biol 211, 211L, 212, 212L, 255, 256, 351: Biol 356 or 366 or 454, and at least 9 credits chosen from a list of approved biological science courses. Chemistry and Mathematics are also required as supporting courses. Students must earn a grade of C- or better in all art and science courses included in the major and must earn a cumulative GPA of 2.00 in both categories. A brochure is available in 102 Catt Hall that gives a detailed listing of the requirements.

Communication Proficiency Requirement. Students must earn a minimum of C in both English 150 and 250 or equivalent composition courses and in one advanced writing course numbered Engl 302 through 316.

Students in BPM I must complete a senior project or an internship experience (BPM I 497) in which they design and produce artwork that is suitable for publication or public display.

A minor in biological illustration is offered. A minimum of 17 credits must be taken, including 8 credits in biological science courses and 9 credits in art and design courses. The biological sciences must include Biol 211, 211L, 212, and 212L. The art and design courses must include BPM I 323 and 337, and an advanced drawing, illustration, electronic media, or painting course. For more information, contact the BPM I adviser in 102 Catt Hall or view the website listed above.

Courses primarily for undergraduate students

BPM I 323. Scientific Illustration Principles and Techniques. (Cross-listed with ArtIS). (0-6) Cr. 3. Repeatable. F. *Prereq: 6 credits in art and design and 3 credits in biological sciences.* Studio basics and professional techniques in black & white, continuous tone, and color. Emphasis on tools, materials, and rendering.

BPM I 326. Illustration and Illustration Software. (Cross-listed with ArtIS). (0-6) Cr. 3. S. *Prereq: 323.* Application of painting, drawing, and image making techniques to communication. Development of technical abilities using illustration software. Digital and print production techniques.

BPM I 327. Illustration as Communication. (Cross-listed with ArtIS). (0-6) Cr. 3. F. *Prereq: 326.* Studio problems in illustration emphasizing composition and communication. Problem solving methodologies.

BPM I 337. Application of Scientific Illustration Techniques. (Cross-listed with ArtIS). (0-6) Cr. 3. Repeatable. S. *Prereq: 327.* Rendering techniques applied to different types of biological and scientific subjects emphasizing communication. The use of traditional and digital media. Term project required.

BPM I 395. Field Illustration. Cr. arr. Repeatable. S.SS. *Prereq: Permission of instructor.* A combination seminar and field trip course emphasizing nature interpretation, field sketching techniques and preparation of a final illustration based on field experience.

BPM I 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the program cooperative education coordinator, junior classification.* Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

BPM I 435l. Illustrating Nature I Sketching. (Cross-listed with Ia LL). Cr. 2. SS. Sketching plants, animals and terrain. Visual communication, development of a personal style, and integration of typographic and visual elements on a page will be emphasized.

BPM I 436l. Illustrating Nature II Photography. (Cross-listed with Ia LL). Cr. 2. SS. Beginning to intermediate technical and compositional aspects of color photography of natural areas and their plants and animals.

BPM I 490. Independent Study. Cr. arr. Repeatable. *Prereq: Written approval of instructor and advisory committee chair on required form in advance of semester of enrollment.*

BPM I 494. Special Topics in Illustration. Cr. arr. Repeatable. Intensive exploration of illustration techniques in a studio or field setting.

BPM I 497. Illustration Internship. Cr. arr. Repeatable. *Prereq: Junior or senior classification in BPM I, written approval of supervising instructor and advisory committee chair on required form in advance of semester of enrollment.* Satisfactory-fail only.

Biological Systems Engineering

Administered by the Department of Agricultural and Biosystems Engineering

Rameshwar Kanwar, Chair of Department

Distinguished Professor: Brown

Distinguished Professor (Emeritus): H. Johnson

University Professor: Bern

University Professor (Emeritus): Baker

Professors: Chen, Downing, Glanville, Harmon, Hoff, Hurburgh, L. Johnson, Kanwar, Misra, Schwab, Van Leeuwen, Xin

Professors (Emeritus): Beer, Bekkum, Buchele, Bundy, Hazen, Hoerner, Keeney, Lovely, Maney, Mangold, Marley, Melvin, Miller, Pedersen, Riley, R. Smith

Professor (Collaborator): Laflen

Associate Professors: Anex, Bhandari, Birrell, Brumm, Burns, Freeman, Koziel, Mickelson, Raman, Steward, Tim

Associate Professor (Emeritus): Anderson, Greiner, Lorimor

Associate Professor (Collaborators): Han

Assistant Professors: Darr, Grewell, Helmers, Kaleita-Forbes, Keren, Kim, Soupir, Tang, Yu

Assistant Professor (Emeritus): Boyd, Bradshaw

Assistant Professors (Adjunct): Inyang, Shahan, Tong

Assistant Professors (Collaborators): Dunn, Malone

Lecturer: Snell

Courses primarily for undergraduate students

BSE 110. Experiencing Biological Systems Engineering. (0-2) Cr. 1. S. Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of biological systems engineering. Report writing, co-ops, internships, careers, registration planning.

BSE 201. Entrepreneurship and Internship Seminar. (Cross-listed with A E, TSM). (1-0) Cr. 1. F.S. *Prereq: Sophomore classification in AE, AST, BSE, or I Tec.* 8 week course. Overview of the entrepreneurial process and its importance in the economy and the engineering/ technical workplace. Preparation for internship experiences. Relationship of workplace competencies to entrepreneurship, intrapreneurship, and internships; portfolios.

BSE 216. Fundamentals of Agricultural and Biosystems Engineering. (Cross-listed with A E). (2-2) Cr. 3. S. *Prereq: A E 110, Engr 160, credit or enrollment in Math 166.* Application of mathematics and engineering sciences to mass and energy balances in agricultural and biological systems. Emphasis is on solving engineering problems in the areas of heat and mass transfer, air and water vapor systems; animal production systems, grain systems; food systems, hydrologic systems, and bioprocessing.

BSE 301. Leadership and Ethics Seminar. (Cross-listed with A E, TSM). (1-0) Cr. 1. F.S. *Prereq: 201.* 8 week course. Leadership and ethics experiences through case studies and seminar presentations by practitioners. Relationship of workplace competencies to leadership and ethics; portfolios.

BSE 316. Applied Numerical Methods for Agricultural and Biosystems Engineering. (Cross-listed with A E). (2-2) Cr. 3. F. *Prereq: Engr 160, Math 266.* Computer aided solution of agricultural engineering problems by use of numerical techniques and Mathematical models. Systems analysis and optimization applicable to agricultural and biological systems.

BSE 380. Principles of Biological Systems Engineering. (3-0) Cr. 3. S. *Prereq: 216, Ch E 357 or M E 436.* Unit-operation analysis of biological systems, through the study of mass, energy, and information transport in bioresource production and conversion systems. Quantification and modeling of biomass production, ecological interactions, and bioreactor operations.

BSE 401. Professionalism Seminar. (Cross-listed with A E, TSM). (1-0) Cr. 1. F.S. *Prereq: 301.* 8 week course. Examination of professionalism in the context of engineering and technology. Time, project and personnel management. Communications and professional portfolios. Professional licensure. Transition to professional careers.

BSE 411. Bioprocessing and Bioproducts. (Dual-listed with 511). (Cross-listed with A E, BioE, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

BSE 415. Agricultural Engineering Design I. (Cross-listed with A E). (1-2) Cr. 2. F.S. *Prereq: A E 271 or 272, E M 324.* Identification of current design problems in agricultural engineering. Development of alternate solutions using creativity and engineering analysis and synthesis techniques. Nonmajor graduate credit.

BSE 416. Agricultural Engineering Design II. (Cross-listed with A E). (1-2) Cr. 2. F.S. *Prereq: 415.* Selection of promising solutions to design problems identified in 415 for development by design teams. Presentation of designs through oral and written reports and prototypes. Nonmajor graduate credit.

BSE 480. Engineering Analysis of Biological Systems. (Dual-listed with 580). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: 216; Math 266; Biol 211 or 212; M E 330.* Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues.

BSE 511. Bioprocessing and Bioproducts. (Dual-listed with 411). (Cross-listed with A E, BRT, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

BSE 580. Engineering Analysis of Biological Systems. (Dual-listed with 480). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: 216; Math 266; Biol 211 or 212; M E 330.* Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues. Students enrolled in A E 580 will be required to answer additional exam questions and report on two journal articles.

Biology

www.biology.iastate.edu

(Interdepartmental Undergraduate Program)

James T. Colbert, Program Coordinator

Iowa State University is a major center for research and education in the biological sciences. With over 200 faculty in the life sciences, students have the opportunity to learn from some of the nation's leaders in biological research and teaching and to participate in innovative, meaningful research projects that explore frontiers of biology. Few other universities have such a wealth of faculty expertise available to undergraduate students, making Iowa State's Biology Program the logical choice for those who want to participate in a thriving academic community.

The faculties of the Department of Ecology, Evolution and Organismal Biology and the Department of Genetics, Development and Cell Biology jointly offer the undergraduate biology major. This high quality academic program has the flexibility to accommodate a range of career goals while taking advantage of the university's strengths in science and technology. A bachelor's degree in biology provides excellent preparation for graduate study in biological disciplines ranging from the molecular to the ecological levels, and for entrance into various professional schools, such as human medicine, physical therapy, or veterinary medicine. The major is well suited for those who plan to teach biology, who wish to enter government or industrial employment in health or environmental professions, or who prefer educational breadth as an end in itself. By working with our professional and faculty advisers, it is possible to design a unique program of study that will meet student needs and objectives.

Students with special interests and aptitudes should consider combining biology with a minor or a second major in another subject, such as chemistry, environmental studies, journalism, mathematics, music, statistics, or many other subjects offered by the university.

Undergraduate Study

Biology majors, start their studies in the biological sciences by taking a unified biology core curriculum consisting of six integrated courses, five with labs. The first year (Biol 211, 211L, 212, 212L) provides a broad introduction to the nature of life. During the first year, students also take Biol 110 and 111, which are half semester courses designed to introduce the student to the discipline of biology and opportunities for careers in biology. The second year explores concepts in ecology in Biol 312 and the principles of genetics in Biol 313 and 313L. The third year includes courses in cell and molecular biology (Biol 314, 314L) and evolutionary biology (Biol 315). Biology majors must take an additional 20 credits of biological science at the 300 level or above from an approved list of courses. Of these, at least 8 credits must be taken as biology courses, and a minimum of two laboratory or field courses must also be included. Students may earn the B.S. degree in Biology from either the College of Liberal Arts and Sciences or from the College of Agriculture and Life Sciences. Contact the Biology Program Office for details regarding differences in general education and course requirements which are specific to these colleges.

Biology majors should carefully consider their selection of upper-level courses to allow them to emphasize one or more of the sub-disciplines of Biology relevant to their post-baccalaureate objectives. The Biology Program has identified areas of special interest for many disciplines within Biology, with supporting 300-, 400-, and 500-level courses, enabling majors to gain substantial experience in these areas prior to graduation. Faculty advisers with experience in these subject areas work with students to provide advice about preparing for future training in a range of Biology-related professions. Consult the Biology Program advising staff for more information.

Most biology courses numbered 300 or above can be used to satisfy the additional credit requirement. Some courses taught in other departments can also be applied to the biology major; advanced students should consider including 500 level courses in their programs. Check the Biology Program's World Wide Web site for a complete listing of acceptable upper-level life science courses

Biology majors must demonstrate competency in their understanding of the biological sciences. Thus, grades of C- or better in all biological science courses applied to the major are required. Furthermore, in order to graduate, a student must have a cumulative average in the major of at least 2.00.

Courses offered at other locations

In addition to biological science courses taught on campus, students may take courses at various remote locations and arrange to have the credits count toward the advanced courses required in

the biology major. Courses in field and aquatic biology are offered at the Iowa Lakeside Laboratory. Courses in marine biology can be taken at the Gulf Coast Research Laboratory in Mississippi. Iowa State University is a member of the Organization for Tropical Studies, and students may take courses at the organization's field Station in Costa Rica. Courses taught at field Stations associated with other universities throughout the country may also be applied to the degree. Attending a summer field Station adds an important component to an undergraduate program of study.

Courses Offered at Iowa Lakeside Laboratory at Milford, Iowa

Iowa Lakeside Lab is an Iowa Regents facility located at Lake Okoboji in northwest Iowa where various summer courses in field and aquatic biology are offered. Any of the following courses taken at the lab are directly applicable to the degree program in Biology. See the *Iowa Lakeside Laboratory* entry elsewhere in the catalog for a full description of the courses.

Courses offered at Gulf Coast Research Laboratory

The Gulf Coast Research Laboratory is affiliated with the University of Southern Mississippi. Iowa State students may register for marine biology courses and transfer credit to their degree programs under the number Biol 480. Written permission of the Biology Program Director is required for this arrangement. Courses that are available each summer may be viewed at www.coms.usm.edu.

Courses offered at Summer Biological Field Stations

Courses taken at summer field Stations may be transferred to Iowa State University as credit in Biol 481. Such Stations are found throughout the country and often offer courses that emphasize the adaptation of plants and animals to unique environments. See www.biology.iastate.edu for links to field Stations in different biomes, e.g. marine/coastal, Great Lakes, taiga, deciduous forests, deserts, Rocky Mts.

Courses offered by the Organization for Tropical Studies

Iowa State students may register for courses in tropical biology taught in Costa Rica by the Organization for Tropical Studies. Credit is transferred to Iowa State as Biology 482. For further information check www.ots.duke.edu or inquire in the Biology Program Office.

Undergraduate research. Students who have interest in biological research are encouraged to become involved in the research projects of faculty members on campus. Those doing so may receive credit for the experience in Biol 490. Internship experiences are often available at other universities and at industrial or government laboratories. Students participating in such projects may receive internship credit in Biol 494. Making the effort to find a suitable research mentor and engaging in research work can be one of the most valuable experiences of an undergraduate education.

International experience. Because major discoveries in science often result from global efforts, biology majors are encouraged to include an international or study abroad component in their degree programs. This can be done by participating in international field trips originating from the ISU campus in Biol 394 or similar courses in other departments. Many students choose to study abroad, attending a university in another country for up to a year as an exchange student. Minors in Emerging Global Disease, International Studies, or a foreign language can add an international emphasis to a degree in biology. Biology advisers are eager to help plan and arrange such experiences with interested students.

Supporting course requirements. Understanding the modern biological sciences requires an understanding of the physical and Mathematical sciences. Consequently, a minimum number of credits in general chemistry, organic chemistry, biochemistry, and physics are required. See the Biology Program Web Site for specific supporting science requirements.

The Math requirement is competency based. After demonstrating competency in algebra and trigonometry, biology majors must take: two semesters of calculus; or two semesters of Statistics; or one semester of calculus and one semester of Statistics chosen from a list of approved courses available on the Biology Program Web Site and in the Biology Program Office.

Students in the College of Liberal Arts and Sciences, must fulfill the foreign language and general education requirements listed elsewhere in this catalog for that college. Students in the College of Agriculture and Life Sciences must meet the general education requirements for that college as listed elsewhere in the catalog.

Given the important role of writing in the modern sciences, biology majors must demonstrate English competency by earning a minimum of C in both English 150 and 250 or equivalent composition courses and in one advanced writing course numbered English 302 through 316, or JI MC 347.

Customizing a degree

The advantage of choosing a biology major is the flexibility it allows in customizing a program of study to individual goals. That said, the faculty recognizes that many students studying biology have common goals. Consequently, the faculty has developed specific recommendations for students interested in pursuing the following areas of study:

Teacher Licensure. Biology majors seeking licensure to teach biology in secondary schools must meet requirements of the Teacher Education Program as well as those of the Biology Program. In addition they must apply formally for admission to the teacher education program. See the section on Teacher Education for a list of licensure areas, degree requirements, and other information about this program.

Premedical and Prehealth Professions Studies. Biology majors who will go on to medical or health professional schools are urged to determine the entrance requirements for the institutions where they might study. A list of courses recommended for those who wish to pursue a pre-med curriculum is available in the Biology Program office.

Preveterinary Studies. Many students whose goal is to attend veterinary school choose Biology as their major. The requirements for entrance to the Iowa State Veterinary College are listed elsewhere in this bulletin and should be consulted as programs of study are planned.

Preparation for Graduate Studies. Students who are considering graduate school to further their education in a biological sciences should identify a faculty member who has similar interests. Faculty can mentor students as undergraduates providing a smooth transition to graduate school.

Minor

A minor in Biology is offered by the Biology Program. The minor requires 15 credits in Biology, and includes the completion of the specific courses listed below: Biol 211 and 211L, 212 and 212L, and 7 credits in biology courses numbered 300 or above. Nine (9) credits of the required courses must only apply to the minor. For more information, see the Biology Program Web Site, or contact the Biology, Environmental Science, and Genetics Student Services Office in 103 Bessey Hall.

Graduate Study

Biology is an undergraduate major only. Persons interested in graduate study in the biological sciences should apply directly to one of the life science graduate programs at Iowa State University. Interdepartmental graduate offerings in Bioinformatics and Computational Biology; Ecology and Evolutionary Biology; Genetics; Molecular, Cellular and Developmental Biology; Neuroscience; Plant Physiology; Toxicology; Immunobiology; and Environmental Science are also available. (See *Index*.)

A non-thesis master's degree in Interdisciplinary Graduate Studies (biological sciences) has been established particularly for those who wish to have a more diversified program of advanced study than that generally permitted by specific departments and programs.

Courses primarily for undergraduate students

Biol 101. Introductory Biology. (3-0) Cr. 3. F.S.SS. Life considered at cellular, organism, and population levels. Function and diversity of the living world. Presentation of basic biological principles as well as topics and issues of current human interest. Non-majors only. Only one of Biol 101 or 211 may count toward graduation.

Biol 110. Introduction to Biology. Cr. 0.5. F. Orientation to the scope of the biological sciences, and discussion of professional opportunities. Required of first year biology majors. Satisfactory-fail only.

Biol 111. Opportunities in Biology. (1-0) Cr. 0.5. S. Introduction to biological science disciplines and professional opportunities through faculty presentations which examine a variety of current research topics. Satisfactory-fail only.

Biol 155. Human Biology. (3-0) Cr. 3. F.S. A survey course of human biology, including principal structures and functions of the body systems and the diseases and disorders associated with them. Designed to meet general education requirements in natural science. Not recommended for those seeking a career in the allied health professions or for students majoring in life science.

Biol 165. Field Botany. (2-4) Cr. 2. F.SS. 8 weeks. Field and laboratory studies of plants in various local habitats. Includes trees, shrubs, flowering plants and other green plants, lichens and fungi. Not recommended for students with professional interest in plant science.

Biol 173. Environmental Biology. (Cross-listed with Env S). (3-0) Cr. 3. F.S. An introduction to the structure and function of natural systems at scales from the individual to the biosphere and the complex interactions between humans and their environment. Discussions of human population growth, biodiversity, sustainability, resource use, and pollution. Non-majors only.

Biol 204. Biodiversity. (Cross-listed with Env S). (4-0) Cr. 2. S. *Prereq: One course in life sciences*. Survey of the major groups of organisms and biological systems. Definition, measurements, and patterns of distribution of organisms. Sources of information about biodiversity. Not intended for major credit in the biological sciences. Half semester course.

Biol 211. Principles of Biology I. (3-0) Cr. 3. F.S. *Prereq: High school biology and chemistry or credit or enrollment in Chem 163 or 177.* Introduction to the nature of life, including the cellular basis of life; the nature of heredity; evolution; diversity of microbial, plant, and animal life; and principles of ecology. Intended for life science majors. Only one of Biol 101 or 211 may count toward graduation.

Biol 211L. Principles of Biology Laboratory I. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 211.* Laboratory to accompany 211.

Biol 212. Principles of Biology II. (3-0) Cr. 3. F.S. *Prereq: 211.* Introduction to the nature of life, including the cellular basis of life; energy relationships; the nature of heredity; evolution; form and function of microbial, plant, and animal life.

Biol 212L. Principles of Biology Laboratory II. (0-3) Cr. 1. F.S. *Prereq: credit or enrollment in 212.* Laboratory to accompany 212.

Biol 255. Fundamentals of Human Anatomy. (3-0) Cr. 3. F. *Prereq: high school biology and chemistry, or Biol 101.* An introduction to human anatomy, beginning with cells and tissues, surveying all body systems, relating form to function. Systems covered include: integumentary, bones and joints, muscles, nervous, sensory, endocrine, circulatory, lymphatic, respiratory, digestive, urinary, and reproductive. Pre-Medical students should consider Biol 351 for their anatomy background. Not intended for major credit in biology.

Biol 255L. Fundamentals of Human Anatomy Laboratory. (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 255.* Investigation of human anatomy using models and dissections of preserved organs and model mammals. Pre-Medical students should consider 351 for their anatomy background. Not intended for major credit in biology.

Biol 256. Fundamentals of Human Physiology. (3-0) Cr. 3. S. *Prereq: high school biology and chemistry, or Biol 101, or 255 (recommended).* An introduction to human physiology, studying the function of all body systems. Systems covered include: integumentary, bones and joints, muscles, nervous, sensory, endocrine, circulatory, lymphatic and immune, respiratory, digestive, urinary, and reproductive. Pre-Medical students should consider 335 for their physiology background. Not intended for major credit in biology.

Biol 256L. Fundamentals of Human Physiology Laboratory. (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 256.* Student-conducted experiments investigating concepts of human physiology with computer data acquisition and analysis. Interpretation of experimental results and preparation of lab reports. Pre-Medical students should consider 335 for their anatomy and physiology background. Not intended for major credit in biology.

Biol 258. Human Reproduction. (Cross-listed with W S). (3-0) Cr. 3. F. *Prereq: Biol 101, or 155, or 211.* Anatomy and physiology of human reproductive systems, including fertility, pregnancy, and delivery.

Biol 305. Embryology. (2-0) Cr. 2. S. *Prereq: 212.* Basic principles and processes of development. Course will cover classical as well as current aspects of developmental biology. Emphasis will be on vertebrate model systems. Not acceptable for credit in the major for Biology or Genetics major.

Biol 305L. Embryology Laboratory. (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 305.* Selected experiments demonstrating basic concepts in development. Mixture of live embryo experiments and vertebrate developmental anatomy.

Biol 306. Metabolic Physiology of Mammals. Cr. 3. Prereq: 211, 212. Introduction to physiology of metabolic function in mammals and other animals. Metabolic processes and their interactions with various subsystems, approached form an organismal perspective. Integration of cellular, gastrointestinal, cardiovascular, respiratory, and renal processes, relevant to their control and integration at the nervous and endocrine system levels. Functional aspects of organismal physiology; energy and water balances, physiology of rest exercise, and environmental stress. Students cannot receive credit for both Biol 306 and Biol 335

Biol 307. Women in Science and Engineering. (Cross-listed with W S). (3-0) Cr. 3. F. *Prereq: a 200 level course in science, engineering or women's studies; Engl 250.* The interrelationships of women and science and engineering examined from historical, sociological, philosophical, and biological perspectives. Factors contributing to underrepresentation; feminist critiques of science; examination of successful strategies.

Biol 312. Ecology. (Cross-listed with A Ecl, EnSci). (3-3) Cr. 4. F.SS. *Prereq: 211L and 212L.* Fundamental concepts and principles of ecology dealing with organisms, populations, communities and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats.

Biol 313. Principles of Genetics. (Cross-listed with Gen). (3-0) Cr. 3. F.S. *Prereq: 211, 211L, 212, and 212L.* Introduction to the principles of transmission and molecular genetics of plants, animals, and bacteria. Recombination, structure and replication of DNA, gene expression, cloning, quantitative and population genetics. Students may receive graduation credit for no more than one of the following: Gen 260, Gen 313 and 313L, Gen 320, Biol 313 and 313L, and Agron 320.

Biol 313L. Genetics Laboratory. (Cross-listed with Gen). (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 313.* Laboratory to accompany 313. Students may receive graduation credit for no more than one of the following: Biol 313 and 313L, Gen 260, Gen 313, Gen 320, and Agron 320.

Biol 314. Principles of Molecular Cell Biology. (3-0) Cr. 3. F.S. *Prereq: Biol 313.* Integration of elementary principles of metabolism, bioenergetics, cell structure and function to develop a molecular view of how the cell works.

Biol 314L. Molecular Cell Biology Laboratory. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 314.* Laboratory to accompany Biology 314.

Biol 315. Biological Evolution. (3-0) Cr. 3. F.S. *Prereq: 313.* The mechanisms of evolution. Topics in microevolution: population genetics, natural selection, genetic variation, and adaptation. Macroevolution: speciation, extinction, phylogeny, and major evolutionary patterns.

Biology 328. Cell Physiology of Human Diseases. (3-0) Cr. 3. Prereq: 212. Survey of macromolecular and ultrastructural organization of animal cell and membrane structures, including recent molecular discoveries in areas of genomics and proteomics involved with cell growth and cell interactions. Emphasis on selected topics of cellular functions with known human disease states.

Biol 330. Principles of Plant Physiology. (3-0) Cr. 3. *Prereq: Biol 313 or Gen 320; Biol 314 or BBMB 301; Chem 231 or 332; Phys 106 or 111.* An overview of classical and current concepts, principles and approaches regarding the basic mechanisms of plant function underlying growth, development and survival of plants. Topics covered include environmental and developmental signals, plant hormone action, signal transduction, mineral nutrition, water relations, metabolism and photosynthesis..

Biol 330L. Principles of Plant Physiology Laboratory. (0-3) Cr. 1. *Prereq: Credit or enrollment in 330.* Laboratory to accompany Biol 330. Experiments and explorations illustrating fundamental principles of plant physiology. Nonmajor graduate credit.

Biol 335. Principles of Animal Physiology. (3-3) Cr. 4. F.S. *Prereq: Biol 314.* Introduction to systemic functions with emphasis on mammals. Nonmajor graduate credit.

Biology 336. Ecological and Evolutionary Animal Physiology. (3-0) Cr. 3. *Prereq: 211, 212.* Study of mechanisms by which animals perform life-sustaining functions; the evolution and adaptive significance of physiology traits, the diversity of physiological mechanisms, and how physiology and ecology interact.

Biol 351. Comparative Chordate Anatomy. (3-4) Cr. 5. S. *Prereq: 212, junior classification.* The evolution of chordates as reflected in the anatomy of extinct and living forms. Lecture topics include the history and diversity of chordates; comparisons of anatomic structures among major groups, the adaptive significance of anatomic structures. Laboratory involves dissection of representative species.

Biol 352. Vertebrate Histology. (3-3) Cr. 4. S. *Prereq: 212.* Microscopic structure of vertebrate tissues and organs, with an introduction to histological techniques.

Biol 353. Introductory Parasitology. (Cross-listed with Micro). (3-3) Cr. 4. F. *Prereq: Biol 212.* Biology and host-parasite relationships of major groups of animal parasites, and techniques of diagnosing and studying parasites.

Biol 354. Animal Behavior. (3-0) Cr. 3. F. *Prereq: 212.* Ethological and Sociobiological approaches to animal behavior. Genetic and developmental aspects of behavior, biological rhythms, orientation (including navigation, migration), communication, and social behavior (mating, aggression, parental care).

Biol 354L. Laboratory in Animal Behavior. (0-3) Cr. 1. F. *Prereq: Credit or enrollment in Biol 354.* Laboratory techniques for observation, description and analysis of animal activities; independent projects.

Biol 355. Plants and People. (3-0) Cr. 3. S. *Prereq: Credit in 211 and 211L.* Uses of plants and fungi by humans and the importance of plants in the past, present and future. Discussion of fruits, vegetables, grains, herbs, spices, beverages, oils, fibers, wood, medicines, and drugs, in the context of their agricultural, cultural, and economic roles in modern Societies. Emphasis on origins and worldwide diversity of culturally important plants, their characteristics, and uses.

Biol 356. Dendrology. (Cross-listed with For). (2-4) Cr. 4. F. *Prereq: Biol 211.* Identification and ecology of North American woody plant species. Importance of woody plants in timber production and wildlife habitat. Natural disturbances, human impacts, management and restoration concerns for major North American forest regions will be addressed. Nonmajor graduate credit.

Biol 364. Invertebrate Biology. Cr. arr. F. *Prereq: Biol 212.* Emphasis on diversity, development, physiology and behavior of invertebrate organisms-the "spineless wonders" of the world. Laboratory involves hands-on study and investigation of living invertebrates.

Biol 365. Vertebrate Biology. (Cross-listed with A Ecl). (3-2) Cr. 4. F. *Prereq: 212, 212L.* Evolution, biology, and classification of fish, amphibians, reptiles, birds, and mammals. Emphasis on a comparative analysis of the structure and function of organ Systems. Laboratory exercises concentrate on morphology and identification of orders of vertebrates.

Biol 366. Plant Systematics. (2-4) Cr. 4. S. *Prereq: 211.* Introduction to plant phylogenetic systematics, plant classification, survey of flowering plant families, identification and field study of local plants.

Biol 371. Ecological Methods. (Cross-listed with A Ecl). (2-2) Cr. 3. F. *Prereq: 312; Stat 101 or 104.* Quantitative techniques used in management of natural resources with emphasis on inventory and manipulation of habitat and animal populations. Nonmajor graduate credit.

Biol 381. Environmental Systems I: Introduction to Environmental Systems. (Cross-listed with EnSci, Env S, Micro). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including Biology and chemistry.* Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

Biol 382. Environmental Systems II: Analysis of Environmental Systems. (Cross-listed with EnSci). (2-4) Cr. 4. S. *Prereq: EnSci 381.* Continuation of EnSci 381. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

Biol 393. North American Field Trips in Biology. Cr. arr. Repeatable. *Prereq: Two courses in the biological sciences and by approval of application.* Extended field trips, usually during break periods, to North American locations of interest to biologists. Inquire in the Biology Program Office, 103 Bessey Hall, for trip schedule.
A. Pre-trip Seminar. Cr. 1. Discussion of relevant biological and cultural topics during semester preceding trip.
B. Field trip. Cr. 1 to 3. Trip to North American location under supervision of faculty member. Report required.

Biol 394. International Field Trips in Biology. Cr. arr. Repeatable. *Prereq: Two courses in the biological sciences and by approval of application.* Extended field trips, usually during break periods, to international locations of interest to biologists. Inquire in the Biology Program Office, 103 Bessey Hall, for trip schedule.
A. Pre-trip Seminar. Cr. 1. Discussion of relevant biological and cultural topics during semester preceding trip.
B. Field trip. Cr. 1 to 3. Trip to international location under supervision of faculty member. Report required. Offered on a satisfactory-fail grading basis only.

Biol 423. Developmental Biology. (3-0) Cr. 3. S. *Prereq: Biol 313.* Principles of embryogenesis and animal development. Establishment of body axes, organ and limb development, and specification of cell fates. Emphasis on cell signaling and the control of gene expression within the context of a developing organism. Medically relevant subjects will be discussed, including stem cells, cancer biology, fertilization, and cloning.

Biol 423L. Developmental Biology Laboratory. (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 423.* Experiments and explorations illustrating fundamental principles of multicellular development.

Biol 428. Topics in Cell Biology. (3-0) Cr. 3. S. *Prereq: 314.* Selected topics on biological organization and function at the cellular level. Emphasis on biomembranes. Nonmajor graduate credit.

Biol 434. General Comparative Endocrinology. Cr. arr. S. *Prereq: 314.* Dual-listed with EEOB 534. Chemical integration of vertebrate organisms. The structure, development, and evolution of the endocrine glands and the function and structure of their hormones. Laboratory techniques for studying hormonal phenomena. Nonmajor graduate credit.

Biol 436. Neurobiology. (3-0) Cr. arr. F. *Prereq: Biol 335 or Psych 310; physics recommended; permission of instructor to enroll in lab.* (3-3) for 4 cr. Integration, coding, plasticity, and development in nervous systems. Nonmajor graduate credit.

Biol 436L. Neurobiology Laboratory. (0-3) Cr. 1. F. Prereq: Credit or enrollment in 436; permission of instructor to enroll in lab. Laboratory experimentation and demonstrations on integration, coding plasticity, and development in nervous systems. Nonmajor graduate credit.

Biol 439. Environmental Physiology. Cr. arr. Alt. S., offered 2010. *Prereq: 355 or A Ecl 311; physics recommended.* Dual-listed with EEOB 539. Physiological adaptations to the environment with an emphasis on vertebrates. Nonmajor graduate credit.

Biol 444. Introduction to Bioinformatics. (Cross-listed with BCB, Com S, Cpr E, Gen). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics. Nonmajor graduate credit.

Biol 454. Plant Anatomy. (3-3) Cr. 4. F. *Prereq: Biol 212L; 366 recommended.* Characteristics of cell and tissue types in vascular plants. Anatomy of developing and mature stems, roots, and leaves, including secondary (woody) growth. Introduction to the special anatomy of flowers and seeds. Nonmajor graduate credit.

Biol 455. Bryophyte and Lichen Biodiversity. (Dual-listed with EEOB.) Cr. 3. *Prereq: Biol 212, Biol 212L.* Introduction to the biology and ecology of mosses, liverworts, and lichens. Emphasis on identification and diversity of local representatives of these three groups of organisms. Required field trips and service-learning. Nonmajor graduate credit.

Biol 456. Principles of Mycology. (Cross-listed with Micro). (2-3) Cr. 3. F. *Prereq: 10 credits in biological sciences.* Morphology, diversity and ecology of fungi; their relation to agriculture and industry and human health. Nonmajor graduate credit.

Biol 457. Herpetology. (Cross-listed with A Ecl). (2-3) Cr. 3. F. *Prereq: A Ecl 365 or Biol 351.* Dual-listed with EEOB 557. Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodilians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

Biol 458. Ornithology. (Cross-listed with A Ecl). (2-3) Cr. 3. S. *Prereq: A Ecl 365 or Biol 351.* Dual-listed with EEOB 558. Biology, ecology, evolution, and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation. Laboratory exercises complement lecture topics, emphasize identification and distribution of Midwest birds, and include field trips.

Biol 459. Mammalogy. (Cross-listed with A Ecl). (2-3) Cr. 3. S. *Prereq: 351 or A Ecl 365.* Dual-listed with EEOB 559. Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. Laboratory focus on identification, distribution, habits, and habitats of mammals.

Biol 462. Evolutionary Genetics. (Cross-listed with Gen). (3-0) Cr. 3. S. *Prereq: Biol 315.* The genetic basis of evolutionary processes in higher organisms. The role of genetic variation in adaptation, natural selection, adaptive processes, and the influence of random processes on evolutionary change. Nonmajor graduate credit.

Biol 465. Morphometric Analysis. (3-2) Cr. 4. Alt. S., offered 2010. *Prereq: Stat 401.* Dual-listed with EEOB 565. A comprehensive overview of the theory and methods for the analysis of biological shape with emphasis on data acquisition, standardization, statistical analysis, and visualization of results. Methods for both landmark and outline data will be discussed. Nonmajor graduate credit.

Biol 471. Introductory Conservation Biology. (3-0) Cr. 3. Prereq: Biol 312. Examination of conservation issues from a population and community perspective. The role of genetics, demography, and environment in determining population viability, habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology.

Biol 472. Community Ecology. (2-2) Cr. 3. S. *Prereq: Biol 312.* The effect of interspecific interactions on the structure and dynamics of natural and managed communities; including concepts of guild structure and trophic web dynamics and their importance to the productivity, diversity, stability, and sustainability of communities. The implications of interspecifc interactions in the management of wild species will be emphasized with illustrative case histories of interactions between plants, invertebrates, and vertebrates. Nonmajor graduate credit.

Biol 474. Plant Ecology. (3-0) Cr. 3. S. *Prereq: Biol 312.* Principles of plant population and community ecology. Nonmajor graduate credit.

Biol 476. Functional Ecology. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312.* Dual-listed with EEOB 576. The nature of adaptations to physical and biotic environments. Biophysical, biomechanical, and physiological bases of the structure, form, growth, distribution, and abundance of organisms.

Biol 480. Studies in Marine Biology. Cr. arr. Repeatable. Courses taken at Gulf Coast Research Laboratory and other marine biological Stations are transferred to Iowa State University under this number.

Biol 481. Summer Field Studies. Cr. arr. Repeatable. Courses taken at summer biological field Stations are transferred to Iowa State University under this number. See www.biology.iastate.edu for links to field Stations located in different biomes: coastal, Great Lakes, taiga, deciduous forests, deserts, Rocky Mountains.

Biol 482. Tropical Biology. Cr. arr. Repeatable. *Prereq: One year of college biology; knowledge of Spanish desirable but not required.* Students registering for courses taught by the Organization for Tropical Studies will receive credit for this ISU course when requesting a transfer of credits.

Biol 484. Ecosystem Ecology. (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: Combined 12 credits in biology and chemistry.* Introduction of the study of ecosystems and the factors that influence their properties and dynamics. Conceptual foundations for ecosystem studies. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems.

Biol 486. Aquatic Ecology. (Cross-listed with EnSci, A Ecl). (3-0) Cr. 3. F. *Prereq: Biol 312 or EnSci 381 or EnSci 402 or NREM 301.* Dual-listed with EEOB 586. Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology. Nonmajor graduate credit.

Biol 486L. Aquatic Ecology Laboratory. (Cross-listed with A Ecl, EnSci). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in 486.* Dual-listed with EEOB 586L. Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts. Nonmajor graduate credit.

Biol 487. Microbial Ecology. (Cross-listed with EnSci, Micro). (3-0) Cr. 3. F. *Prereq: Six credits in biology and 6 credits in chemistry.* Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems. Nonmajor graduate credit.

Biol 488. Identification of Aquatic Organisms. (0-3) Cr. 1. F.S. On line taxonomic and identification exercises to accompany 486. Instruction and practice in the identification of algae, aquatic macrophytes, zooplankton, and benthos. Nonmajor graduate credit.

Biol 489. Population Ecology. (2-2) Cr. 3. F. *Prereq: Biol 312, Stat 101 or 104, a course in calculus, or graduate standing.* Dual-listed with EEOB 589. Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

Biol 490. Independent Study. Cr. arr. Repeatable. *Prereq: 8 credits in biology and permission of instructor.* Research opportunities for undergraduate students in the biological sciences. No more than 9 credits in Biol 490 may be counted toward graduation and of those, only 6 credits may be applied to the major.
I. Iowa Lakeside Laboratory. (Same as Ia LL 490I) Cr. 1 to 4 each time taken. See Iowa Lakeside Laboratory.
R. Biological research. Cr. 1 to 6 each time taken. For students registering to work on an independent research project under the direction of a faculty member.

Biol 491. Laboratory Teaching Experience. Cr. arr. Repeatable. *Prereq: Permission of supervising staff. For students* registering to be undergraduate laboratory assistants. Satisfactory-fail only.

Biol 494. Biology Internship. Cr. arr. Repeatable. *Prereq: 8 credits in biology and permission of instructor.* Intended to provide credit for significant professional experiences in biological sciences. A written proposal is required prior to registration. Intended for Biology majors.

Biol 495. Undergraduate Seminar. Cr. arr. Repeatable. F.S. *Prereq: 15 credits in biological science; permission of instructor.* Content varies from year to year and may include detailed discussion of special topics in biology, current issues in biology, or careers in biology.

Biol 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Junior classification and permission of the department cooperative education coordinator.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Biomedical Sciences

James Bloedel, Chair of Department

Distinguished Professors: Anderson, Kanthasamy

Distinguished Professors (Emeritus): Christensen, Dellmann

University Professor: Draper

University Professors (Emeritus): Adams, Reece

Professors: Bloedel, Evans, Franke, Goff, Hsu, King, Lin, Martin, Nara, Riedesel, Sharp, Uemura, Ware

Professors (Emeritus): Ahrens, Bal, Carithers, Dyer, Engen, Ghoshal, Randic

Associate Professors: Bracha, Carlson, Day, Jeftinija, Millman, Sakaguchi, Singh

Associate Professors (Emeritus): Crump, Martin

Associate Professors (Collaborators): Hamouche, Kangas, Richt

Assistant Professors: M. Greenlee, Kanthasamy, Kimber, Palic, Rowe

Assistant Professor (Adjunct): Singh

Assistant Professors (Collaborators): Barton, J. Greenlee, Kesl, Kwon

Senior Lecturer: Bolser

Lecturer: Kibbel

Professional Program of Study

For professional curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see Veterinary Medicine, Curriculum.

A good foundation in anatomy, physiology, and pharmacology of animals is necessary to understand the mechanisms of animal disease processes and their treatment. Study of mammalian anatomy and physiology prepares students with a background in the structural and functional activities of cells, tissues, organs, and body systems relevant to veterinary medicine.

An understanding of drug action is essential for rational drug therapy. The general pharmacology courses provide students with a background in basic pharmacology to include pharmacodynamics, toxicology, and the clinical application of drugs. Special emphasis is placed on chemical agents and therapeutic practices specific to veterinary medicine.

Graduate Programs

The department offers Master of Science and Doctor of Philosophy degrees with a major in Biomedical Sciences and specializations in Anatomy, Physiology, Pharmacology, and Cell Biology. Up to 10 credits of dual-listed veterinary courses may be applied for major graduate credit. Departmental research facilities allow for training in experimental anatomy, pharmacology, and physiology. Graduate studies are supervised by faculty members recognized in their areas of expertise. Current areas of research include: Alzheimer's disease, aquatic animal health, calcium and mineral homeostasis, diabetes mellitus, glia-neuron signaling, neurophysiology of pain, neurotoxicology, physiology and pharmacology of nematode ion-channels, Parkinson's disease, pharmacology of schistosomiasis, pharmacology of salmonellosis, physiology and pharmacology of thalamic neurons, physiology of the retina, Spinal Muscular Atrophy, and study of neural stem cells. The objective of the department is to prepare graduate students for successful careers in biomedical research and professional service. The department is part of interdepartmental programs in neuroscience, toxicology, and molecular, cellular, and developmental biology. The combined Ph.D./DVM program is an option offered by the department.

Courses primarily for undergraduate students

B M S 329. Anatomy and Physiology of Domestic Animals. (3-0) Cr. 3. S. *Prereq: Biol 212, 212L.* Survey of body systems of domestic animals. Provides a medical science orientation particularly useful to students in a preveterinary medicine curriculum.

Courses primarily for professional curriculum students

B M S 330. Principles of Morphology I. (Dual-listed with 530). (3-6) Cr. 5. F. *Prereq: First-year classification in veterinary medicine.* Anatomy of the dog.

B M S 331. Principles of Morphology II. (Dual-listed with 531). (2-6) Cr. 4. S. *Prereq: First-year classification in veterinary medicine.* Comparative and topographic anatomy of horse, ruminants, pig, and chicken.

B M S 333. Biomedical Sciences I. (5-3) Cr. 6. F. *Prereq: First-year classification in veterinary medicine.* Microscopic anatomy and physiology of cells, tissues, cardiovascular system, respiratory system, and urinary system.

B M S 334. Biomedical Sciences II. (5-3) Cr. 6. S. *Prereq: First-year classification in veterinary medicine.* Microscopic anatomy of the immune system and integument. Microscopic anatomy and physiology of the digestive system, endocrine system, and reproductive system.

B M S 337. Neuroanatomy. (Dual-listed with 537). (2-2) Cr. 3. S. *Prereq: First-year classification in veterinary medicine.* Neuroanatomy of domestic animals.

B M S 339. Clinical Foundations I. (Cross-listed with V C S). (0-2) Cr. 1. F. *Prereq: First-year classification in veterinary medicine.* Canine physical examination; basic behavior, animal handling and restraint; medical record keeping.

B M S 345. Case Study I. (0-2) Cr. 1. F. *Prereq: First-year classification in veterinary medicine.* Clinical applications of basic sciences taught concurrently in the fall semester of the first year curriculum in veterinary medicine.

B M S 346. Case Study II. (0-1) Cr. 1. S. *Prereq: First-year classification in veterinary medicine.* Clinical applications of basic sciences taught concurrently in the spring semester of the first year curriculum in veterinary medicine.

B M S 354. General Pharmacology. (Dual-listed with 554). (3-0) Cr. 3. S. *Prereq: 333, 334.* General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems. Nonmajor graduate credit.

B M S 355. Topics in Molecular Veterinary Medicine. (Dual-listed with 555). (1-0) Cr. 1. S. *Prereq: Enrollment in or completion of 354..* Receptor and signal transduction anomalies and their diagnosis in veterinary medicine.

B M S 401. Intro to Aquatic Animal Medicine. (Cross-listed with A Ecl). (1-2) Cr. 1. S. 8 week course. Introductory course with focus on fin fish production, health and medicine. Course content will help define future roles for veterinarians, producers, and service providers. Emphasis will be placed on anatomy, pathology, infectious diseases, nutrition, regulatory constraints in production, food safety, and current research. Field trip to aquaculture facility.

B M S 403. Behavior of Domestic Animals. (1-0) Cr. 1. Alt. S., offered 2010. *Prereq: Classification in veterinary medicine.* Normal and abnormal behavior of domestic animals.

B M S 415. Anatomy of Laboratory Animals. (Dual-listed with 515). (1-2) Cr. 2. Alt. S., offered 2010. *Prereq: One year of college biology.* Gross and microscopic anatomy of laboratory animals.

B M S 416. Avian Anatomy. (Dual-listed with 516). (1-2) Cr. 2. Alt. S., offered 2011. *Prereq: One year college biology.* Gross and microscopic anatomy of domestic, exotic, and pet birds.

B M S 421. Special and Applied Anatomy of the Horse. (1-3) Cr. 2. F. *Prereq: 330 or 331 or An S 316 or 415, classification in veterinary medicine.* Special and applied anatomy of the horse. Nonmajor graduate credit.

B M S 443. Pharmacology and Therapeutics. (Dual-listed with 543). (3-0) Cr. 3. F. *Prereq: 354.* Pharmacology and therapeutic uses of fluids, antimicrobial and antiparasitic drugs, clinical use of veterinary drugs, and adverse drug reactions.

B M S 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*
H. Honors

B M S 496. International Preceptorship. (0-40) Cr. arr. Repeatable. S. *Prereq: Second-year classification in veterinary medicine.* International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduate students

B M S 501. Selected Research Methods in Biomedical Sciences. (0-8) Cr. 3. F.S.SS. *Prereq: Graduate classification, permission of a BMS faculty member.* Experience in biomedical techniques in selected BMS laboratories that include but is not limited to cytochemical methods, molecular biological techniques, extracellular and intracellular unit recording, microiontophoresis, microinjection, spectrophoto-fluorometric analysis of chemicals, use of radioisotopes, radioimmunoassay, Ca2+ imaging, confocal microscopy, fluorescence microscopy, and immunocytochemistry.

B M S 515. Anatomy of Laboratory Animals. (Dual-listed with 415). (1-2) Cr. 2. Alt. S., offered 2010. *Prereq: One year of college biology and graduate classification..* Gross and microscopic anatomy of laboratory animals.

B M S 516. Avian Anatomy. (Dual-listed with 416). (1-2) Cr. 2. Alt. S., offered 2011. *Prereq: One year college biology.* Gross and microscopic anatomy of domestic, exotic, and pet birds.

B M S 530. Principles of Morphology I. (Dual-listed with 330). (3-6) Cr. 5. F. *Prereq: 10 credits in biological science and permission of the instructor.* Anatomy of the dog.

B M S 531. Principles of Morphology II. (Dual-listed with 331). (2-6) Cr. 4. S. *Prereq: B M S 530.* Comparative and topographic anatomy of horse, ruminants, pig, and chicken.

B M S 537. Neuroanatomy. (Dual-listed with 337). (2-2) Cr. 3. S. *Prereq: 10 credits in biological science and permission of the instructor.* Neuroanatomy of domestic animals.

B M S 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BBMB, BCB, FS HN, Hort, NutrS, VDPAM, EEOB, NREM, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

B M S 543. Pharmacology and Therapeutics. (Dual-listed with 443). (3-0) Cr. 3. F. *Prereq: 554.* Pharmacology and therapeutic uses of fluids, antimicrobial and antiparasitic drugs, clinical use of veterinary drugs, and adverse drug reactions.

B M S 549. Advanced Vertebrate Physiology I. (Cross-listed with An S, Kin). (3-0) Cr. 3. F. *Prereq: Biol 335, credit or enrollment in BBMB 404 or 420.* Neurophysiology, sensory systems, muscle, neuroendocrinology, and endocrinology.

B M S 552. Advanced Vertebrate Physiology II. (Cross-listed with An S, Kin, NutrS). (3-0) Cr. 3. S. *Prereq: Biol 335, credit or enrollment in BBMB 404 or 420.* Cardiovascular, renal, respiratory, and digestive physiology.

B M S 554. General Pharmacology. (Dual-listed with 354). (Cross-listed with Tox). (3-0) Cr. 3. S. *Prereq: 549 and 552; BBMB 404, 405.* General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems.

B M S 555. Topics in Molecular Veterinary Medicine. (Dual-listed with 355). (1-0) Cr. 1. S. *Prereq: Enrollment in or completion of 554 and graduate classification.* Receptor and signal transduction anomalies and their diagnosis in veterinary medicine.

B M S 556. Cellular, Molecular and Developmental Neuroscience. (Cross-listed with GDCB, Neuro). Cr. arr. F. *Prereq: Biol 335 or Biol 436; physics recommended.* Fundamental principles of neuroscience including cellular and molecular neuroscience, nervous system development, sensory, motor and regulatory systems.

B M S 575. Cell Biology. (Cross-listed with Tox). (3-0) Cr. 3. F. *Prereq: 10 credits in biological science and permission of instructor.* A multi-instructor course covering major topics in cell structure and function, including: universal features of prokaryotic and eukaryotic cells, types of utilization and conversion of energy, genetic control of cell shape and functionality, internal organization of cells, communication between cells and their environment, development of multicellular systems. Students have to write a term paper.

B M S 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*
A. Anatomy
B. Physiology
C. Pharmacology
D. Cell biology

B M S 599. Creative Component. Cr. arr. F.S.SS. *Prereq: Enrollment in BMS graduate program, and permission of instructor..* Creative component for non-thesis Master of Science degree.

Courses for graduate students

B M S 688. Research Review. Cr. 1. Repeatable. F.S. *Prereq: Enrollment in BMS graduate program.* A forum for B M S students to gain experience in the critical exchange of ideas through oral presentation and discussion of scientific information.

B M S 690. Advanced Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*
A. Anatomy
B. Physiology
C. Pharmacology
D. Cell biology

B M S 698. Seminar. Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in BMS graduate program..*
A. Cr. R each time taken. F.
S. Attendance required. B. Cr. 1 each time taken. F.S.S
S. Attendance and presentation required. Offered on a satisfactory-fail grading basis only.

B M S 699. Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in BMS graduate program..*
A. Anatomy
B. Physiology
C. Pharmacology
D. Cell biology

Biorenewable Resources and Technology

www.biorenew.iastate.edu

(Interdepartmental Graduate Program)

D. R. Raman, Chair

Program Coordinating Committee: R. Anex, R.C. Brown, L. Johnson, G. Kraus, M. Liebman, B. Nikolau, B. Shanks

Over 60 Iowa State University faculty members from 16 academic departments and five colleges are affiliated with the Biorenewable Resources and Technology (BRT) graduate program; a complete and up-to-date listing is maintained at: www.biorenew.iastate.edu.

Graduate Study

The graduate program in Biorenewable Resources and Technology (BRT) offers students advanced study in the use of plant and crop-based resources in the production of biobased products (fuels, chemicals, materials, and energy). The BRT program was the first graduate program in biorenewable resources established in the United States. This multi-disciplinary program offers the degrees of master of science and doctor of philosophy in Biorenewable Resources and Technology, and a minor to students taking major work in other departments. The curriculum is designed to encourage students to obtain co-major degrees in Biorenewable Resources and Technology and a more traditional science or engineering discipline. A thesis is required for the master of science degree.

Prerequisite to major graduate work is a bachelor's degree or prior graduate training in engineering or a physical or biological discipline, including agricultural sciences.

The core required courses in the Biorenewable Resources and Technology graduate program include: a foundation course entitled BRT 501 "Fundamentals of Biorenewable Resources", BRT 506 "Biobased Products Seminar", BRT 590 "Special Topics", and BRT 591L "Biorenewable Resources Laboratory". The elective core courses must come from an approved list of courses from a variety of traditional disciplines encompassing one or more of four areas crucial to the development of biobased products: plant science, production, processing, and utilization. Students must complete elective core courses from at least three of the four topical areas, selected in consultation with the student's Program of Study (POS) committee

Graduates of the program will be equipped with skills to develop and manage cost effective and environmentally attractive technologies for producing fuels, chemicals, materials, foods and energy from renewable plant biomass.

Information on application procedures and specific requirements of the major can be obtained from the following Internet address: www.biorenew.iastate.edu

Courses primarily for graduate students, open to qualified undergraduate students

BRT 501. Fundamentals of Biorenewable Resources. (3-0) Cr. 3. S. *Prereq: Undergraduate training in an engineering or physical or biological discipline or degrees in agriculture or economics.* Introduction to the science and engineering of converting biorenewable resources into bioenergy and biobased products. Survey of biorenewable resource base and properties; description of biobased products; methods of biorenewable resource production; processing technologies for fuels, chemicals, materials, and energy; environmental impacts; economics of biobased products and bioenergy.

BRT 506. Biobased Products Seminar. Cr. arr. F.S. *Prereq: Undergraduate training in an engineering or physical or biological discipline or degrees in agriculture or economics.* Taken one semester for 1 credit and remaining semesters as R credit. Seminars and discussion on current topics in biorenewable resources and technology. Satisfactory-fail only.
A. Cr. 1. Paper required.
B. Cr.
R. Attendance only.

BRT 511. Bioprocessing and Bioproducts. (Cross-listed with A E, BSE, C E). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 101 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofules, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis. Term paper for graduate level only.

BRT 535. Thermochemical Processing of Biomass. (Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: Undergraduate course work in thermodynamics and transport phenomena.* Introduction to thermal and catalytic processes for the conversion of biomass to biofuels and other biobased products. Topics include gasification, fast pyrolysis, hydrothermal processing, syngas to synfuels, and bio-oil upgrading. Application of thermodynamics, heat transfer, and fluid dynamics to bioenergy and biofuels.

BRT 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Investigation of an approved topic on an individual basis. Course content and requirements to be designed and developed in consultation with the student's major professor or instructor, but in all cases a formal report should be written.

BRT 591L. Biorenewable Resources Laboratory. (0-3) Cr. 1. Repeatable. F.S.SS. *Prereq: Permission of student's major professor and instructor.* Special topics laboratory and research experience in biorenewable resources and technology that affords an experience beyond thesis-focused research. To be designed in consultation with the student's major professor and instructor. A laboratory report is required. For student in the BRT program, BRT 591L may be taken twice. For student in the BRT program, BRT 591L may be taken twice.

Courses for graduate students

BRT 699. Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of student's major professor.*

Botany

www.eeob.iastate.edu

Interdepartmental Graduate Major

Robert S. Wallace, Director of Graduate Education

Participating Faculty: D. Bassham, L. Clark, J. Colbert, W. Crumpton, D. Farrar (Emeritus), H. Horner, T. Jurik, K. Moloney, J. Nason, D. Oliver, J. Pritchard (Adjunct), J. Raich, S. Rodermel, L. Tiffany (Emeritus), M. Spalding, A. van der Valk, R. Wallace, J. Wendel, B. Wilsey, E. Wurtele

Undergraduate Study

Students wishing to pursue an undergraduate degree in the basic plant sciences are encouraged to investigate the numerous possibilities available to them at Iowa State University. The undergraduate Biology Program, jointly administered by faculties of the departments of Ecology, Evolution, and Organismal Biology (EEOB) and Genetics, Cell and Developmental Biology (GDCB), includes a wide spectrum of opportunities for students to develop their academic interests through the study of plant biology. Students can major in Biology in the College of Liberal Arts and Sciences or in the College of Agriculture. Contact the Biology Student Services office in 103 Bessey Hall for general information about the Biology Program. For those students interested in applied plant sciences, undergraduate majors in Agronomy, Horticulture, and Forestry are also available through the College of Agriculture.

Graduate Study

The Botany Graduate Program offers work for the degrees Master of Science and Doctor of Philosophy with a graduate major in Botany, and minor work for students majoring in other departments or graduate programs. Within the Botany Graduate Major, one of the following areas of specialization may be designated: aquatic and wetland ecology, cytology, ecology, morphology, mycology, physiology and molecular biology, or systematics and evolution. Relevant graduate courses that may be counted toward completion of these degrees are offered by the Departments of EEOB and GDCB, and by other departments and programs. The specific requirements for each student's course distribution and research activities are set by the Program of Study Committee established for each student individually, and must satisfy all requirements of the Graduate College (See *Index*). GRE (and if necessary, TOEFL) scores are required of all applicants; students are encouraged to contact faculty prior to application.

Related interdepartmental graduate majors in Ecology and Evolutionary Biology (EEOB); Environmental Science (EnSci); Genetics (IG); Molecular, Cellular and Developmental Biology (MCDB); Plant Physiology (IPPM); and Toxicology should also be investigated as possible graduate programs with specific disciplinary focus.

At present, the Botany Graduate Program is under review and may change Status in the near future. Before applying for admission to the Botany Graduate Major, prospective students should contact the Botany Graduate Program Director of Graduate Education Dr. Robert Wallace (rwallace@iastate.edu) for specific details about the program's Status and application procedures.

Business Administration

Labh S. Hira, Dean

Undergraduate Study

Kay M. Palan, Professor in charge, Undergraduate Programs in Business.

For undergraduate curriculum leading to the degree bachelor of science, majors in accounting, business economics, finance, management, management information systems, marketing, operations and supply chain management, logistics and supply chain management and a secondary major in international business, see College of Business, Curricula.

The department of Business Administration supports the undergraduate programs in the departments of Accounting, Finance, Logistics, Operations, and Management Information Systems, Management, and Marketing by providing specialized coursework in orientation to business, and cooperative education opportunities.

Graduate Study

Michael Crum, Professor in Charge, Graduate Programs in Business

The College of Business offers work towards two graduate programs in business administration: the master of business administration (MBA) and the master of science in business (M.S.), which are described below. The college also has two specialized master degree programs: the master of accounting (M.Acc.), which is described under the Department of Accounting and the master of science in information systems (M.S.I.S.) which is described under Management Information Systems. The college also offers a Ph.D. in business and technology, with specialization in customer management, supply chain management, and management of information technology. Finally, the College of Business is a participating member of the following interdepartmental programs: master of science in transportation, master of science in seed technology and business, master of science and Ph.D. in human computer interaction, and master of science in information assurance.

Master of Business Administration (M.B.A.)

The College of Business offers a 48 credit program leading to a nonthesis master of business administration degree with a specialization in accounting, agribusiness, family financial planning, finance, information systems, international business, marketing, or supply chain management. The coursework is designed to provide the knowledge, skills, and abilities for managerial success and leadership in organizations. The M.B.A. is the professional management education program for those pursuing careers in business.

Students working toward the M.B.A. are required to complete a series of core courses in the basic functional areas of business (accounting, economics, statistics, finance, supply chain management, organizational behavior, management information systems, marketing, international business, ethics and social responsibility, strategic management), and advanced elective coursework.

Courses for the M.B.A. are provided by the departments of Accounting, Economics, Finance, Logistics, Operations and Management Information Systems, Management, Marketing, and Statistics. Courses from other departments may also be chosen to meet specific student interests.

A concurrent B.S./M.B.A. is available to eligible engineering undergraduate students majoring in civil, computer, electrical, industrial, or mechanical engineering. The College of Business and the College of Veterinary Medicine offer a concurrent M.B.A./D.V.M. degree.

Double master's degree programs are offered with architecture (M.Arch./M.B.A.), community and regional planning (M.B.A./ M.C.R.P.), information systems (M.B.A./M.S.I.S.) and Statistics (M.B.A./ M.S.-Statistics).

Students may enroll in the M.B.A. on either a full-time or part-time basis. The part-time M.B.A. is designed for employed professionals. Part-time MBA classes are held in the evenings in Ames and Des Moines.

The M.B.A. program is open to all individuals with a baccalaureate degree. Undergraduates from liberal arts, science, and technical programs are especially encouraged to apply. Academic potential and promise for a productive career in business and for managerial success and leadership in organizations are important criteria for admission. Applicants must submit Graduate Management Admission Test (GMAT) scores, official transcripts of previous academic work, personal essays, a resume, and three letters of reference. International students whose native language is not English and who did not graduate from a U.S. college or university are required to submit the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS) scores.

Applicants are considered for fall semester entry only into the full-time M.B.A. Although applications will be considered after this date, candidates are encouraged to submit their application materials by June 1 (March 1 for international students). Part-time M.B.A. applications are considered for fall, spring, or summer entry.

Master of Science (M.S.) in Business

The College of Business offers graduate work leading to the master of science degree with a major in business. All the departments in the college, (Accounting, Finance, Logistics, Operations and Management Information Systems, Management, and Marketing), and the departments of Economics and Statistics cooperate in providing coursework toward this degree. The program is designed to serve those students who desire specialized study of an area within business at the master's level. It also serves to develop their research capabilities.

The M.S. degree is best suited for students with degrees or academic backgrounds in business as they may complete the program within the 30 credit minimum. Students without business backgrounds are required to fulfill pre-requisites and common body of knowledge coursework in accounting, finance, management information systems, marketing, organizational behavior, supply chain management, global business, business ethics, and strategy. The program is composed of 7 credits of required courses in economics and Statistics plus 3 to 6 credits of thesis and 17 to 20 credits of coursework in an area of emphasis. The student, with the help of a program of study committee, designs an educational program in specialized functional or industry areas within business.

Application deadline for the M.S. program is May 1 for fall admission and November 1 for spring admission. Applicants must submit official transcripts of previous educational coursework and degrees, the Graduate Management Admission Test (GMAT) scores, personal essays, resume, and three letters of reference. International students whose native language is not English and who did not graduate from a U.S. college or university are required to submit the Test of English as a Foreign Language (TOEFL) scores.

Ph.D. in Business and Technology

The College of Business offers graduate work leading to the doctor of philosophy degree in business and technology, with one of three specializations—customer management (CM), supply chain management (SCM), or management of information technology (MIT). Many departments in the college (Logistics, Operations, Management Information Systems, marketing and Management), and the departments of Statistics, Economics, Psychology and Sociology cooperate in providing coursework toward this degree. The program will prepare individuals for academic careers in research, teaching, and public service at institutions of higher learning in the United States and other countries. The PhD program consists of a 44-credit course curriculum followed by a 12-credit thesis or dissertation.

Students do not need to have an undergraduate or master's degree in business in order to qualify for enrollment in the PhD program. However, students without a graduate degree in business will be required to complete 18 hours of business foundation requirements. These include:

- Financial and managerial accounting (min. 2 Cr)
- Corporate finance (min. 2 Cr)
- Strategic management (min. 2 Cr)
- Management information systems (min. 2 Cr)
- Marketing (min. 2 Cr)
- Supply chain management (min. 2 Cr)
- Economics – micro and macro (min. 6 Cr)

Students can choose one of three areas of specialization—CM, SCM or MIT. The customer management (CM) area will focus on identification and delivery of solutions that help improve the ways in which businesses attract, capture, service and maintain customers. To do these activities well, organizations will need to integrate process goals and activities across different functional areas and across multiple organizational partners. This area of study will examine issues relating to inter-functional and inter-organizational relationships and their management in pursuit of maximizing the lifetime value of a businesses' customer base.

The supply chain management (SCM) specialization will focus on the design, development, and control of business processes for conversion of inputs into outputs and distribution of those outputs. The traditional focus of SCM was on integration of processes across multiple functions within the firm—operations management, logistics, and purchasing primarily, with elements of marketing and information systems included as well. However, in today's world, where competition is across supply chain networks, SCM, just like CM, will involve integrating business processes across firms.

The management of information technology (MIT) specialization examines issues related to the development, building, management, and use of information and knowledge-based technologies. Such technologies enable users to collect organizational data, provide a platform for organizing and disseminating the data, and offer operational, decision support, and knowledge management tools through which users can leverage data and information for making better organizational decisions. Students in the MIT specialization will study areas such as information technology analysis and development, database and knowledge management systems, decision support and data mining, human computer interaction, system security and integrity, and project management and collaborative teamwork.

Programs of study for the doctoral study are designed for each student in consultation with the major professor and the student's PhD committee. Each student must complete advanced courses in their area of specialization, a minor area that supports the major area, and research methods. Students must demonstrate competence in theory and research methods by passing qualifying examinations.

Application deadline for the Ph.D. program is February 1 for fall admission. Applicants must submit official transcripts of previous educational coursework and degrees, the Graduate Management Admission Test (GMAT) scores, personal essays, resume, and three letters of reference. International students whose native language is not English and who did not graduate from a U.S. college or university are required to submit TOEFL (Test of English as a Foreign Language) scores.

Courses primarily for undergraduate students

BusAd 101. Orientation. (1-0) Cr. 0.5. F.S. First 8 weeks. A required orientation for all College of Business students. Review of college and university requirements, transfer credits, academic planning, university policies and deadlines, and registration procedures. Includes group advising for course selection and registration. Either BusAd 101 or 102 may be counted towards graduation. Satisfactory-fail only.

BusAd 101H. Orientation. (1-0) Cr. 0.5. F. *Prereq: Membership in the Freshman Honors Program.* Designed to supplement the Freshman Honors orientation (Hon 121) with college specific information, to facilitate the development of Honors programs of study in business, and to acquaint students with university policies and procedures. Either BusAd 101 or 102 may be counted towards graduation. Satisfactory-fail only.

BusAd 102. Expanded Orientation. (1-0) Cr. 1. F.S. A required orientation for all College of Business Students involved with a Business Learning Team. Review of college and university requirements, transfer credits, academic planning, university policies and deadlines and registration procedures. Includes a consideration of various business majors and careers, tools for success in college including writing skills and presentations from employers, alumni and current students. Either BusAd 101 or 102 may be counted towards graduation. Satisfactory-fail only.

BusAd 150. Computer Competencies for Business. Cr. R. Students will demonstrate proficiency in MS Word, Excel, and PowerPoint, as well as the ability to conduct research using the Internet, use WebCT, and communicate via e-mail. Self-paced instruction available for students who are unable to demonstrate appropriate proficiency. Satisfactory-fail only.

BusAd 201. Career Issues in Business. (1-0) Cr. 0.5. F.S. *Prereq: 101.* Eight-week course designed to provide students with knowledge of careers in business and issues relevant to any workplace. Presentations by business professionals, current students who have previously interned, and faculty and staff with knowledge of careers in the various majors. Includes coverage of diversity and ethics issues in the workplace. Satisfactory-fail only.

BusAd 250. Introduction to Business. (3-0) Cr. 3. *Prereq: 101, 150 or Com S 103.* Introduction to the functional areas of business and how the functional areas are integrated for the purpose of implementing business strategy. Introduces students to decision making tools (spreadsheets and databases) that are integral to business decision making. Includes application exercises to all functional areas of business.

BusAd 291. Experiential Learning. Cr. arr. Repeatable. *Prereq: Written approval of supervising instructor and department chair on required form prior to the learning experience.* Supervised travel and/or work experience in a business related discipline. Satisfactory-fail only.
A. Domestic Internship.
B. International Internship.
C. Domestic Travel and Study.
D. International Travel and Study.

BusAd 292. Entrepreneurship & Innovation Learning Community (EILC) Seminar. (1-0) Cr. 1. *Prereq: Current member of or have applied to be a member of Entrepreneurship and Innovation Learning Community (see www.isupjcenter.org/ELC for more information).* Topics related to entrepreneurship and entrepreneurial thinking. Presentations by entrepreneurs and faculty, field trips, business concept development.

BusAd 301. Professional Employment Preparation. (1-0) Cr. 0.5. *Prereq: 201.* Eight-week course designed to provide students with the skills to develop and implement a professional job search and to function professionally in a workplace setting. Topics include resume and professional correspondence, interviewing, working a career fair, the comprehensive job search, evaluating offers, business etiquette, networking, and transitioning to employee. Satisfactory-fail only.

BusAd 325. Biorenewable Systems. (Cross-listed with A E, Agron, An S, Econ, TSM). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing.

BusAd 398. Cooperative Education. Cr. R. Repeatable. *Prereq: Permission of department.* Required of all cooperative students. Students must register for this course prior to commencing each work period. No more than three credits may be taken in addition to BusAd 398 during any given semester. Satisfactory-fail only.

BusAd 490. Independent Study. Cr. arr. Repeatable. *Prereq: 490A: Mgmt 414, Mkt 448, LSCM 466 or Fin 380; senior classification, permission of instructor; for 490H: Admission to the Business Honors Program.*
A. International Business
E. Entrepreneurship
H. Honors

BusAd 491. Professional Experiential Learning. Cr. arr. Repeatable. *Prereq: Professional program, 12 credits from College of Business; written approval of supervising instructor and department chair on required form prior to the learning experience.* Supervised travel and/or work experiences in a business related discipline. Satisfactory-fail only.
A. Domestic Internship.
B. International Internship.
C. Domestic Travel and Study.
D. International Travel and Study.
E. Other Experiential Learning Experience.

BusAd 492. The Washington Center Experience. Cr. arr. *Prereq: Professional program, written approval of supervising instructor and department chair on required form prior to the learning experience.* Participation in The Washington Center seminar/internship program. Includes seminars/forums, work experience, and a portfolio of experiences.

Courses primarily for graduate students, open to qualified undergraduate students

BusAd 501. Strategy and Planning. (2-0) Cr. 2. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Critical analysis of current practice and case studies in strategic management with an emphasis on integrative decision making. Strategy formulation and implementation will be investigated in the context of complex business environments.

BusAd 503. information Systems. (2-0) Cr. 2. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Introduction to a broad variety of information systems (IS) topics, including current and emerging developments in information technology (IT), IT strategy in the context of corporate strategy, and IS planning and development of enterprise architectures. Cases and discussions highlight the techniques and tactics used by managers to cope with strategic

issues within an increasingly technical competitive environment.

BusAd 504. Marketing and Logistics. (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Integration of the business functions concerned with the marketing and movement of goods along the supply chain with the primary goal of creating value for the ultimate customer. Coordination of marketing, production, and logistics activities within the firm and with outside suppliers and customers in the supply chain.

BusAd 507. Organizational Behavior. (2-0) Cr. 2. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Understanding human behavior in organizations, and the nature of organizations from a managerial perspective. Special emphasis on how individual differences, such as perceptions, personality, and motivation, influence individual and group behavior in organizations and on how behavior can be influenced by job design, leadership, groups, and the structure of organizations.

BusAd 508. Accounting and Finance. (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Survey of fundamental topics in accounting and finance. Financial statement reporting and analysis for agriculture firms, corporate governance issues related to financial reporting, (e.g., Sarbanes-Oxley). Basic tools and techniques used in financial management, including stock and bond valuation. How to assess and use capital budgeting methods to evaluate proposed firm investments.

BusAd 509. Seed Trade, Policy and Regulation. (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor.* Cultural, financial, economic, political, legal/regulatory environments shaping an organization's international business strategy. Topics include entry (and repatriation) of people, firms, goods, services, and capital. Special attention to the institutions of seed regulation and policy. Ethical issues facing managers operating in an international context.

BusAd 533. Economic and Business Decision Tools. (Cross-listed with Econ). (3-0) Cr. 3. *Prereq: Econ 501 or Econ 532.* Team taught by faculty in the Department of Economics and the College of Business, this course focuses on applied economic and business tools for decision making. The topics covered include: Monte Carlo analysis with applications to option pricing and insurance mechanism design, portfolio analysis using existing standard spreadsheet software and add-ons, dynamic programming tools for inventory management and sequential decisions, discrete choice modeling and Statistical bootstrapping, and financial performance evaluation using commercially available software.

BusAd 591. Professional Experiential Learning. Cr. arr. Repeatable. *Prereq: Graduate standing; written approval of supervising instructor and department chair on required form prior to the learning experience.* Academically supervised travel and/or work experiences in a business related discipline.

BusAd 592. MBA Professional Skills Development. Cr. R. *Prereq: Admission to Full-time MBA Program.* Provides first-year MBA students with tools necessary to develop and implement a successful internship and career search, and to develop professional skills critical for success in the competitive business environment. Topics include career search strategy, resume and cover letter development, interviewing, strategic networking, salary negotiation, impression management, team skills development, presentation skills development, and business etiquette. Required for all full-time MBA students. Satisfactory-fail only.

BusAd 598. Cooperative Education. Cr. R. *Prereq: Permission of instructor.* Professional work experience. Students must register for this course prior to commencing work. Satisfactory-fail only.

BusAd 599. Creative Component. Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair.* Preparation and writing of creative component.
A. Accounting
C. Finance
E. Management
F. Marketing
H. Logistics and Supply Chain Management
I. Agribusiness
J. General Business
K. Management Information Systems
L. Operations and Supply Chain Management

Courses primarily for graduate students

BusAd 699. Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification, permission of major professor.* Research.

Chemical Engineering

(Administered by the Department of Chemical and Biological Engineering)

www.cbe.iastate.edu

James Hill, Chair of Department

Distinguished Professors: Brown, Reilly

Distinguished Professors (Emeritus): Burnet, Doraiswamy, Seagrave

University Professor: Hill

University Professor (Emeritus): Wheelock

Professors: Fox, Glatz, Hebert, Jolls, Kushner, Mallapragada, Narasimhan, Rollins, B. Shanks, J. Shanks

Professors (Emeritus): Abraham, Boylan, Schrader, Ulrichson, Youngquist

Professor (Collaborator): Porter

Associate Professors: Hillier, Olsen, Vigil

Associate Professor (Emeritus): Collins

Associate Professors (Adjunct): Hanneman

Assistant Professors: Clapp, Cochran, Dong, Jarboe, Lamm, O'Donnell, Schneider

Senior Lecturer: Loveland

Lecturer: Stiehl

Undergraduate Study

For undergraduate curriculum in chemical engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*. This curriculum is accredited by the Engineering Accreditation Commission of ABET.

Chemical engineering is a profession which provides a link between scientific knowledge and manufactured products. The chemical engineer relies on science, experience, creativity, and ingenuity to produce these materials economically. Almost everything of a material nature used by Society today has at some point felt the influence of the chemical engineer. From raw materials such as minerals, coal, petroleum, and agricultural products, chemical engineers create versatile intermediate and commodity chemicals, high performance fuels, new materials for construction, pharmaceuticals, high performance foodstuffs, synthetic textiles, plastics, solid state electronic components, and dozens of other engineered materials. The chemical engineer's influence has been important in the development of catalysts, fuel cells, automatic controls, biochemical processes, artificial kidneys, tissue engineering, nuclear energy, medical instruments and devices, as well as in the development of air and water pollution control systems. Many new and equally exciting challenges await the practicing chemical engineer of the future.

The profession of chemical engineering embraces a wide variety of activities including research, process development, product development, design, manufacturing supervision, technical sales, consulting, and teaching. The engineer can be behind a desk, in a laboratory, in a manufacturing plant, or engaged in nationwide and worldwide travel. Successful chemical engineers find chemistry, mathematics, and physics to be interesting and exciting. Many chemical engineers also have interest in the biological sciences. The curriculum in chemical engineering includes continued study of chemistry, mathematics, and physics as well as intensive study in the engineering sciences such as chemical reaction engineering, thermodynamics, mass transfer, fluid mechanics, heat transfer, system analysis and process synthesis, and design.

The curriculum in chemical engineering is designed to produce graduates that have the ability to apply knowledge of mathematics, science, and engineering; the ability to design, conduct and interpret experiments, and the ability to design a chemical engineering system, component, or process. Graduates should also have the ability to function on multi-disciplinary teams; the ability to identify, formulate, and solve chemical engineering problems; and the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The curriculum should also assure that graduates have the ability to communicate effectively, the broad education necessary to understand the impact of chemical engineering solutions in a global and Societal context, and recognition of the need for, and an ability to engage in life-long learning, as well as a knowledge of contemporary issues and an understanding of professional and ethical responsibility.

The curriculum assures that graduates have a thorough grounding in chemistry, along with a working knowledge of advanced chemistry such as organic, inorganic, physical, analytical, materials chemistry, or biochemistry. In addition, a working knowledge, including safety and environmental aspects, of material and energy balances applied to chemical processes; thermodynamics of physical and chemical equilibria; heat, mass, and momentum transfer; chemical reaction engineering; continuous and stage-wise separation operations; process dynamics and control; process design; and appropriate modern experimental and computing techniques is assured.

A significant number of chemical engineering graduates should have an ability to function as engineers in an international setting, and an ability to pursue research and advanced studies in chemical engineering, or in related fields such as medicine, law, and business.

A cooperative education program is available to students in chemical engineering. See *Cooperative Programs, College of Engineering.*

Graduate Study

The department offers work for the degrees master of science, master of engineering, and doctor of philosophy with major in chemical engineering, and minor work to students taking major work in other departments. Prerequisite to major graduate work is a bachelor's degree in chemical engineering, chemistry, or other related field. Students with undergraduate background other than chemical engineering should contact the department for further details. A thesis is required for the master of science degree. The master of science degree also requires a minimum of 30 graduate credits (minimum of 15 for coursework,

13 within Ch E and 2 outside). The master of engineering requirements are the same for credits and include a special project rather than research thesis. The doctor of philosophy degree requires a minimum of 72 graduate credits (minimum of 30 for coursework, 19 inside Ch E and a minimum of 8 credits taken outside of Ch E). Candidates for the doctor of philosophy degree can refer to the department's home page and/or the department's Graduate Student Handbook for degree options and credit requirements.

Courses primarily for undergraduate students

Ch E 104. Chemical Engineering Learning Community. Cr. R. F.S. *Prereq: Enrollment in Chemical Engineering Learning Team.* (1-0) Curriculum in career planning and academic course support for Freshmen learning team.

Ch E 204. Chemical Engineering Continuing Learning Community. Cr. R. F.S. *Prereq: Corequisite-enrollment in Chemical Engineering Learning Team.* (1-0) Curriculum and career planning, academic course support for learning community.

Ch E 210. Material and Energy Balances. (3-0) Cr. 3. F.S. *Prereq: Chem 178, Math 166.* Introduction to chemical processes. Physical behavior of gases, liquids, and solids. Application of material and energy balances to chemical engineering equipment and processes.

Ch E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

Ch E 302. Seminar. (1-0) Cr. 1. F. *Prereq: Junior classification in chemical engineering.*

Ch E 310. Computational Methods in Chemical Engineering. (3-0) Cr. 3. F.S. *Prereq: 210 and Engr 160.* Numerical methods for solving systems of linear and nonlinear equations, ordinary differential equations, numerical differentiation and integration, and nonlinear regression using chemical engineering examples. Nonmajor graduate credit.

Ch E 325. Chemical Engineering Laboratory I. (0-4) Cr. 2. F.S. *Prereq: 357, credit or enrollment in 381.* Experiments covering fundamental material and energy balances, momentum and energy transport operations, and thermodynamics. Computer applications. Nonmajor graduate credit.

Ch E 356. Transport Phenomena I. (3-0) Cr. 3. F.S. *Prereq: 210, Phys 221, credit or enrollment in Math 267.* Momentum and mechanical energy balances. Incompressible and compressible fluid flow. Applications to fluid drag, piping system design, filtration, packed beds and settling. Nonmajor graduate credit.

Ch E 357. Transport Phenomena II. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in 310; 356.* Conduction and diffusion, convective heat and mass transfer, boiling and condensation, radiation, and design of heat exchange equipment. Introduction to diffusion. Nonmajor graduate credit.

Ch E 358. Separations. (3-0) Cr. 3. F.S. *Prereq: 310, 357.* Diffusion and mass transfer in fluids. Analysis and design of continuous contacting and multistage separation processes. Binary and multicomponent distillation, absorption, extraction, evaporation, membrane processes, and simultaneous heat and mass transfer. Nonmajor graduate credit.

Ch E 381. Chemical Engineering Thermodynamics. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in 310; Math 267, Phys 222, Chem 325.* Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of fluids, phase equilibria, and chemical reaction equilibria. Nonmajor graduate credit.

Ch E 382. Chemical Reaction Engineering. (3-0) Cr. 3. F.S. *Prereq: Credit in 310; 381, credit or enrollment in 357.* Kinetics of chemical reactions. Design of homogeneous and heterogeneous chemical reactors. Nonmajor graduate credit.

Ch E 391. Foreign Study Orientation. Cr. arr. *Prereq: Credit or enrollment in 357 and 381 or permission of instructor.* Credit for graduation allowable only upon completion of Ch E 392. Satisfactory-fail only.
A. Foreign Study Orientation ISU (1-0) Cr. 1.
S. B. Foreign Study Orientation Europe Cr. 2. SS.

Ch E 392. Foreign Study Program. Cr. 4. SS. *Prereq: 391A, enrollment in 391B.* Study of chemical engineering including laboratories and lectures at University College London or other collaborating international universities. Comparative study of U.S. and international manufacturing facilities. Expenses required.

Ch E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period. Students must register for this course prior to commencing work.

Ch E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* One semester maximum per academic year professional work period. Students must register for this course prior to commencing work.

Ch E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

Ch E 406. Environmental Chemodynamics. (3-0) Cr. 3. F. *Prereq: 381, credit or enrollment in 358.* Examines the mechanisms and rates of chemical transport across air, water, and soil interfaces. Applications of transport and thermodynamic fundamentals to movement of chemicals in the environment. Nonmajor graduate credit.

Ch E 408. Surface and Colloid Chemistry. (Dual-listed with 508). (3-0) Cr. 3. F. *Prereq: 381 or equivalent.* Examines the factors underlying interfacial phenomena, with an emphasis on the thermodynamics of surfaces, structural aspects, and electrical phenomena. Application areas include emulsification, foaming, detergency, sedimentaton, fluidization, nucleation, wetting, adhesion, flotation, and electrophoresis. Nonmajor graduate credit.

Ch E 415. Biochemical Engineering. (Dual-listed with 515). (3-0) Cr. 3. S. *Prereq: 357, 382 recommended, Chem 331.* Application of basic chemical engineering principles in biochemical and biological process industries such as enzyme technology and fermentation. Nonmajor graduate credit.

Ch E 421. Process Control. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in 358, 382, Math 267.* Control of industrial chemical processes. Device applications and limitations. Dynamics of chemical process components and process control systems. Nonmajor graduate credit.

Ch E 426. Chemical Engineering Laboratory II. (0-4) Cr. 2. F.S. *Prereq: 325, 358, 382.* Experiments in heat and mass transfer, staged operations, chemical reactor performance, unit processes. Computer applications. Only one of Ch E 426 or 427 may count toward graduation. Nonmajor graduate credit.

Ch E 427. Biological Engineering Laboratory. (0-4) Cr. 2. S. *Prereq: Credit in 325, 358, 382 and BBMB 301.* Experiments on biological applications in chemical engineering. Only one of Ch E 426 or 427 may count toward graduation. Nonmajor graduate credit.

Ch E 430. Process and Plant Design. (2-6) Cr. 4. F.S. *Prereq: 358, 382.* Synthesis of chemical engineering processes, equipment and plants. Cost estimation and feasibility analysis. Nonmajor graduate credit.

Ch E 440. Biomedical Applications of Chemical Engineering. (Dual-listed with 540). (3-0) Cr. 3. *Prereq: 210, Math 266, Phys 222.* Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical engineering and applied physiology; survey of biomedical engineering; biomaterials; biomedical imaging. Nonmajor graduate credit.

Ch E 442. Polymers and Polymer Engineering. (Cross-listed with Mat E). (3-0) Cr. 3. S. *Prereq: 382 and Chem 331 or Mat E 351.* Chemistry of polymers, addition and condensation polymerization. Physical and mechanical properties, polymer rheology, production methods. Applications of polymers in the chemical industry. Nonmajor graduate credit.

Ch E 490. Independent Study. (0-18) Cr. arr. Repeatable. Introduction to research methods; investigation of an approved topic.
H. Honors

Ch E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Ch E 499. Undergraduate Research. (0-9) Cr. 3. Repeatable. *Prereq: Permission of department.* Research in chosen area of chemical engineering, with final written report. Students are encouraged to elect this course for two consecutive semesters. For students majoring in chemical engineering. No more than 6 credits of Ch E 499 may be counted toward graduation.

Courses primarily for graduate students, open to qualified undergraduate students

Ch E 508. Surface and Colloid Chemistry. (Dual-listed with 408). (3-0) Cr. 3. F. Examines the factors underlying interfacial phenomena, with an emphasis on the thermodynamics of surfaces, structural aspects, and electrical phenomena. Application areas include emulsification, foaming, detergency, sedimentation, fluidization, nucleation, wetting, adhesion, flotation, and electrophoresis. Term project required for graduate credit.

Ch E 515. Biochemical Engineering. (Dual-listed with 415). (3-0) Cr. 3. S. *Prereq: 357, 382, Chem 331.* Application of basic chemical engineering principles in biochemical and biological process industries such as enzyme technology and fermentation. Term project required for graduate credit.

Ch E 540. Biomedical Applications of Chemical Engineering. (Dual-listed with 440). (3-0) Cr. 3. *Prereq: 210, Math 266, Phys 222.* Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical engineering and applied physiology; survey of biomedical engineering; biomaterials; biomedical imaging. Term project required for graduate credit.

Ch E 542. Polymeric Biomaterials. (3-0) Cr. 3. *Prereq: Chem 331 or a polymers class.* Polymeric biomaterials, overview of biomaterial requirements, different classes of polymers used as biomaterials, specific bioapplications of polymers.

Ch E 545. Analytical and Numerical Methods. (3-0) Cr. 3. F. *Prereq: 358, Math 267.* Analysis of equipment and processes by analytic and/or numerical solution of descriptive differential equations. Operational and series techniques, boundary value problems, numerical interpolation and approximation, integration techniques.

Ch E 554. Integrated Transport Phenomena. (4-0) Cr. 4. F. *Prereq: 357, 381, Math 267, credit or enrollment in 545.* Conservation equations governing diffusive and convective transport of momentum, thermal energy and chemical species. Transport during laminar flow in conduits, boundary layer flow, creeping flow. Heat and mass transport coupled with chemical reactions and phase change. Scaling and approximation methods for Mathematical solution of transport models. Diffusive fluxes; conservation equations

for heat and mass transfer; scaling and approximation techniques; fundamentals of fluid mechanics; unidirectional flow; creeping flow; laminar flow at high Reynolds number; forced-convection heat and mass transfer in confined and unconfined laminar flows.

Ch E 562. Bioseparations. (3-0) Cr. 3. *Prereq: 357 or advanced standing in a science major.* Principles and techniques for separation and recovery of biologically-produced molecules, especially proteins. Relationship between the chemistry of biological molecules and efficient separation and preservation of biological activity. Includes centrifugation and filtration, membrane processing, extraction, precipitation and crystallization, chromatography, and electrophoresis.

Ch E 572. Turbulence. (Cross-listed with Aer E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Aer E 543 or M E 538.* Qualitative features of turbulence. Statistical and spectral representation of turbulent velocity fields: averages, moments, correlations, length and time scales and the energy cascade. Averaged equations of motion, closure requirements, Reynolds stress, dissipation rate. Isotropic turbulence, homogeneous shear flows, free shear flows, wall bounded flows. Scalar transport, particulate transport.

Ch E 583. Advanced Thermodynamics. (3-0) Cr. 3. F. *Prereq: 381.* Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of non-ideal fluids and solutions; phase and chemical-reaction equilibria/stability.

Ch E 587. Advanced Chemical Reactor Design. (3-0) Cr. 3. S. *Prereq: 382.* Analysis of complex reactions and kinetics. Fixed bed, fluidized bed, and other industrial reactors. Analysis and design of non-ideal flow mixing, and residence times. Heterogeneous reactors.

Ch E 590. Special Topics. Cr. arr. Repeatable. Investigation of an approved topic on an individual basis.

Ch E 595. Special Topics. Cr. arr. Repeatable.
A. Separations
B. Advanced Control Theory
C. Crystallization
D. Thermodynamics
G. Biological Engineering
I. Materials & Biomaterials
J. Protein Engineering/Bioseparations
K. Surfaces
L. Combinatorial Design

Ch E 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

Ch E 601. Seminar. Cr. R. Repeatable. F.S. Satisfactory-fail only.

Ch E 625. Metabolic Engineering. (3-0) Cr. 3. *Prereq: 382, Chem 331.* Principles of metabolic engineering. Emphasis on emerging examples in biorenewables and plant metabolic engineering. Overview of biochemical pathways, determination of flux distributions by stoichiometric and labeling techniques; kinetics and thermodynamics of metabolic networks; metabolic control analysis; genetic engineering for overexpression, deregulation, or inhibition of enzymes; directed evolution; application of bioinformatics, genomics, and proteomics.

Ch E 632. Multiphase Flow. (Cross-listed with M E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: M E 538.* Single particle, mutliparticle and two-phase fluid flow phenomena (gas-solid, liquid-solid and gas-liquid mixtures); particle interactions, transport phenomena, wall effects; bubbles, equations of multiphase flow. Dense phase (fluidized and packed beds) and ducted flows; momentum, heat and mass transfer. Computer solutions.

Ch E 642. Principles and Applications of Molecular Simulation. (3-0) Cr. 3. *Prereq: 545.* Principles of Statistical physics. General features of molecular simulations including Monte Carlo (MC) methods, molecular mechanics (MM), and molecular dynamics (MD). Overview of intermolecular and interatomic potentials. Evaluation of phase equilibria, free energies, and surface/interfacial properties. Coarse-grained methods.

Ch E 652. Advanced Transport. (3-0) Cr. 3. *Prereq: 552 and 553.* Advanced topics in momentum transport, fluid mechanics, and mass transport including study of recent literature.

Ch E 688. Catalysis and Catalytic Processes. (3-0) Cr. 3. *Prereq: 382.* Principles and applications of heterogeneous and homogeneous catalysis. Adsorption. Reaction kinetics and mass transfer effects. Catalyst characterization. Industrial catalytic processes.

Ch E 690. Advanced Topics. Cr. arr. Repeatable.
A. Separations
B. Advanced Statistical Modeling and Control
C. Crystallization
D. Thermodynamics
E. Protein Engineering/Bioseparations
F. Biological Engineering
G. Materials & Biomaterials
H. Surfaces
I. Combinatorial Design

Ch E 697. Engineering Internship. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of major professor, graduate classification.* One semester and one summer maximum per academic year professional work period.

Ch E 699. Research. Cr. arr. Repeatable.

Chemistry

www.chem.iastate.edu

Jacob Petrich, Chair of Department

Distinguished Professors: Barton, Corbett, Gordon, Larock, Thiel

Distinguished Professors (Emeritus): Angelici, Espenson, Fritz, Johnson, Ruedenberg, Yeung

University Professors: Hoffman, Kraus, Verkade

Professors: Geoffroy, Greenbowe, Holme, Hong, Houk, Jenks, Lin, Miller, Petrich, Schmidt-Rohr, Shin, Trahanovsky, Windus, Woo

Professors (Emeritus): Franzen, Gerstein, Hutton, Jacobson, McCarley, Powell, Russell, Struve

Professor (Adjunct): Bakac, Pruski

Professor (Adjunct Emeritus): Trahanovsky

Professor (Collaborator): Porter

Associate Professors: Hillier, Pohl, Song, Zhao

Assistant Professors: Fang, Jeffries-El, Lee, Sadow, Smith, Stauffer

Senior Lecturers: Burnett

Lecturers: Bonaccorsi, Kingston

Undergraduate Study

For undergraduate curricula in liberal arts and sciences leading to the degrees bachelor of science and bachelor of arts, see *Liberal Arts and Sciences, Curriculum*.

Graduates holding the B.S. degree in chemistry qualify in many fields: as teachers of chemistry, as supervisors in industry, as technical sales personnel, and as research chemists in federal, state, municipal, academic, or industrial laboratories. Students with high scholastic standing often continue with graduate work, where they can explore more thoroughly the specialized areas of chemistry in which they are interested.

The B.A. degree is useful for students who intend to pursue studies in parallel areas, such as secondary school teaching, or to obtain joint majors or strong minors. The B.A. degree does not prepare students as well for graduate study or professional employment in chemistry.

Graduates have firm foundations in the fundamentals and application of current chemical theories. They are able to design, carry-out, record, and analyze the results of chemical experiments. They are able to use modern instrumentation and classical techniques to identify and solve chemical problems as well as explore new areas of research. Graduates are able to communicate the results of their work to chemists, as well as non-chemists. They understand the ethical and environmental dimensions of problems and issues facing chemists. They follow the proper procedures and regulations for safe storage, labeling, use of chemicals, and disposal of chemicals. Graduates are skilled in problem solving, critical thinking, and analytical reasoning. These skills can be applied to careers in education and industry and professions such as law, medicine, environmental sciences, and forensic sciences. The curricula in chemistry are approved by the American Chemical Society (ACS). Students who complete the program obtain an ACS certified baccalaureate degree provided they also take one Biochemistry course, typically BBMB 301 or 404.

Liberal arts majors who wish to transfer into chemistry at the end of their second year may still complete all degree requirements and graduate within five years.

Undergraduate students seeking the B.S. degree in chemistry usually take courses essential to the degree program according to the following schedule:

First year: Chem 177 and 178, or 201, 177L or 201L; 211, 211L; Math 165, 166; Engl 150; Lib 160.

Second year: Chem 331, 332, 333L, 334L; Math 265; Phys 221, 222.

Third year: Chem 324, 325, 322L, 316, 316L, 301; Engl 250 or 250H; Foreign language requirement.

Fourth year: Chem 402, 401L, 2 advanced chemistry courses (minimum 4 credits). Chem 399 or 499 is strongly recommended. Credits earned in 399/499 can only be used to meet one of the advanced course requirements.

Chemistry majors seeking certification to teach chemistry in secondary schools must meet the requirements of the College of Human Sciences as well as those of the chemistry program. In addition, they must apply formally for admission to the teacher education program.

Undergraduate students seeking the B.A. degree in chemistry have the following courses in their degree programs as minimum requirements: 177, 178, and 177L, or 201 and 177L or 201L; 211, 211L, 301, 316, 316L, 324, 321L or 322L, 325, 331, 331L, 332, 332L. Math 165, 166 and Phys 221, 222 are required as supporting work.

The Department offers a minor in chemistry which may be earned by credit in Chem 177, 177L (or 167 and 167L), 178, 211, 211L, 324, 331, 331L and one of the following: Chem 301; 316 and 316L or 325 and 321L, or 332 and 332L. The total minimum credits in chemistry thus will be 20 to 23 depending on which advanced courses are selected.

Communication Proficiency requirement: The Department requires a grade of C– or better in each of English 150 and 250 or 250H.

Graduate Study

The Department offers work for the degrees master of science and doctor of philosophy with majors in chemistry analytical, inorganic, organic, and physical chemistry. Co-majors may be taken between areas within chemistry or between one of the areas in chemistry and another department. Courses in other areas of chemistry as well as courses in other departments may be used to satisfy the requirement for coursework outside the major field. A Ph.D. student in chemistry may choose an additional specialty in one of the six areas: Materials Chemistry, Industrial Chemistry,

Biomolecular Sciences, Chemistry Education, Chemical Instrumentation, and forensic Chemistry. A minimum of ten credits is required for each additional specialty. A course which counts towards an additional specialty may also count toward the outside course requirement. A minor in chemistry is available to students in other departments. The Department participates in the interdepartmental major in toxicology.

The Department of Chemistry requires all graduate students majoring in chemistry to teach as part of their training for an advanced degree. Prerequisite to major graduate work is the completion of undergraduate work in chemistry, mathematics, and physics substantially equivalent to that required of undergraduate chemistry majors at this institution.

The course numbers for general chemistry courses include 155-178, and 201.

Index to field of work for 200 level courses and above is given by the second and third digits of course numbers:

(a) Inorganic Chemistry 00-09
(b) Analytical Chemistry 10-19
(c) Physical Chemistry 20-29 and 60-69
(d) Organic Chemistry 30-39
(e) Chemical Education 50-59
(f) Interdisciplinary Chemistry 70-89
(g) Research 99

Courses primarily for undergraduate students

Chem 050. Preparation for College Chemistry. (3-0) F. *Prereq: 1 year high school algebra.* An in-depth active learning experience designed to impart the fundamental concepts and principles of chemistry, with an emphasis on Mathematics skills and logical thinking. For students intending to enroll in general chemistry and who have not taken high school chemistry or who have not had a high school college preparatory chemistry course. Credit for Chem 50 does not count toward graduation.

Chem 155. Foundations of Chemistry for Engineers. (3-0) Cr. 3. F. *Prereq: Math 140 or the high school equivalent.* The first semester of a two semester sequence covering principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. Chem 155 may not be counted for credit toward graduation in any engineering curriculum.

Chem 160. Chemistry in Modern Society. (3-0) Cr. 3. Alt. S., offered 2010. Aspects of chemistry visible to a nonscientist in our Society. A survey of selected areas of chemistry with emphasis on the interface between chemistry and other fields of human activity.

Chem 163. College Chemistry. (4-0) Cr. 4. F.S. *Prereq: 1 year of high school algebra and geometry and either Chem 50 or 155 or 1 year of high school chemistry; and credit or enrollment in 163L.* The first semester of a two semester sequence. A general survey of chemistry and properties with an emphasis on conceptual problems. Stoichiometry, atomic structure, chemical bonding, states of matter, energy relations, acid-base theory and oxidation-reduction reactions. The 163, 164 sequence does not meet the prerequisite for 331. Credit for examination (test-out exams) for 163 is available only to students who are not currently enrolled in the course. Only one of Chem 163, 165, 167, 177, or 201 may count toward graduation.

Chem 163L. Laboratory in College Chemistry. (0-3) Cr. 1. F.S.SS. *Prereq: Credit or enrollment for credit in 163.* Laboratory to accompany 163. Must be taken with 163. Only one of Chem 163L, 167L, and 177L may count toward graduation.

Chem 165. Foundations of Chemistry for Engineers. (4-0) Cr. 4. S. *Prereq: 155.* Continuation of 155. Principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. Chem 165 or 167 satisfies the chemistry requirement in engineering curricula. Only one of Chem 163, 165, 167, 177, or 201 may count toward graduation.

Chem 167. General Chemistry for Engineering Students. (4-0) Cr. 4. F.S. *Prereq: Math 140 or the high school equivalent and one year of traditional college prep chemistry or Chem 50.* Principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. This is an accelerated course designed for students with an excellent preparation in Math and science and is a terminal course intended for engineering students who do not plan to take additional courses in chemistry. Credit by examination (test-out exams) for 167 is available only to students who are not currently enrolled in the course. Only one of Chem 163, 165, 167, 177, or 201 may count toward graduation.

Chem 167L. Laboratory in General Chemistry for Engineering. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment for credit in 167 or 165.* Laboratory to accompany 167. Only one of Chem 163L, 167L, and 177L may count toward graduation.

Chem 177. General Chemistry I. (4-0) Cr. 4. F.S.SS. *Prereq: Math 140 or high school equivalent and 50, 155 or 1 year high school chemistry and credit or enrollment in 177L. Chemistry and biochemistry majors may consider taking 201.* The first semester of a two semester sequence which explores chemistry at a greater depth and with more emphasis on concepts, problems, and calculations than 163-164. Recommended for physical and biological science majors, chemical engineering majors, and all others intending to take 300-level chemistry courses. Principles and quantitative relationships, stoichiometry, chemical equilibrium, acid-base chemistry, thermochemistry, rates and mechanism of reactions, changes of state, solution behavior, atomic structure, periodic relationships, chemical bonding. Credit by examination (test-out exams) for 177 is available only to students who are not currently enrolled in the course. Only one of Chem 163, 165, 167, 177, or 201 may count toward graduation.

Chem 177L. Laboratory in General Chemistry I. (0-3) Cr. 1. F.S.SS. *Prereq: Credit or enrollment for credit in 177.* Laboratory to accompany 177. 177L must be taken with 177. 177N: for chemistry and biochemistry majors. Only one of Chem 163L, 167L, and 177L may count toward graduation.

Chem 177N. Laboratory in General Chemistry I. (0-3) Cr. 1. F.S.SS. *Prereq: Credit or enrollment for credit in 177. For chemistry and biochemistry majors.* Laboratory to accompany 177. 177N must be taken with 177. Graduation Messages: Only one of Chem 163L, 167L, and 177N may count toward graduation.

Chem 178. General Chemistry II. (3-0) Cr. 3. F.S. *Prereq: 177, 177L.* Continuation of 177. Recommended for physical or biological science majors, chemical engineering majors, and all others intending to take 300-level chemistry courses. Credit by examination (test-out exams) for 178 is available only to students who are not currently enrolled in the course. Only one of Chem 164 and 178 may count toward graduation.

Chem 178L. Laboratory in College Chemistry II. (0-3) Cr. 1. F.S. *Prereq: 177L and credit or enrollment for credit in 178.* Laboratory to accompany 178. 178L is not a necessary corequisite with 178. Only one of Chem 164L and 178L may count toward graduation.

Chem 201. Advanced General Chemistry. (5-0) Cr. 5. F. *Prereq: Math 140 or high school equivalent and one year of high school chemistry. Co-enrollment in 201L.* A one semester course in general chemistry designed to give students an in-depth, broad-based view of modern chemistry, and, in part, to facilitate participation in independent undergraduate research. Topics include stoichiometry, atomic and molecular structure, chemical bonding, kinetics, chemical equilibria, and thermodynamics. Discussion of current trends in various chemical disciplines, which may be given by guest experts in chemistry, biochemistry, and chemical engineering, will help the student appreciate the scope of the chemical sciences and how research is carried out. Only one of Chem 163, 165, 167, 177, or 201 may count toward graduation.

Chem 201L. Laboratory in Advanced General Chemistry. (0-3) Cr. 1. *Prereq: Credit or enrollment for credit in 201.* Laboratory to accompany 201. Introductory lab experience in synthesis and analysis to prepare student for research activities 201L must be taken with 201. Only one of 163L, 167L, 177L, 177N or 201L may count toward graduation.

Chem 211. Quantitative and Environmental Analysis. (2-0) Cr. 2. F.S. *Prereq: 164 and 164L, credit or enrollment in 178, or 201 and 201L; and concurrent enrollment in 211L.* Theory and practice of elementary volumetric, chromatographic, electrochemical and spectrometric methods of analysis. Chemical equilibrium, sampling, and data evaluation. Emphasis on environmental analytical chemistry; the same methods are widely used in biological and materials sciences as well.

Chem 211L. Quantitative and Environmental Analysis Laboratory. (0-6) Cr. 2. F.S. *Prereq: Credit or enrollment in 164 and 164L, or 178; and concurrent enrollment in Chem 211.* Introductory laboratory experience in volumetric, spectrometric, electrochemical and chromatographic methods of chemical analysis.

Chem 231. Elementary Organic Chemistry. (3-0) Cr. 3. F.S.SS. *Prereq: 163, 163L, or 177, 177L; credit or enrollment in 231L.* A survey of modern organic chemistry including nomenclature, structure and bonding, and reactions of hydrocarbons and important classes of natural and synthetic organic compounds. For students desiring only an elementary course in organic chemistry. Students in physical or biological sciences and premedical or preveterinary curricula should take the full year sequence 331 and 332 (with the accompanying laboratories 331L and 332L). Only one of Chem 231 and 331 or BBMB 221 may count toward graduation.

Chem 231L. Laboratory in Elementary Organic Chemistry. (0-3) Cr. 1. F.S.SS. *Prereq: Credit or enrollment for credit in 231; 163L or 177L.* Laboratory to accompany 231. 231L must be taken with 231. Only one of Chem 231L and 331L may count toward graduation.

Chem 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the Department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Chem 299. Undergraduate Research (for Freshmen and Sophomores). Cr. arr. Repeatable. *Prereq: Permission of staff member with whom student proposes to work.*

Chem 301. Inorganic Chemistry. (2-0) Cr. 2. S. *Prereq: 324.* Atomic and molecular structure and bonding principles; molecular shapes and symmetry; acids and bases; solid-state structures and properties; inorganic chemistry of H, B, C. Nonmajor graduate credit.

Chem 316. Instrumental Methods of Chemical Analysis. (2-0) Cr. 2. F. *Prereq: 211, 211L, Math 166, and concurrent enrollment in 316L; Phys 222 recommended.* Quantitative and qualitative instrumental analysis. Operational theory of instruments, atomic and molecular absorption and emission spectroscopy, electroanalysis, mass spectrometry, liquid and gas chromatography, electrophoresis, literature of chemical analysis. Nonmajor graduate credit.

Chem 316L. Instrumental Analysis Laboratory. (0-6) Cr. 2. F. *Prereq: Credit or enrollment in Chem 316.* Advanced laboratory experience in UV-visible spectrophotometry, atomic absorption and emission spectrometry, electrochemistry, gas and liquid chromatography, electrophoresis, mass spectrometry, and other instrumental methods. Nonmajor graduate credit.

Chem 321L. Laboratory in Physical Chemistry. (1-3) Cr. 2. S. *Prereq: Credit or enrollment for credit in 324 or 325.* Error analysis; use of computers for interfacing to experiments and for data analysis; thermodynamics, infrared and optical spectroscopy, lasers. Not applicable towards the B.S. degree in Chemistry. Only one of Chem 321L and 322L may count toward graduation. Nonmajor graduate credit.

Chem 322L. Laboratory in Physical Chemistry. (1-6) Cr. 3. S. *Prereq: Chem 324.* Error analysis; use of computers for interfacing to experiments and for data analysis; thermodynamics, surface science, infrared and optical spectroscopy, lasers. Only one of Chem 321L and 322L may count toward graduation. Nonmajor graduate credit.

Chem 324. Introductory Quantum Mechanics. (3-0) Cr. 3. F. *Prereq: 178, Math 166, Phys 222 recommended.* Quantum mechanics, atomic and molecular structure, spectroscopy, kinetic theory of gases, chemical kinetics. Nonmajor graduate credit.

Chem 325. Chemical Thermodynamics. (3-0) Cr. 3. F.S. *Prereq: 178, Math 166, Phys 222 recommended.* Classical thermodynamics 1st, 2nd, and 3rd laws with applications to gases and interfacial systems, multicomponent, multiphase equilibrium of reacting systems, surface chemistry, and electrochemical cells. Students taking a two-semester physical chemistry sequence are advised to take 324 first; in the spring semester, a molecular-based section of this course, stressing Statistical thermodynamics, is offered for which knowledge of 324 is useful. Nonmajor graduate credit.

Chem 331. Organic Chemistry I. (3-0) Cr. 3. F.S. *Prereq: 178 or 201, enrollment in 331L highly recommended.* The first half of a two semester sequence. Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms. For students majoring in physical and biological sciences, premedical and preveterinary curricula, chemistry and biochemistry. Students desiring only one semester of organic chemistry should take 231 and 231L, not 331. Only one of Chem 231 and 331 may count toward graduation. Nonmajor graduate credit.

Chem 331L. Laboratory in Organic Chemistry I. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment for credit in 331, 177L.* Laboratory to accompany 331. Chemistry and biochemistry majors are encouraged to take 333L. Only one of Chem 231L and 331L may count toward graduation.

Chem 332. Organic Chemistry II. (3-0) Cr. 3. F.S. *Prereq: 331, enrollment in 332L highly recommended.* Continuation of 331. Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms, natural products, carbohydrates and proteins. For students majoring in physical and biological sciences, premedical and preveterinary curricula, chemistry and biochemistry. Nonmajor graduate credit.

Chem 332L. Laboratory in Organic Chemistry II. (0-3) Cr. 1. F.S. *Prereq: 331L, credit or enrollment for credit in 332.* Laboratory to accompany 332. Chemistry and biochemistry majors are encouraged to take 334L.

Chem 333L. Laboratory in Organic Chemistry I (for Chemistry and Biochemistry Majors). (0-6) Cr. 2. F. *Prereq: Credit or enrollment for credit in 331.* Laboratory to accompany 331 for chemistry and biochemistry majors.

Chem 334L. Laboratory in Organic Chemistry II (for Chemistry and Biochemistry Majors). (0-6) Cr. 2. S. *Prereq: 333L, credit or enrollment for credit in 332.* Laboratory to accompany 332 for chemistry and biochemistry majors.

Chem 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the Department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Chem 399. Undergraduate Research. Cr. arr. *Prereq: Permission of instructor with whom student proposes to work and junior or senior classification.* No more than Six total credits of Chem 399 and Chem 499 may count toward graduation.

Chem 401L. Inorganic Chemistry Laboratory. (0-3) Cr. 1. F. *Prereq: 301.* Preparation and characterization of inorganic and organometallic compounds by modern techniques. For students majoring in chemistry or biochemistry. Nonmajor graduate credit.

Chem 402. Advanced Inorganic Chemistry. (Dual-listed with 502). (3-0) Cr. 3. F. *Prereq: 301; 331 recommended.* Chemistry of the d and f metals. Structure, bonding, electronic spectra, and reaction mechanisms. Aspects of organometallic solid state and bioinorganic chemistry. Nonmajor graduate credit.

Chem 490. Independent Study. Cr. arr. *Prereq: Completion of 6 credits in chemistry at the 300 level or higher and permission of instructor.* No more than 9 credits of Chem 490 may count toward graduation.

Chem 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the Department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Chem 499. Senior Research. Cr. arr. Repeatable. *Prereq: Permission of instructor with whom student proposes to work; B average in all chemistry, physics, and mathematics courses.* Research in chosen area of chemistry, with final written report as senior thesis. This course should be elected for two consecutive semesters. For students majoring in chemistry. No more than Six total credits for Chem 399 and 499 may count toward graduation.

Courses primarily for graduate students, open to qualified undergraduate students

Chem 501L. Inorganic Preparations. (0-3) Cr. 1. F. *Prereq: 402.* Preparation and characterization of inorganic and organometallic compounds by modern research techniques.

Chem 502. Advanced Inorganic Chemistry. (Dual-listed with 402). (3-0) Cr. 3. F. *Prereq: 301; 331 recommended.* Chemistry of the d and f metals. Structure, bonding, electronic spectra, and reaction mechanisms. Aspects of organometallic, solid state, and bioinorganic chemistry.

Chem 503. Bioinorganic Chemistry. (Cross-listed with BBMB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 402 or BBMB 405.* Essential elements: transport and storage of ions and of oxygen; metalloenzymes and metallocoenzymes; electron-transfer processes in respiration and photosynthesis; metabolism of nonmetals and redox processes involved in it; medicinal aspects of inorganic chemistry.

Chem 505. Physical Inorganic Chemistry. (3-0) Cr. 3. S. *Prereq: 402 or 502 and 324.* Elementary group theory and molecular orbital theory applied to inorganic chemistry. Spectroscopic methods of characterization of inorganic compounds and organometallic compounds.

Chem 511. Advanced Quantitative Analysis. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 316 and 316L.* General methods of quantitative inorganic and organic analysis. Aqueous and nonaqueous titrimetry; selective reagents; sampling and sample dissolution; modern instrumentation; sensors; atomic and molecular microscopy; bioanalytical methods; data evaluation; chemometrics; and analytical literature.

Chem 512. Electrochemical Methods of Analysis. (3-0) Cr. 3. F. *Prereq: 316 and 316L, 324, and 322L.* Principles of convective-diffusional mass transport in electroanalysis. Applications of potentiometry, voltammetry, and coulometry. Introduction to heterogeneous and homogeneous kinetics in electroanalysis. Analog and digital circuitry. Interfacing.

Chem 513. Analytical Molecular and Atomic Spectroscopy. (3-0) Cr. 3. S. *Prereq: 316 and 316L, 324, 322L.* Introduction to physical optics and design of photometric instruments. Principles of absorption, emission, fluorescence, and Raman Spectroscopy. Error and precision of optical methods. Ultraviolet, visible, and infrared methods of qualitative and quantitative organic and inorganic analysis.

Chem 516. Analytical Separations. (3-0) Cr. 3. F. *Prereq: 316 and 316L, 324, 322L.* Principles and examples of inorganic and organic separation methods applied to analytical chemistry. Solvent extraction, volatilization, ion exchange, liquid and gas chromatography, and electrophoresis.

Chem 531. Organic Synthesis I. (2-0) Cr. 2. S. *Prereq: 332.* Survey of organic functional group transformations.

Chem 532. Organic Synthesis II. (2-0) Cr. 2. F. *Prereq: 531.* Synthesis of complex organic compounds including natural products.

Chem 537. Physical Organic Chemistry I. (3-0) Cr. 3. F. *Prereq: 332.* Molecular structure, stereochemistry, introduction to reaction mechanisms, thermodynamic and kinetic data, linear free energy relationships, isotope effects, orbital symmetry.

Chem 538. Physical Organic Chemistry II. (3-0) Cr. 3. S. *Prereq: 537.* Survey of reactive intermediates including cations, anions, carbenes, and radicals.

Chem 540. Seminar in forensic Sciences. (1-0) Cr. 1. Repeatable. S. *Prereq: Chem 231 or graduate enrollment.* Seminars by professional criminalists, research scientists, Certificate students, and educators. Emphasis on opportunities for research and development, citizen involvement, and educational outreach related to forensic science. Weekly report required.

Chem 542. Independent Research and Presentation in Forensic Science. (1-0) Cr. 1. S. *Prereq: Enrollment in the Graduate Certificate in Forensic Sciences.* Research topic approved by course instructor. Written and oral reports required. Oral report given in forensics seminar, Chem 540.

Chem 550. Safety in the Chemical Laboratory. (1-0) Cr. 1. S. *Prereq: 332L.* Introduction to laboratory safety and chemical hygiene. Use of engineering controls and personal protective equipment. Chemical storage and waste disposal practices. Handling hazardous chemicals. Radiation safety and laser safety. Satisfactory-fail only.

Chem 555. Teaching College Chemistry. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Graduate or senior classification..* Methods of instruction, strategies and techniques for effective teaching and learning along with practice teaching in undergraduate chemistry recitation and laboratory courses. Cooperative learning, guided-inquiry, learning cycles, conceptual change, models and modeling, concept maps, visualization, computer simulations, web-based delivery systems, and learning theories.

Chem 561. Fundamentals of Quantum Mechanics. (4-0) Cr. 4. F. *Prereq: 324.* Schroedinger equation and exact solutions; square wells and barriers; harmonic oscillator; the hydrogen atom; atomic orbitals; operators including angular momenta; time-independent and time-dependent perturbation theory; Schroedinger and Heisenberg representations; unitary operators; interaction picture, density matrix.

Chem 562. Fundamentals of Atomic and Molecular Quantum Mechanics. (3-0) Cr. 3. S. *Prereq: 561, credit or enrollment in 583.* Variational method, many electron atoms; addition of angular momentum, self-consistent field method for open and closed shells, linear combinations of atomic orbitals, origin of chemical bonding, many-electron diatomic and polyatomic molecules, treatments of electron correlation, approximation methods.

Chem 563. Statistical Mechanics. (3-0) Cr. 3. S. *Prereq: 325.* Microscopic and macroscopic properties, laws of thermodynamics, ensembles and distribution functions, applications to gases, solids, and chemical equilibrium.

Chem 564. Molecular Spectroscopy and Structure. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 505 or 562.* Maxwell's field equations, interaction of light with matter including time-dependent perturbation theory, microwave, vibrational (infra-red, Raman) and electronic spectroscopies, symmetry derived selection rules, special lineshapes and introduction to nonlinear and coherent laser spectroscopies.

Chem 571. Solid-State Chemistry. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 301, 324.* A study of solid state materials including structures, bonding, defects, disorder, phase transitions, ionic mobility, metal-insulator transitions, band theory, synthesis and intercalation.

Chem 572. Spectrometric Identification of Organic Compounds. (2-3) Cr. 3. F. *Prereq: 332.* Principles of infrared, ultraviolet, nuclear magnetic resonance, and mass spectroscopy as applied to organic chemistry.

Chem 574. Organometallic Chemistry of the Transition Metals. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 301, 332.* Transition metal complexes of ligands such as cyclopentadienyl, olefins, acetylenes, benzenes, and carbon monoxide. Homogeneous catalysis.

Chem 576. Surface Chemistry. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 324.* Gas-surface interactions and techniques of characterization. Idealized surface lattices, surface tension, Wulff plots, work function, adsorbate-adsorbate interactions, 2D phase diagrams, diffusion, thin film growth, adsorption and desorption mechanisms/energetics/kinetics, adsorption isotherms, vacuum techniques, electron- and ion-based spectroscopies for surface analysis (including AES, FIM, XPS, UPS, EXAFS, EELS, SIMS, LEED and STM).

Chem 577. Mass Spectrometry. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Basic physics, instrumentation, chemical and biological applications of mass spectrometry.

Chem 578. Chemical Kinetics and Mechanisms. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: 324.* Rates and mechanisms; reversible, consecutive, and competing reactions; chain mechanisms; kinetic isotope effects; very rapid reactions; acid-base catalysis, theories of unimolecular reactions; transition State and Marcus theories.

Chem 579. Introduction to Research in Chemistry. (1-0) Cr. R. F.S. Introduction to the various areas of research in chemistry at Iowa State University.

Chem 580. Introduction to Computational Quantum Chemistry. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 324.* Basic principles of quantum mechanics, schrodinger equation. Hartree-Fock/molecular orbital theory, introduction to group theory, introduction to modern methods of computational chemistry; applications include molecular structure, potential energy surfaces and their relation to chemical reactions; molecular spectroscopy, photochemistry, solvent effects and surface chemistry.

Chem 581. Principles of Lasers and Optics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 324, Phys 222.* Students with weak background should take Chem 580. For students working with lasers and optics; stimulated adsorption and emission based on the classical electron oscillator model; population inversion, laser amplification; laser pumping; oscillation and cavity modes; laser beam characterization; linear propagation; design of laser resonators, ray and wave optics; nonlinear optics.

Chem 583. Chemical Group Theory. (1-0) Cr. 1. F. *Prereq: 324.* Basic concepts and theorems, representation theory; point groups, molecular orbitals, molecular states, molecular vibrations, rotation group and angular momenta; space groups and crystals; permutation group, antisymmetry, and spin states.

Chem 589. Current Topics in Chemistry. (1-0) Cr. R. F.S. Presentation of recent literature and chemical problems under current investigation.

Chem 599. Nonthesis Research. Cr. arr. *Prereq: Permission of instructor concerned.*

Courses for graduate students

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Chem 581. Principles of Lasers and Optics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 324, Phys 222.* Students with weak background should take Chem 580. For students working with lasers and optics; stimulated adsorption and emission based on the classical electron oscillator model; population inversion, laser amplification; laser pumping; oscillation and cavity modes; laser beam characterization; linear propagation; design of laser resonators, ray and wave optics; nonlinear optics.

Chem 583. Chemical Group Theory. (1-0) Cr. 1. F. *Prereq: 324.* Basic concepts and theorems, representation theory; point groups, molecular orbitals, molecular states, molecular vibrations, rotation group and angular momenta; space groups and crystals; permutation group, antisymmetry, and spin states.

Chem 589. Current Topics in Chemistry. (1-0) Cr. R. F.S. Presentation of recent literature and chemical problems under current investigation.

Chem 599. Nonthesis Research. Cr. arr. *Prereq: Permission of instructor concerned.*

Chem 600. Seminar in Inorganic Chemistry. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.*

Chem 601. Selected Topics in Inorganic Chemistry. (2-0) Cr. arr. F.S. *Prereq: Permission of instructor.* Topics such as molecular structure and bonding; organometallic compounds; physical techniques of structure determination; nonaqueous solutions; Zintl phases; transition-metal oxides; free-radical reactions; electron transfer reactions; metal-metal bonding; and bioinorganic chemistry of nucleic acids.

Chem 611. Seminar in Analytical Chemistry. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.*

Chem 619. Special Topics in Analytical Chemistry. (2-0) Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Raman Spectroscopy, sensors, spectroelectrochemistry, capillary electrophoresis, analytical plasmas, chemometrics and bioanalytical chemistry.

Chem 631. Seminar in Organic Chemistry. (1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.*

Chem 632. Selected Topics in Organic Chemistry. (2-0) Cr. arr. Repeatable. F.S. *Prereq: 537.* Topics of current interest in organic chemistry such as spectroscopy, physical organic chemistry, photochemistry, organometallic chemistry, mechanisms of oxidations and reductions, modern organic synthesis, reactive intermediates, bioorganic chemistry, and polymers.

Chem 660. Seminar in Physical Chemistry. (1-0) Cr. 1. Repeatable. S. *Prereq: Permission of instructor.*

Chem 667. Special Topics in Physical Chemistry. (2-0) Cr. arr. F.S. *Prereq: Permission of instructor.* Advanced and recent developments in physical chemistry are selected for each offering.

Chem 699. Research. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

Civil Engineering

(Administered by the Department of Civil, Construction and Environmental Engineering)

James Alleman, Chair of Department

Distinguished Professors: Klaiber

Distinguished Professors (Emeritus): Baumann, Cleasby, Handy

University Professors (Emeritus): Lohnes

Professors: Alleman, Fanous, Jaselskis, Kannel, Maze, Nambisan, Ong, Pometto, Porter, Sarkar, Schaefer, Souleyrette, Van Leeuwen, Wipf

Professors (Emeritus): Bergeson, Brewer, Carstens, Greimann, Hardy, Jellinger, Kao, Lee, Mashaw, Mickle, Morgan, Northup, Oulman, Sanders

Professors (Collaborators): Surampalli

Associate Professors: Abendroth, Baenziger, Bhandari, Ellis, Gu, Hallmark, Jahren, Koziel, Rehmann, Sritharan, Strong, Sung, Wang, White, Williams

Associate Professors (Emeritus): Chase, Mercier, Sheeler, Ward

Assistant Professors: Aslock, Bolluyt, Ceylan, Gkritza, Grewell, Kandil, Rouse, Shane

Assistant Professors (Adjunct): Phares, Plazak, Schlorholtz, Smadi, Taylor

Instructors (Adjunct): Amenson, Gaunt

Senior Lecturers: Cormicle, Jones, Sirotiak, Walton

Lecturers: Baker, Cackler, Hawkins, Hunacek, Mescher, Perkins, Smith, Stout

Clinician: Gopalakrishnan

Undergraduate Study

For undergraduate curriculum in civil engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission of the ABET.

Civil engineering consists of the application of the laws, forces, and materials of nature to the planning, design, construction, maintenance, and operation of public and private facilities, subject to economic, social, and environmental constraints. Commonly included are transportation systems; bridges and buildings; water supply, pollution control, irrigation, and drainage systems; river and harbor improvements; dams and reservoirs. Civil engineering also includes the planning, design, and responsible execution of surveying operations, and the location, delimitation, and delineation of physical and cultural features on the surface of the earth. Research, testing, sales, management, and related functions are also a part of civil engineering. Work on the campus is supplemented by inspection trips which furnish an opportunity for firsthand study of engineering systems in operation, as well as projects under construction.

Environmental engineering, as a specialty area in civil engineering, is concerned with protecting the public and natural health; providing safe, palatable and ample water supply; management of solid and hazardous waste; proper treatment and disposal of domestic and industrial wastewaters and waste; resource recovery; providing adequate drainage of urban and rural areas for sanitation; and the control of water quality, soil contamination, and air pollution. At the undergraduate level, the study of various environmental and water resource engineering topics is part of the course of study leading to the Bachelor's degree in civil engineering.

Program Goal

Consultation with an industrial advisory board of employers of civil engineers, with a broad base of civil engineering educators, and with students and alumni has yielded a continuous process of program planning, program assessment, curriculum development, and instructional development to produce an integrated, learning-based curriculum. The curriculum listed in this catalog has the academic program goal of developing an effective program that fulfills student educational needs and that equips and empowers qualified students for a successful career in civil or environmental engineering.

Program Objectives

To achieve the program goal, the Department has developed objectives intended to result in the following outcomes such that graduates:

1. have a comprehensive education in the fundamentals of civil engineering,

2. are prepared to undertake civil engineering design tasks,

3. demonstrate effective communication skills and teamwork in multidisciplinary projects,

4. play a constructive role to address the needs of Society and the environment, and

5. are motivated to continue their professional development.

The faculty encourages the development of the student's professional skills through participation in cooperative education, internships, or progressive summer engineering employment. Qualified juniors and seniors interested in graduate studies may apply to the Graduate College to concurrently pursue the bachelor degree and a master of science in Civil Engineering or a master of business administration in the College of Business Administration.

Graduate Study

The Department of Civil, Construction and Environmental Engineering offers work for the master of science and doctor of philosophy degrees with a major in civil engineering with areas of specialization in structural engineering, environmental engineering, construction engineering and management, geotechnical engineering, civil engineering materials, and transportation engineering. The department also offers minor work to students from other engineering departments.

Candidates for the degree master of science are required to satisfactorily complete 30 credits of acceptable graduate work, including preparation of a thesis or creative component.

Candidates for the doctor of philosophy degree refer to the department's home page and/or the department's Graduate Student Handbook for degree options and credit requirements. The normal prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of engineering students at this university. However, because of the diversity of interests within the graduate programs in civil engineering, a student may qualify for graduate study even though undergraduate or prior graduate training has been in a discipline other than engineering. Supporting work will be required depending upon the student's background and area of interest. A prospective graduate student is urged to specify the degree program and area of specialization in which he or she is interested on the application for admission. The department participates in the interdepartmental majors in transportation (master of science only), environmental science, and biorenewable resources and technology (see Index).

The Department of Civil, Construction and Environmental Engineering offers a graduate certificate in environmental engineering. Completion of the certificate requires at least twelve credits including 520, 521, 591 (R) seminar, and any two courses related to environmental engineering from those available from the departments of Civil, Construction and Environmental Engineering, Agricultural and Biosystems Engineering, and Chemical and Biological Engineering.

Courses primarily for undergraduate students

C E 101. Technical Lecture. Cr. R. F.S. (1-0) Discussion of various phases of civil engineering. For transfer students only. Evaluation of transfer credits and discussion of graduation requirements. Satisfactory-fail only.

C E 105. Introduction to the Civil Engineering Profession. (1-0) Cr. 1. F.S. Overview of the nature and scope of the civil engineering profession. Exploration of the various specialty areas within civil engineering. Bloom's Taxonomy and creativity. Departmental rules, student services operations, degree requirements, educational objectives, program of study planning, career options, and student organizations.

C E 111. Fundamentals of Surveying I. (2-3) Cr. 3. F.S. *Prereq: 160, credit or enrollment in Engr 170 or C E 170, Math 165, credit or enrollment in C E 105 for C E majors.* Introduction to error theory. Fundamentals of observing distances, elevations, and angles. Traversing. Irregular areas. Circular and parabolic curves. Earthwork including mass diagrams. Construction staking. Computer applications and introduction to photogrammetry, geographic information systems and global positioning systems technology.

C E 120. Civil Engineering Learning Community. Cr. R. Repeatable. Integration of first-year students into the Civil Engineering program. Assignments and activities involving teamwork, academic preparation, study skills, and preparation for entry into the Civil Engineering profession. Completed both individually and in learning teams under the direction of faculty and peer mentors. Satisfactory-fail only.

C E 160. Engineering Problems with Computational Laboratory. (2-2) Cr. 3. F.S. *Prereq: Math 141, 142 or satisfactory scores on mathematics placement assessments; credit or enrollment in Math 165. Form*ulation of engineering problems using spreadsheets and Visual Basic for Application for solution. Presenting results using word processing, tables, and graphs. Introduction to engineering economics and statics. Civil engineering examples.

C E 170. Graphics for Civil Engineering. (0-4) Cr. 2. F.S. *Prereq: Math 165, credit or enrollment in C E 105.* Fundamental graphics. Introduction to computer aided drafting and modeling. Civil engineering applications.

C E 205. Economic Analysis and Technical Communication in Civil Engineering. (3-0) Cr. 3. F.S. *Prereq: Math 166, Engl 250.* Concepts and applications of civil engineering economics. Engineering economics basics including analysis of interest, present worth, annual worth, future worth, and rate of return. Comparison of project alternatives with incremental rate of return, benefit/cost ratio, taxation, depreciation, and inflation. Principles and processes of effective written and oral communication of civil engineering technical information.

C E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

C E 305. Professional Issues in Civil Engineering. (3-0) Cr. 3. F.S. *Prereq: 205.* Civil engineering history and heritage. Professionalism, licensure, liability, ethics, leadership, teamwork, critical thinking, and social responsibility in the practice of civil engineering. Engineering business management principles, including organizational structures and business economics. Applications and impacts of regulations in civil engineering. Written and oral technical presentations.

C E 306. Project Management for Civil Engineers. (2-3) Cr. 3. F.S. *Prereq: 305.* Project management, including work breakdown structures, cost estimating, scheduling, and project control. Civil engineering project life cycle, including planning, design, construction, and maintenance processes. Techniques in interpretation of contract documents and in estimating quantities.

C E 326. Principles of Environmental Engineering. (2-2) Cr. 3. F.S. *Prereq: Chem 167 or 178, Math 166, credit or enrollment in E M 378.* Introduction to environmental problems, water quality indicators and requirements, potable water quality and quantity objectives, water sources and treatment methods; water pollution control objectives and treatment methods; survey of solid and hazardous waste management and air pollution control. Nonmajor graduate credit.

C E 332. Structural Analysis I. (2-2) Cr. 3. F.S. *Prereq: E M 324.* Loads, shear, moment, and deflected shape diagrams for beams and framed structures. Approximate methods. Deformation calculations. Application of flexibility methods to frames and continuous beams. Application of moment distribution and stiffness methods to continuous beams and braced frames. Influence lines for determinate and indeterminate beams using Muller-Breslau principle. Computer applications to analyze beams and frames. Nonmajor graduate credit.

C E 333. Structural Steel Design I. (2-2) Cr. 3. F.S. *Prereq: 332, E M 327.* Design and behavior of the elements of steel structures, proportioning members and connections. Load and Resistance Factor Design. Preliminary design of a building structure. Nonmajor graduate credit.

C E 334. Reinforced Concrete Design I. (2-2) Cr. 3. F.S. *Prereq: 332, E M 327.* Analysis and design of beams, one-way slabs, and columns. Preliminary design of building frames using pattern loading and moment coefficients. Nonmajor graduate credit.

C E 350. Introduction to Transportation Planning. (3-0) Cr. 3. S. *Prereq: 3 credits in statistics, junior classification.* An introductory course for planning urban and regional transportation systems within government. Applications and impacts of legislation, financing, four-step planning process, population trends, land use, societal impacts, public transportation, master plans and traffic impact studies. Organization and coordination of the transportation planning function. Term paper and class participation required. Not available for graduation credit for students in civil engineering.

C E 355. Principles of Transportation Engineering. (2-0) Cr. 2. F.S. *Prereq: 111, 205, Phys 221, a course in statistics from the approved departmental list.* Introduction to planning and operations of transportation facilities. Vehicle/operation/infrastructure characteristics. Technological, economic and environmental factors. Travel demand modeling and capacity analysis.

C E 360. Geotechnical Engineering. (2-3) Cr. 3. F.S. *Prereq: E M 324, credit or enrollment in Geol 201.* Introduction to soil engineering and testing. Identification and classification tests, soil water systems, principles of settlement, stresses in soils, and shear strength testing; slope stability, retaining walls, bearing capacity. Nonmajor graduate credit.

C E 372. Engineering Hydrology and Hydraulics. (3-2) Cr. 4. F.S. *Prereq: E M 378, a course in statistics from the approved department list.* The hydrologic cycle: precipitation, infiltration, runoff, evapotranspiration, groundwater, and streamflow. Hydrograph analysis, flood routing, frequency analysis and urban hydrology. Applied hydraulics including pipe and channel flow with design applications in culverts, pumping, water distribution, storm and sanitary sewer systems. Design project required. Nonmajor graduate credit.

C E 382. Design of Concretes. (2-3) Cr. 3. F.S. *Prereq: Credit or enrollment in 360.* Physical and chemical properties of bituminous, portland, and other cements; aggregate properties and blending; mix design and testing of concretes; admixtures, mixing, handling, placing and curing; principles of pavement thickness design. Nonmajor graduate credit.

C E 383. Design of Portland Cement Concrete. (0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in 360.* For Con E students only. Physical and chemical properties of portland cement and p.c. concrete. Mix design and testing of p.c. concrete.

C E 388. Sustainable Engineering and International Development. (Cross-listed with A E, E E, M E, Mat E). (2-2) Cr. 3. F. *Prereq: Junior classification in engineering.* Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as non-government organizations (NGOs). Course readings, final project/design report.

C E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services, completion of two terms in residence in civil engineering, employment in civil engineering or related field.* Summer professional work period. Students must register for this course prior to commencing work. Satisfactory-fail only.

C E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* One semester maximum per academic year professional work period. Students must register for this course prior to commencing work. Satisfactory-fail only.

C E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

C E 403. Program and Outcome Assessment. Cr. R. F.S. *Prereq: Verification of undergraduate application for graduation by the end of the first week of class. Permission of instructor for students who are scheduled for summer graduation.* Assessment of C E Curriculum and educational objectives. Satisfactory-fail only.

C E 411. Bioprocessing and Bioproducts. (Dual-listed with 511). (Cross-listed with A E, BioE, BSE). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

C E 417. Land Surveying. (2-3) Cr. 3. S. *Prereq: 111.* Legal principles affecting the determination of land boundaries, public domain survey systems. Locating sequential and simultaneous conveyances. Record research, plat preparation, and land description. Study of selected court cases. Nonmajor graduate credit.

C E 420. Environmental Engineering Chemistry. (Dual-listed with 520). (2-3) Cr. 3. F. *Prereq: 326, Chem 177 and 178, Math 166.* Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilbria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions, and mass transfer principles. Individual laboratory practicals and group projects required.

C E 421. Environmental Biotechnology. (Dual-listed with 521). (2-2) Cr. 3. F. *Prereq: 326.* Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, bioenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens, parasites, and disinfection.

C E 424. Air Pollution. (Dual-listed with 524). (Cross-listed with EnSci, A E). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology
E. Agricultural sources of pollution

C E 428. Water and Wastewater Treatment Plant Design. (2-2) Cr. 3. S. *Prereq: 326.* Physical, chemical and biological processes for the treatment of water and wastewater including coagulation and flocculation, sedimentation, filtration, adsorption, chemical oxidation/disinfection, fixed film and suspended growth biological processes and sludge management.

C E 446. Bridge Design. (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 333, 334.* Bridge design in structural steel and reinforced concrete. Application of AASHTO Bridge Design Specifications. Analysis techniques for complex structures. Preliminary designs include investigating alternative structural systems and materials. Final designs include preparation of design calculations and sketches. Nonmajor graduate credit.

C E 447. Building Design. (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 333, 334.* Building design in structural steel and reinforced concrete. Investigation of structural behavior of frameworks. Lateral load resisting systems. Application of current building codes and design specifications. Review of building designs. Preliminary designs include investigating alternative structural systems. Final designs include preparation of design calculations and sketches. Nonmajor graduate credit.

C E 451. Urban Transportation Planning Models. (Dual-listed with 551). (2-2) Cr. 3. F. *Prereq: 350 or 355.* Urban transportation planning context and process. Project planning and programming. Congestion, mitigation, and air quality issues. Transportation data sources. Travel demand and network modeling. Use of popular travel demand software and applications of geographic information systems. Nonmajor graduate credit.

C E 453. Highway Design. (3-3) Cr. 4. F.S. *Prereq: 306, 355, 372, 382.* Introduction to traffic engineering and highway planning. Design, construction, and maintenance of highway facilities; earthwork, drainage structures; pavements. Preparation of environmental impact statement. A complete design project is required. Oral and written reports. Computer applications. Nonmajor graduate credit.

C E 460. Foundation Engineering. (3-0) Cr. 3. F.S. *Prereq: 360.* Fundamentals of foundation engineering. Exploration, sampling, and in-situ tests. Shallow and deep foundations. Settlement and bearing capacity analyses. Stability of excavations and earth retaining structures. Nonmajor graduate credit.

C E 473. Groundwater Hydrology. (Dual-listed with 573). (3-0) Cr. 3. F. *Prereq: 372.* Principles of groundwater flow, hydraulics of wells, super-position, slug and pumping tests, streamlines and flownets, and regional groundwater flow. Contaminant transport. Computer modeling. Nonmajor graduate credit.

C E 483. Pavement Analysis and Design. (Dual-listed with 583). (3-0) Cr. 3. *Prereq: 360 and 382.* Analysis, behavior, performance, and structural design of pavement systems. Topics include climate factors, rehabilitation, life cycle design economics, material and system response, pavement foundations and traffic loadings. Development of models for and analysis of pavement systems. Use of transfer functions relating pavement response to pavement performance. Evaluation and application of current and evolving pavement design practices and procedures. Mechanistic-based pavement design techniques and concepts. Analysis of the effects of maintenance activities on pavement performance and economic evaluation of pavement systems. Nonmajor graduate credit.

C E 485. Civil Engineering Design I. (1-2) Cr. 2. F.S. *Prereq: 306, 326, 333 or 334, 355, Sp Cm 212.* The civil engineering design process, interacting with the client, identification of the engineering problems, development of a technical proposal, identification of design criteria, cost estimating, planning and scheduling, codes and standards, development of feasible alternatives, selection of best alternative, oral presentation and poster.

C E 486. Civil Engineering Design II. (1-4) Cr. 3. F.S. *Prereq: 326, 333 or 334, 382; credit or enrollment in 428 or 453, and 485.* The engineering design computations, case histories of design inadequacies, environmental impact, safety and health in the work place, ethics, contract documents, design plans and specifications, teamwork, synthesis of previous coursework in a group project, oral presentations.

C E 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Independent study in any phase of civil engineering. Pre-enrollment contract required.
H. Honors

C E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

C E 501. Preconstruction Project Engineering and Management. (3-0) Cr. 3. *Prereq: Con E 221 and 421.* Application of engineering and management control techniques to construction project development from conceptualization to notice to proceed. Determinants of construction project success, conceptual estimating, design and engineering planning for automated construction techniques, constructability review procedures, planning for safety, value engineering.

C E 502. Construction Project Engineering and Management. (3-0) Cr. 3. *Prereq: Con E 221 and 421.* Application of engineering and management control techniques to construction projects. Construction project control techniques, equipment selection and utilization, project administration, construction process simulation, Quality Management, and productivity improvement programs.

C E 503. Construction Management Functions and Processes. (3-0) Cr. 3. *Prereq: Con E 421.* Analysis of critical construction management skills. Analysis of organizational systems related to construction management. Case studies. Analysis of theories of motivation, planning, leadership, organizational change, etc., as they relate to field construction operations.

C E 505. Design of Construction Systems. (3-0) Cr. 3. *Prereq: 334, 360, Con E 322 and 340.* Advanced design of concrete formwork and falsework systems. Design for excavation and marine construction including temporary retaining structures and cofferdams. Aggregate production operations, including blasting, crushing, and conveying systems. Rigging system design.

C E 506. Case Histories in Construction Documents. (3-0) Cr. 3. *Prereq: Con E 221, credit or enrollment in Con E 421.* Study of cases involving disputes, claims, and responsibilities encountered by management in construction contract documents. Analysis of methods of resolving differences among the owner, architect, engineer, and construction contractor for a project.

C E 510. Information Technologies for Construction. (3-0) Cr. 3. *Prereq: Con E 421, Engr 160 or C E 160 or equivalent.*Information technologies including microcomputer based systems, management information systems, automation technologies, computer-aided design, and expert systems and their application in the construction industry. Overview of systems acquisition, communications, and networking.

C E 511. Bioprocessing and Bioproducts. (Dual-listed with 411). (Cross-listed with A E, BRT, BSE). (3-0) Cr. 3. F. *Prereq: A E 216 or equivalent, Math 160 or 165, one of Chem 167 or higher, Biol 173 or 211 or higher or BRT 501, senior or graduate classification.* Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis. Term paper for graduate level only.

C E 513. Geodetic and Satellite Surveying. (2-3) Cr. 3. *Prereq: 111.* Triangulation and trilateration observation and computation. Precise leveling. Electronic distance measuring instrument calibration. Geodetic astronomy for latitude and longitude determination. Global positioning systems of satellite observation and computation.

C E 520. Environmental Engineering Chemistry. (Dual-listed with 420). (Cross-listed with EnSci). (2-3) Cr. 3. *Prereq: Chem 177 and 178, Math 166.* Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilibria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions and mass transfer principles. Individual laboratory practicals and group projects required. Term paper and oral presentation for graduate level only.

C E 521. Environmental Biotechnology. (Dual-listed with 421). (Cross-listed with EnSci). (2-2) Cr. 3. *Prereq: 326.* Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, bioenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens and parasites, and disinfection. Term paper and oral presentation.

C E 522. Water Pollution Control Processes. (Cross-listed with EnSci). (2-2) Cr. 3. *Prereq: 521.* Fundamentals of biochemical processes, aerobic growth in a single CSTR, multiple events in complex systems, and techniques for evaluating kinetic parameters; unit processes of activated sludge system, attached growth systems, stabilization and aerated lagoon systems, biosolids digestion and disposal, nutrient removal, and anaerobic treatment systems.

C E 523. Physical-Chemical Treatment Process. (Cross-listed with EnSci). (2-2) Cr. 3. *Prereq: 520.* Material and energy balances. Principles and design of physical-chemical unit processes; including screening, coagulation, flocculation, chemical precipitation, sedimentation, filtration, lime softening and stabilization, oxidation, adsorption, membrane processes, ion exchange and disinfection; recovery of resources from residuals and sludges; laboratory exercises and demonstrations; case studies in mineral processing and secondary industries.

C E 524. Air Pollution. (Dual-listed with 424). (Cross-listed with A E, EnSci). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology
E. Agricultural sources of pollution

C E 527. Solid Waste Management. (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 326.* Planning and design of solid waste management systems; includes characterization and collection of domestic, commercial, and industrial solid wastes, waste minimization and recycling, energy and materials recovery, composting, incineration, and landfill design.

C E 529. Hazardous Waste Management. (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 326.* Regulatory requirements for the classification, transport, storage and treatment of hazardous wastes. Analysis and design of alternatives for treatment and disposal technologies, including physical, chemical, and biological treatment, solidification, incineration, and secure landfill design. Regulatory requirements and procedures for hazardous waste contaminated site investigations and risk analysis. Analysis and design of remedial action alternatives for site restoration.

C E 532. Structural Analysis II. (3-0) Cr. 3. F. *Prereq: 332.* Analysis of indeterminate structural problems by the force and generalized direct displacement methods. Direct stiffness method for 2-D frames, grids, 3-D frames. Additional topics for the stiffness method.

C E 533. Structural Steel Design II. (3-0) Cr. 3. *Prereq: 333.* Every third semester, offered F 2009. Development of the AISC design equations for and the design of tension members, columns, beams, beam-columns, and plate girders for Load and Resistance Factor Design. Elastic and inelastic buckling of members and member elements. Torsion of W-shapes.

C E 534. Reinforced Concrete Design II. (2-2) Cr. 3. *Prereq: 334.* Every third semester, offered F 2010. Design of reinforced concrete long columns, floor slabs, building frames, isolated footings and combined footings. Design and behavior considerations for torsion, biaxial bending, structural joints and shear friction. Introduction to cold-formed composite steel and composite floor slab design.

C E 535. Prestressed Concrete Structures. (3-0) Cr. 3. *Prereq: 334.* Every third semester, offered F 2009. Design of prestressed concrete structures, review of hardware, stress calculations, prestress losses, section proportioning, flexural design, shear design, deflections, statically indeterminate structures.

C E 536. Masonry and Timber Design. (2-2) Cr. 3. *Prereq: 334.* Every third semester, offered S 2010. Behavior and design of clay and concrete masonry beams, columns, walls, and structural systems. Behavior and design of timber and laminated timber beams, columns, connections, and structural systems.

C E 541. Dynamic Analysis of Structures. (3-0) Cr. 3. *Prereq: E M 345 and credit or enrollment in 532.* Every third semester, offered S 2010. Single and multi-degree-of-freedom systems. Free and forced vibrations. Linear and nonlinear response. Modal analysis. Response spectra. Seismic analysis.

C E 542. Structural Analysis by Finite Elements. (3-0) Cr. 3. S. *Prereq: 532.* Use of the finite element method for the analysis of complex structural configurations. Plane stress, plate and shell finite elements. General purpose finite element programs.

C E 545. Seismic Design. (3-0) Cr. 3. *Prereq: 333, 334.* Every third semester, offered F 2010. Seismic hazard in the United States. Engineering characteristics of ground motions. Structural damage in past earthquakes. Capacity design Philosophy for seismic resistant design. Conceptual design of structures. Capacity design process including design of structural members.

C E 547. Analysis and Design of Plate and Slab Structures. (3-0) Cr. 3. *Prereq: 334, E M 514, Math 266.* Bending and buckling of thin plate components in structures utilizing classical and energy methods. Analysis of shell roofs by membrane and bending theories.

C E 550. Advanced Highway Design. (3-0) Cr. 3. *Prereq: 453.* Evaluation of rural and urban street and highway design theory. Establishment of design criteria, application to street and highway systems, and to intersections and interchanges; drainage design, and urban freeway design aspects. Computer applications.

C E 551. Urban Transportation Planning Models. (Dual-listed with 451). (2-2) Cr. 3. F. *Prereq: 350 or 355.* Urban transportation planning context and process. Project planning and programming. Congestion, mitigation, and air quality issues. Transportation data sources. Travel demand and network modeling. Use of popular travel demand software and applications of geographic information systems. Term project required for graduate credit.

C E 552. Traffic Safety, Operations, and Maintenance. (2-2) Cr. 3. *Prereq: 355.* Engineering aspects of highway traffic safety. Reduction of accident incidence and severity through highway design and traffic control. Accident analysis. Legal implications. Safety in highway design, maintenance, and operation.

C E 553. Traffic Engineering. (2-2) Cr. 3. *Prereq: 355.* Driver, pedestrian, and vehicular characteristics. Traffic characteristics; highway capacity; traffic studies and analyses. Principles of traffic control for improved highway traffic service. Application of intersection, corridor or network analysis computer evaluation and optimization tools.

C E 554. Advanced Technology in Transportation. (3-0) Cr. 3. *Prereq: 350, 355, graduate standing in transportation or civil engineering.* Advanced traffic control systems including signal systems technology and field assets. Regional traffic management and communications centers. Traffic surveillance, monitoring and incident management. Advanced traveler information systems. The automated highway.

C E 555. Advanced Traffic Operations. (3-0) Cr. 3. *Prereq: 553.* Solve real-world traffic engineering problems; explore interactions between traffic systems components; advanced skills related to signal timing, coordination, and optimization; practical applications of common traffic engineering tools.

C E 556. Transportation Data Analysis. (3-0) Cr. 3. *Prereq: 355, Stat 101 or 105.* Analysis of transportation data, identification of data sources and limitations. Static and dynamic data elements such as infrastructure characteristics, flow and operations-related data elements. Spatial and temporal extents data for planning, design, operations, and management of transportation systems. Summarizing, analyzing, modeling, and interpreting data. Use of information technologies for highways, transit, and aviation systems.

C E 557. Transportation Systems Analysis. (3-0) Cr. 3. *Prereq: 355, 3 credits in statistics or probability.* Travel studies and analysis of data. Travel projections. Public transportation forecasts and analyses. Statewide, regional, and local transportation system planning. Corridor travel planning. Optimization of systems.

C E 558. Transportation Systems Development and Management Laboratory. (2-2) Cr. 3. *Prereq: 350 or 355.* Study of designated problems in traffic engineering, urban transportation planning, and urban development. Forecasting and evaluation of social, economic, and environmental impact of proposed solutions; considerations of alternatives. Formulation of recommendations and publication of a report. Presentation of recommendations in the host community.

C E 559. Transportation Infrastructure/Asset Management. (3-0) Cr. 3. *Prereq: 355 or 453, 382.* Engineering management techniques for maintaining and managing infrastructure assets. Systematic approach to management through value engineering, engineering economics, and life cycle cost analysis. Selection and scheduling of maintenance activities. Analysis of network-wide resource needs. Project level analysis.

C E 560. Fundamentals of Soil Mechanics. (3-0) Cr. 3. *Prereq: 360.* Limiting stress analysis, stress paths, introduction to critical state soil mechanics, constitutive models, soil strength under various drainage conditions, seepage, pore pressure parameters, consolidation, slope stability and retaining wall applications.

C E 561. Applied Foundation Engineering. (2-3) Cr. 3. *Prereq: 460.* Lateral earth pressure theories and retaining structures. Field investigations, in-situ testing, foundations on expansive soils, and analysis and design of shallow and deep foundations. Foundation engineering reports.

C E 562. Site Evaluations for Civil Engineering Projects. (2-2) Cr. 3. *Prereq: 360.* Identification and mapping of engineering soils from airphotos. Use of remote sensing and GIS, planning subsurface investigations, geomaterials prospecting, water resource applications.

C E 563. Experimental Methods in Geo-Engineering. (1-4) Cr. 3. *Prereq: 360.* Principles of geo-engineering laboratory testing including the conduct, analysis, and interpretation of soil classification tests, compaction tests, permeability tests, consolidation, triaxial, direct and ring shear tests. Issues regarding laboratory testing versus field testing and acquisition, transport, storage, and preparation of samples for geotechnical testing. Field and laboratory geotechnical monitoring techniques, including the measurements of deformation, strain, total stress and pore water pressure.

C E 564. Application of Numerical Methods to Geotechnical Design. (3-0) Cr. 3. *Prereq: 560.* Application of numerical methods to analysis and design of foundations, underground structures, and soil-structure interaction. Application of slope stability software. Layered soils, bearing capacity and settlement for complex geometries, wave equation for piles, and foundation vibrations.

C E 565. Fundamentals of Geomaterials Behavior. (2-3) Cr. 3. *Prereq: 382.* Atoms and molecules, crystal chemistry, clay minerals, structure of solids, phase transformations and phase equilibria. Surfaces and interfacial phenomena, colloid chemistry, mechanical properties. Applications to soils and civil engineering materials. Overview of state-of-the-art instrumental techniques for analysis of the physicochemical properties of soils and civil engineering materials.

C E 567. Geomaterials Stabilization. (2-2) Cr. 3. *Prereq: 565.* Soil and aggregate physical and chemical stabilization procedures. Soil stabilization analysis and design. Ground modification methods. Geosynthetics application and design.

C E 570. Applied Hydraulic Design. (2-2) Cr. 3. *Prereq: 372.* Flow characteristics in natural and constructed channels; principles of hydraulic design of culverts, bridge waterway openings, spillways, hydraulic gates and gated structures, pumping Stations, and miscellaneous water control structures; pipe networks, mathematical modeling. Design project.

C E 571. Surface Water Hydrology. (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 372.* Analysis of hydrologic data including precipitation, infiltration, evapotranspiration, direct runoff and streamflow; theory and use of frequency analysis; theory of streamflow and reservoir routing; use of deterministic and Statistical hydrologic models. Fundamentals of surface water quality modeling, point and non-point sources of contamination. Design project.

C E 572. Analysis and Modeling Aquatic Environments. (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 372.* Principles of surface water flows and mixing. Introduction to hydrologic transport and water quality simulation in natural water systems. Advection, diffusion and dispersion, chemical and biologic kinetics, and water quality dynamics. Applications to temperature, dissolved oxygen, primary productivity, and other water quality problems in rivers, lakes and reservoirs. Deterministic vs. stochastic models.

C E 573. Groundwater Hydrology. (Dual-listed with 473). (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 372.* Principles of groundwater flow, hydraulics of wells, super-position, slug and pumping tests,

streamlines and flownets, and regional groundwater flow. Contaminant transport. Computer modeling. Individual and group projects.

C E 574. Environmental Impact Assessment. (Cross-listed with EnSci). (3-0) Cr. 3. *Prereq: 4 courses in natural, biological or engineering sciences and senior or above classification.* Review of federal and state requirements for environmental impact assessment, requirements of the National Environmental Policy Act and Council on Environmental Quality, methods of evaluating the environmental impacts on the physical, biological, socioeconomic, cultural/historical, human health and psychological environments, public participation in EIS, review and evaluate project environmental impact statements. An environmental impact assessment of a proposed project will be completed in small teams.

C E 576. Environmental Flows. (3-0) Cr. 3. *Prereq: EM 378 or equivalent.* Analysis and applications of flows in civil engineering, environmental engineering, and water resources. Primary topics include conservation laws, laminar flow, turbulence, mixing, diffusion, dispersion, water waves, and boundary layers. Associated applications include particle settling, transfer at air-water and water-sediment boundaries, flow and friction in pipes and open channels, contaminant transport, waves in lakes, jets, plumes, and salt wedges.

C E 581. Geotechnical and Materials Engineering Seminar. Cr. R. Repeatable. *Prereq: Graduate classification.* (1-0) Students and outside/invited speakers give weekly presentations about the ongoing research work and Geotechnical and Materials Engineering issues. Satisfactory-fail only.

C E 583. Pavement Analysis and Design. (Dual-listed with 483). (3-0) Cr. 3. *Prereq: 360 and 382.* Analysis, behavior, performance, and structural design of pavement systems. Topics include climate factors, rehabilitation, life cycle design economics, material and system response, pavement foundations and traffic loadings. Development of models for and analysis of pavement systems. Use of transfer functions relating pavement response to pavement performance. Evaluation and application of current and evolving pavement design practices and procedures. Mechanistic-based pavement design techniques and concepts. Analysis of the effects of maintenance activities on pavement performance and economic evaluation of pavement systems.

C E 586. Advanced Asphalt Materials. (2-3) Cr. 3. *Prereq: 382.* Advanced asphalt concrete (SUPERPAVE) mix designs. Aggregates. Admixtures. Production and construction, quality control and inspection. Nondestructive testing. Pavement thickness design. Materials engineering reports.

C E 587. Advanced Portland Cement Concretes. (2-3) Cr. 3. *Prereq: 382 or 383.* Hydraulic cements, aggregates, admixtures, and mix design; concrete production, quality control, early-age properties and durability. Concrete distress examination, identification, prevention, and nondestructive testing; advanced concrete technology, high-strength and high performance concrete.

C E 590. Special Topics. Cr. arr. Repeatable. F.S.SS. Pre-enrollment contract required.

C E 591. Seminar in Environmental Engineering. Cr. R. Repeatable. F.S. *Prereq: Graduate classification.* (1-0) Contemporary environmental engineering issues. Outside speakers. Review of ongoing research in environmental engineering. Satisfactory-fail only.

C E 594. Special Topics in Construction Engineering and Management. Cr. arr. Repeatable. *Prereq: Con E 322, Con E 340 or C E 306, and permission of instructor.* Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:
A. Planning and Scheduling
B. Computer Applications for Planning and Scheduling
C. Cost Estimating
D. Computer Applications for Cost Estimating
E. Project Controls
F. Computer Applications for Project Controls
G. Integration of Planning, Scheduling and Project Controls
J. Trenchless Technologies
K. Electrical and Mechanical Construction
L. Advanced Building Construction Topics
M. Design Build Construction
N. Industrial Construction
O. Highway and Heavy Construction
P. Advanced Technologies
Q. Construction Quality Control
R. Risk Management
S. Building Information Modeling

C E 595. Research Methods in Construction Engineering and Management. (0-1) Cr. 1. *Prereq: Credit or enrollment in 501, 502, 503, or 505.* Assigned readings and reports on research methods to solve construction engineering and management problems such as robotics, project controls, automation, etc. Identification of research methods and priorities, selection and development of research design, and critique of research in construction engineering and management.

C E 599. Creative Component. Cr. arr. Repeatable. Pre-enrollment contract required. Advanced topic for creative component report in lieu of thesis.

Courses for graduate students

C E 622. Advanced Topics in Environmental Engineering. (2-0) Cr. 2. Repeatable. *Prereq: Permission of environmental engineering graduate faculty.* Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:
A. Water Pollution Control
B. Water Treatment
C. Solid and Hazardous Waste
D. Water Resources

C E 649. Advanced Topics in Structural Engineering. (3-0) Cr. 3. Repeatable. *Prereq: Permission of structural engineering graduate faculty.* Advanced concepts in structural engineering topics. Emphasis for a particular offering will be selected from the following topics:
A. Behavior of Metal Structures
B. Design of Concrete Shells
D. Advanced Matrix Analysis of Structures
E. Dynamic Design of Structures
F. Reliability Assessment of Structures.

C E 690. Advanced Topics. Cr. arr. Repeatable. F.S.SS. Pre-enrollment contract required.

C E 697. Engineering Internship. Cr. R. Repeatable. *Prereq: Permission of coop advisor, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

C E 699. Research. Cr. arr. Repeatable. *Prereq: Pre-enrollment contract required.* Advanced topic for thesis/dissertation.

Classical Studies

www.iastate.edu/~classics

(Interdepartmental Undergraduate Program)

Program Committee: M. Henry, Chair; G. Betcher, T. Butler, J. Cunnally, J. Goodwin, M. Graham, J. Hagge, D. Hollander, R. Meyer, M. Mook

The Classical Studies program is a cross-disciplinary program in the College of Liberal Arts and Sciences which offers an integrated curriculum of courses in the languages, literatures, history, and thought of ancient Greece and Rome from prehistoric times to the reign of the Emperor Constantine. Complete and current information about the Program may be found on-line at: www.iastate.edu/ ~classics/

Courses in Classical Studies provide background for students whose major fields of study or career interests include Anthropology, English, World Languages and Cultures, History, Music, Philosophy, Women's Studies, law, medicine, material culture, political science, the life sciences and related fields. Students who wish to pursue an interdisciplinary major in Classical Studies should consult the Program Chair.

A student who wishes to declare a minor must successfully complete the following requirements: (a) Greek 102 or Latin 102; (b) Cl St 273 or 275; (c) Three additional courses (nine credits) from the courses listed below (primary or departmental), or as approved by the program committee

Courses primarily for undergraduate students

Cl St 273. Greek and Roman Mythology. (3-0) Cr. 3. F.SS. Survey of the legends, myths of the classical world with emphasis on the principal gods, and heroes, and their relation to ancient social, psychological, and religious practices; some attention may be given to important modern theories.
H. Honors (4-0) Cr. 4.

Cl St 275. The Ancient City. (3-0) Cr. 3. S. Examination of ancient urban life, including historical context, physical space, material culture, religion, literature, and art; examination of civic identity (the "polis"). Contrast between the concepts of urban and rural. Examples drawn from specific ancient cities; some attention to modern methods of recovering the conditions of ancient urban life and the fundamental concept of the city in European history.
H. Honors. (4-0) Cr. 4.

Cl St 304. Cultural Heritage of the Ancient World. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* Historical examination of art, literature, thought, and religious beliefs of major civilizations of the ancient Mediterranean countries until the end of the 8th century.

Cl St 310. Ancient Philosophy. (Cross-listed with Phil). (3-0) Cr. 3. F. *Prereq: Phil 201.* Survey of ancient Greek Philosophy, focusing on the pre-Socratics, Plato, and Aristotle. Questions concerning being, knowledge, language, and the good life are treated in depth. Nonmajor graduate credit.

Cl St 350. Rhetorical Theories and Issues in Context. (Cross-listed with Engl, Sp Cm). (3-0) Cr. 3. S. *Prereq: Engl 250.* Ideas about the relationship between rhetoric and Society in contemporary and historical contexts. An exploration of classical and contemporary rhetorical theories in relation to selected topics that may include politics, gender, race, ethics, education, science, or technology.

Cl St 353. World Literature: Western Foundations through Renaissance. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Engl 250.* Representative works from the drama, epics, poetry, and prose of the Ancient World through the late sixteenth century. May include Homer, Aeschylus, Sappho, Catullus, Dante, Marie de France, Boccaccio, Christine de Pizan, Cervantes, and others.

Cl St 367. Christianity in the Roman Empire. (Cross-listed with Relig). (3-0) Cr. 3. An historical introduction to the rise of Christianity in the Roman empire, with special attention to the impact of Greco-Roman culture on the thought and practice of Christians and the interaction of early Christians with their contemporaries. Nonmajor graduate credit.

Cl St 372. Greek and Roman Tragedy and Comedy. (3-0) Cr. 3. S. *Prereq: 273 or 275 or one course in Latin or Greek or English 250.* Greek and Roman drama from the beginnings until today. Readings in English from authors such as Aeschylus, Sophocles, Euripides, Aristophanes, Menander, Plautus, Terence, Seneca. Course may cover performance, theories of comedy and tragedy, recent and current expressions of the comic and tragic in film and other media.
H. Honors (4-0) Cr. 4.

Cl St 373. Heroes of Greece, Rome, and Today. (3-0) Cr. 3. F. *Prereq: 273 or 275 or one course in Latin or Greek or English 250.* Cultural and political significance of ancient epic, especially in Greece and Rome. Course may include study of the heroic code in antiquity and its modern expressions including in film. Readings in English from authors such as Homer and Vergil.
H. Honors (4-0) Cr. 4.

Cl St 374. Women in the Ancient Mediterranean World. (Cross-listed with Hist, W S). (3-0) Cr. 3. Repeatable. S. *Prereq: Any one course in Cl St, W S, Latin, or Greek.* Chronological and topical survey of the Status of women in the Ancient Mediterranean world; study of constructs of the female and the feminine. Readings from ancient and modern sources. Emphasis on either the Greek world and Hellenistic Egypt, or Hellenistic Egypt and Rome.
A. Hellenic World and Hellenistic Egypt
B. Roman World including Roman Egypt

Cl St 376. Classical Archaeology. (Cross-listed with Hist, Relig). (3-0) Cr. 3. Repeatable. S. Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.
A. Bronze Age (Minoan and Mycenaean palatial cultures) and Early Iron Age Greece. (ca 3000-700 BCE).
B. Archaic through Hellenistic Greece (ca 700-30 BCE).

Cl St 383. Greek and Roman Art. (Cross-listed with Art H, Dsn S). (3-0) Cr. 3. Greek art from Neolithic through Hellenistic periods. Roman art from the traditional founding to t he end of the empire in the West. Nonmajor graduate credit.

Cl St 394. The Archaeology of Greece: An Introduction. (2-0) Cr. 2. S. Introduction to the topography, history, archaeology, monuments and art of Greece from the Bronze Age through the Ottoman period; attention given to the culture of modern Greece, preparatory to study abroad in Greece (Cl St 395).

Cl St 395. Study Abroad: The Archaeology of Greece. Cr. arr. SS. *Prereq: 394.* Supervised on-site instruction in the archaeology, monuments, and art of Greece from the Bronze Age through the Ottoman period; attention given to the culture of modern Greece.

Cl St 402. Greek Civilization. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* Ancient Greece from the Bronze Age to the Hellenistic period; evolution of the Greek polis and its cultural contributions with a particular emphasis on the writings of Herodotus and Thucydides.

Cl St 403. Roman Civilization. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* Ancient Rome from the Regal Period to the Fall of the Western Empire; evolution of Roman institutions and Rome's cultural contributions studied through original sources. Nonmajor graduate credit.

Cl St 404. Roman Social History. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines major topics in Roman social history during the late Republic and early Empire such as class, family, slavery, religion and the economy. Nonmajor graduate credit.

Cl St 430. Western Political Thought: Plato to Machiavelli. (Cross-listed with Pol S). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European History.* Major concepts in original texts of classical, medieval, and renaissance authors: justice, community, man's basic nature; natural law; force; Society outside the political order. Nonmajor graduate credit.

Cl St 480. Seminar in Classical Studies. (3-0) Cr. 3. *Prereq: 30 credits in Classical Studies or related courses, permission of Program Chair.* Advanced study of a selected topic in Classical Studies. Research paper or project selected by the student.

Cl St 490. Independent Study. Cr. arr. Repeatable. *Prereq: 7 credits in classical studies at the 200 level or higher; permission of the Program Chair.* Designed to meet the needs of students who wish to study specific topics in classical civilization in areas where courses are not offered, or to pursue such study beyond the limits of existing courses.

Courses for graduate students, major or minor, open to qualified undergraduates

Cl St 512. Proseminar in Ancient European History. (Cross-listed with Hist). (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Readings in European History.
A. Ancient (Same as Hist 512A)

Cl St 594. Seminar in Ancient European History. (Cross-listed with Hist). (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Topics vary each time offered.
A. Ancient (Same as Hist 594A)

Primary Courses (Offered by Other Departments)

Art H 383. Greek and Roman Art. See *Art and Design.*

Greek 101. Elementary Ancient Greek I. See *World Languages and Cultures.*

Greek 102. Elementary Ancient Greek II. See *World Languages and Cultures.*

Greek 201. Intermediate Classical Greek. See *World Languages and Cultures.*

Greek 332. Introduction to Classical Greek Literature. See *World Languages and Cultures.*

Greek 441. Advanced Readings in Greek Literature. See *World Languages and Cultures.*

Greek 442. Advanced Topics in Greek Literature. See *World Languages and Cultures.*

Greek 490. Independent Study. See *Foreign Language and Literature* website. (www.language.iastate.edu)

Hist 280. Introduction to History of Science I. See *History.*

Latin 101. Elementary Latin I. See *World Languages and Cultures.*

Latin 102. Elementary Latin II. See *World Languages and Cultures.*

Latin 201. Intermediate Latin. See *World Languages and Cultures.*

Latin 332. Introduction to Latin Literature. See *World Languages and Cultures.*

Latin 441. Advanced Readings in Latin Literature. See *World Languages and Cultures.*

Latin 442. Advanced Topics in Latin Literature. See *World Languages and Cultures.*

Latin 490. Independent Study. See *World Languages and Cultures* website. (www.language.iastate.edu)

Communication Studies

(Administered by the College of Liberal Arts and Sciences)

The Communication Studies Major

The communication studies major prepares students for careers in business and industry and graduate education. Students majoring in ComSt will find their career opportunities enhanced in professions requiring applied communication expertise, e.g., human resource management, personnel, public relations, training and development, sales, management, organizational development, business communication, law, and international and intercultural relations.

ComSt majors master a focused course of inquiry into the contemporary study of human communication. The ComSt major provides this focus through emphasis in applied communication theory and research in interpersonal, small group, organizational, and intercultural communication.

ComSt majors must earn at least 120.5 credits, with 45 credits at the 300-400 levels, and a minimum of 33 credits in ComSt.

Communication Proficiency Requirement:

To meet the University's Communication Proficiency requirement students are required to take Engl 302, 309, 314, or 415. An average of C- is required in English 150, 250 (or 250H), and this additional writing course.

The Communication Studies Major

Core Requirements (15 credits)
- 3 Introduction to Communication Studies, ComSt 101
- 3 Introduction to Interpersonal Communication, ComSt 102
- 3 Introduction to Communication Research Methods, ComSt 203
- 3 Human Communication Theory, ComSt 301

Select one of these courses:
- 3 Professional Communication, ComSt 214
- 3 Conflict Management, ComSt 218
- 3 Fundamentals of Public Speaking, SpCm 212

Upper Division Requirements (Select five course/15 credits)
- 3 Language, Thought and Action, ComSt 305
- 3 Intercultural Communication, ComSt 310
- 3 Relational Communication, ComSt 311
- 3 Organizational Communication, ComSt 314
- 3 Small Group Communication, ComSt 317
- 3 Nonverbal Communication, ComSt 325
- 3 Computer Mediated Communication, ComSt 330
- 3 Semantics, SpCm 305
- 3 Gender and Communication, ComSt 323

Select one of these seminars:
- 3 Communication Theory or Research, ComSt 404A
- 3 Interpersonal Communication, ComSt 404B
- 3 Small Group Communication, ComSt 404C
- 3 Organizational Communication, ComSt 404D
- 3 Intercultural Communication, ComSt 404E
- 3 Nonverbal Communication, ComSt 404F
- 3 Training and Development, ComSt 404G
- 3 Computer Mediated Communication, ComSt 404H

33 Total

Enhancement Requirement (4 credits)
- 4 Computer Applications, Com S 103
  Recommended: Stat 101 or equivalent

Communication Studies. The requirements for a minor in ComSt may be fulfilled by credit in ComSt 101, ComSt 203, ComSt 301 plus at least 9 additional hours of communication studies, of which 6 credits are in courses numbered 300 or above. Students must earn a grade of C or better in all courses taken for the minor. No credits in 490, 499, or 590 may apply toward the minor.

Communication Studies (ComSt)

Courses primarily for undergraduate students

ComSt 101. Introduction to Communication Studies. (3-0) Cr. 3. An introduction to communication theory, the development and functions of communication, and a survey of interpersonal, small group, organizational, and intercultural communication.

ComSt 102. Introduction to Interpersonal Communication. (3-0) Cr. 3. Application of communication principles, theory, and research to the process of interpersonal communication; includes verbal, nonverbal, listening, conflict management, and communication skills most relevant to a broad range of interpersonal settings.

ComSt 203. Introduction to Communication Research Methods. (3-0) Cr. 3. An introduction to analyzing and conducting communication research. Includes theory development, statistics, and methodologies.

ComSt 214. Professional Communication. (3-0) Cr. 3. Communication theory and skill development in organizational settings. Emphasis on: interpersonal skill development, team and meeting facilitation, informational interviewing, and team presentations and self-assessment.

ComSt 218. Conflict Management. (3-0) Cr. 3. Exploration of communication theories, principles and methods associated with effective conflict management.

ComSt 301. Human Communication Theory. (3-0) Cr. 3. *Prereq: 101.* Examination of the major theories related to human communication; with particular emphasis on theories underlying interpersonal, small group, organizational, and intercultural communication.

ComSt 305. Language, Thought and Action. (Cross-listed with Sp Cm, Ling). (3-0) Cr. 3. F.S.SS. *Prereq: Engl 250.* The study of symbolic processes and how meaning is conveyed in words, sentences, and utterances; discussion of modern theories of meaning; and an exploration of relationships among language, thought and action. Nonmajor graduate credit.

ComSt 310. Intercultural Communication. (3-0) Cr. 3. *Prereq: 101 or 102, 203, 301.* Examines the theories, principles and research on intercultural communication to enhance cultural sensitivity and to recognize, accept, and adapt to cultural diversity. Interactive assignments.

ComSt 311. Relational Communication. (3-0) Cr. 3. *Prereq: 102, 203, 301.* A study of contemporary interpersonal communication theories and research. Emphasis on relational development research including initiation, maintenance, conflict management, and dissolution.

ComSt 314. Organizational Communication. (3-0) Cr. 3. *Prereq: 101 or 102, 203, 301.* Theory and research in organizational communication; strategies for assessing and improving individual and organizational communication effectiveness; an understanding of how organizational meaning is created and sustained through human communication.

ComSt 317. Small Group Communication. (3-0) Cr. 3. *Prereq: 101 or 102, 203, 301.* Theory and research in small group communication; application to group decision-making and leadership. Includes communication analyses of groups and teams.

ComSt 323. Gender and Communication. (Cross-listed with Sp Cm, W S). (3-0) Cr. 3. F. *Prereq: Sp Cm 212.* The rhetorical strategies women and men use to succeed in oral communication; the theory, principles, and practice of effective gender communication in a variety of settings. Nonmajor graduate credit.

ComSt 325. Nonverbal Communication. (Cross-listed with Sp Cm). (3-0) Cr. 3. *Prereq: ComSt 101 or 102, 203, 301.* Theory and research in nonverbal communication; exploration of nonverbal subcodes; function of nonverbal communication in various contexts; student-designed investigations.

ComSt 330. Computer Mediated Communication. (3-0) Cr. 3. *Prereq: 101 or 102, 203, 301.* Theories and perspectives related to mediated communication in interpersonal and organizational settings. Focus on how new technology will impact human interaction with computers as well as between and among humans.

ComSt 404. Seminar in Communication Studies. (Dual-listed with 504). (3-0) Cr. 3. Repeatable. *Prereq: ComSt 301 plus 9 additional hours of 300 level ComSt courses.*
A. Communication Theory or Research
B. Interpersonal Communication
C. Small Group Communication
D. Organizational Communication
E. Intercultural Communication
F. Nonverbal Communication
G. Training and Development
I. Computer Mediated Communication

ComSt 490. Independent Study. Cr. arr. Repeatable. *Prereq: 9 credits in communication studies and junior classification.* Application must be submitted for approval the semester prior to the independent study.

ComSt 499. Professional Internship. Cr. arr. Repeatable. Four hundred hours of on-site work is required for 3 hours credit. Registration by application only. Application must be submitted to Communication Studies faculty adviser for approval the semester prior to the internship.

Courses primarily for graduate students, open to qualified undergraduate students

ComSt 504. Seminar in Communication Studies. (Dual-listed with 404). (3-0) Cr. 3. Repeatable. F.S. *Prereq: Graduate standing and permission of instructor.*
A. Communication Theory and Research
B. Interpersonal Communication
C. Small Group Communication
D. Organizational Communication
E. Intercultural Communication
F. Nonverbal Communication
G. Training and Development
I. Computer Mediated Communication

ComSt 590. Special Topics. Cr. arr. Repeatable. Application must be submitted for approval the semester prior to the independent study.

Community Development

www.gpidea.org

(Interinstitutional Graduate Program)

Participating Institutions:

Iowa State University
Kansas State University
University of Nebraska
North Dakota State University
South Dakota State University

Community Development is an interinstitutional distance education program offered through the Web. The student selects a home institution, which grants the degree. After admission at the home institution, the student takes courses from each of the six institutions: Iowa State University, Kansas State University, University of Nebraska, North Dakota State University, and South Dakota State University.

At Iowa State University, Community Development is an optional area of specialization within the Interdisciplinary Graduate Studies degree program that consists of 37 semester credits for completion of the program. A thesis or creative component is required. A computer with minimum specifications, Web access, and an email address are required for completing the program.

Registration

Students choosing to receive their degree from Iowa State University complete all the admissions, registration and fee payment processes through ISU.

C Dev 502. Community and Natural Resource Management. (3-0) Cr. 3. Detailed introduction to community resource management. Theoretical frameworks, methodological investigation, applied practices. Enhancement of ability of community development professionals to work with communities to plan, develop and monitor conversation and development of natural resources with multiple functions.

C Dev 503. Community Development I: Principles and Strategies of Community Change. (3-0) Cr. 3. Analysis of principles and practices of community change and development. Use of case studies to relate community development approaches to conceptual models from diverse disciplines. Exploration of professional practice principles, and student construction of their personal framework for practicing community development.

C Dev 504. Community Analysis: Introduction to Methods. (3-0) Cr. 3. Introduction to research methods relevant to community development. Formulate and begin a research effort, methods of data collection and how conceptual frameworks are used to develop the questions and analyze data. Emphasis on strategies for reporting findings and applying findings in community action and methods of evaluating the entire research process. Significant attention paid to issues of research ethics and inclusiveness.

C Dev 505. Community Development II: Organizing for Community Change. (3-0) Cr. 3. Examines role of civil Society in community planning efforts. Comparative approach to planning theories and approaches. Focus on change within communities and the roles of government, planners, and citizens in reacting to or shaping change. Dimensions of social capital and the context of change covered.

C Dev 506. Community and Regional Economic Analysis. (3-0) Cr. 3. Introduction to concepts of communities and regions, theories of economic growth, drivers of economic growth, the economic base of a community, sources of growth or decline in the community, roles of local government and institutions, and analytical tools. Strategies for local economic Development will also be explored.

C Dev 507. Introduction to Native Communities. (3-0) Cr. 3. A base knowledge course. For students currently working within, in partnership with, or considering working with Native communities. Basic understanding within the context of community development of the diversity of the tribal structures and cultures and the unique history and jurisdictional considerations of these nations. Working with tribes, Federal and Indian relations, and governance and cultural issues.

C Dev 508. Ecological Economics. (3-0) Cr. 3. Approaches economy and community by looking at the inherent interdependence, jointness, and potential complimentarity between ecology and economy (utility) of a place.

C Dev 509. Building Native Community and Economic Capacity. (3-0) Cr. 3. Focus on non-western approaches to helping Native communities build their capacity. Students will learn to take a participatory, culture-centered, and strength-based approach to development.

C Dev 510. Indian Country Agriculture and Natural Resources. (3-0) Cr. 3. Introduction to the historical and contemporary issues related to natural resource management on Native American lands. Philosophical and economic arguments concerning natural resource conservation, preservation and extraction will be explored.

C Dev 512. Sustainable Communities. (3-0) Cr. 3. Students will learn the conceptual relationships among Community and Sustainable Development and Sustainable Communities and examine the social, environmental, and economic aspects of sustainable communities. The course includes analysis of public policy impacts on community sustainability, practical actions for enhancing sustainability, and changing power dynamics and reward structures involved in incorporating sustainability into Community Development.

C Dev 513. Economic Development Strategies and Programs. (3-0) Cr. 3. Course explores theories of local economic Development and addresses the development issues faced by communities in the 21st century. Students will understand and apply concepts from economic Development planning, economic analysis, business development, human resource development, community-based development, and high-technology development.

C Dev 520. Orientation in Community Development. (1-0) Cr. 1. Introduction to the Community Development program. Focus on on-line delivery methods, graduate level research and writing, technology skills.

C Dev 522. Community Leadership and Capacity Building. (3-0) Cr. 3. Defining leadership and applying it to the workplace. Understanding of potential link between leadership and community capacity. Identifying strategies for leadership development in communities.

C Dev 523. Grantwriting for Community Development Professionals. (3-0) Cr. 3. Basic Grant Development and Management will introduce students to the grant-getting process and provide an overview of what happens after a project is funded. The following topics will be covered: researching funding sources, generating cutting edge ideas, assessing needs, planning a project, establishing credibility, formulating a sustainable budget, designing an evaluation plan, managing the funded project, and disseminating project results.

C Dev 524. Non-Profit Management in Community Development. (3-0) Cr. 3. Understanding of how non-profit organizations are run in order that they may participate more fully in community development efforts. Learning skills necessary to assist organizations to manage community development projects and programs, such as, budgeting, planning, personnel, facilities, volunteer management, and fundraising.

C Dev 542. The Policy and Politics of Coastal Areas. (Cross-listed with Pol S). (3-0) Cr. 3. Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, tradeoffs between conservation and jobs, the quality of coastal lifestyle, ways in which citizens participate in policy for coastal areas.

C Dev 599. Creative Component. Cr. arr.

Community and Regional Planning

Douglas Johnston, Chair of Department

Professors: Johnston, Mahayni

Professors (Emeritus): Shinn

Associate Professors: Borich, Bradbury, Coates, Owusu

Associate Professors (Emeritus): Huntington, Knox, Malone

Assistant Professors: Basmajian, Clapp, Haddad, Sandoval, Taylor, Trabalzi

Assistant Professors (Adjunct): Swenson

Lecturers: Jensen, Mehrotra

Undergraduate Study

For undergraduate curriculum in community and regional planning leading to the degree bachelor of science, see College of Design, Curricula.

Community and regional planning is a professional field of study aimed at assessing the ever-changing socioeconomic and physical environments of our communities and planning for their future. Planners evaluate and seize opportunities to understand and solve problems. Most planners work at the local level, but they are concerned with issues that affect the world: the preservation and enhancement of the quality of life in a community, the protection of the environment, the promotion of equitable economic opportunity; and the management of growth and change of all kinds.

Planning has its roots in landscape architecture, architecture, engineering, law, economics, and public administration. Most contemporary planners are trained in the physical and social sciences so they can understand the society and economy in which plans must be implemented. Planning demands technical competence as well as creativity, plus pragmatism and an ability to envision alternatives to the physical and social environments in which we live.

Graduates of the Community and Regional Planning department will be capable of performing in entry level positions in public planning agencies or with planning consulting firms. Graduates are able to integrate planning knowledge and skills in practical applications to current planning issues, and to communicate in written and oral form.

Graduates of the Community and Regional Planning Department are expected to have knowledge of the structure and functions of urban settlements, the history of planning, and aspects of plan and policy making. Graduates should have skills in problem formulation, quantitative analysis, written/oral and graphic communications, collaborative approaches to these, and in synthesizing and applying knowledge to practice. Graduates are expected to assess the impact of values in terms of equity and social justice, economic welfare and efficiency, environmental sustainability, and cultural heritage in the context of citizen involvement in decision making.

The curriculum is accredited by the Planning Accreditation Board of the American Institute of Certified Planners and the Association of Collegiate Schools of Planning, thus providing the student with an education which, when combined with experience, supports the individual's eligibility for membership in the American Institute of Certified Planners.

The department cooperates in the undergraduate minors in design studies and environmental studies.

Graduate Study

The Department offers work for the Master of Community and Regional Planning degree with areas of concentration in land use and transportation, community design and development, and rural and environmental planning. In addition, students can design their own area of concentration if it does not fit in any of the three areas, with the assistance of their major professor. The program of graduate study is accredited by the Planning Accreditation Board of the American Institute of Certified Planners and the Association of Collegiate Schools of Planning.

Degree requirements include completion of a 2-year, 48-credit program, including a thesis of 6 credits or a professional planning report of 4 credits. The planning core consists of C R P 501, 502, 511, 521, 523, 532, 561, and 592. Satisfactory completion of the core requirements and the acceptance of a thesis (6 credits) or a professional planning report (4 credits) are required for the M.C.R.P. degree. Students with a bachelors' degree in community and regional planning from an accredited planning school can waive up to 9 credits. The ability to waive credits is determined by a review of the coursework completed during undergraduate study, the grades received (only a grade of "B" or higher is acceptable) and the student's planning experience. The decision to waive up to 9 credits of the masters program should be made before first time registration for classes through a petition to the DOGE. In addition, the student is encouraged to complete three months of acceptable work experience in a planning office between the first and second year of study. No foreign language is required for the degree master of community and regional planning.

Double degree programs are offered with architecture (M.C.R.P/M.Arch.), business (M.C.R.P/M.B.A.), public administration (M.C.R.P/M.P.A.), and landscape architecture (M.C.R.P/M.L.A.). The department also participates in the interdepartmental major in transportation.

The department also offers a 13-credit graduate certificate in Geographic Information Systems (GIS) in spatial analysis, GIS applications and program management. The program is open to graduate students in all disciplines of the University. Information guides for the graduate degree and certificate may be obtained from the department office at the department's web page at: http://www.design.iastate.edu/CRP/

CRP currently offers several courses via distance learning to graduates and planning professionals interested in expanding their knowledge of planning. Further details of current distance course offerings may be found on the CRP website and on the ISU Continuing Education website. For more information, send an e-mail to crp@iastate.edu

Courses primarily for undergraduate students

C R P 253. Survey of Community and Regional Planning. (3-0) Cr. 3. F. A historical survey of planning, the nature and problems of urban areas, and the goals, procedures, and results of urban planning.

C R P 270. Forces Shaping Our Metropolitan Environment. (Cross-listed with Dsn S). (3-0) Cr. 3. S. Must be taken prior to completing 9 credits in C R P. Introduction to the social, political, physical, and economic forces as they shape metropolitan areas. A comprehensive picture of metropolitan development showing important roles other urban disciplines play in the planning process and the interrelationships of the disciplines.

C R P 272. Planning Analysis and Techniques I. (2-2) Cr. 3. F. Existing and emerging techniques for preparation of community planning studies. Sources of planning information and data. Survey techniques including survey instruments, sampling methods, sample size for demographic studies. Land use surveys for comprehensive and transportation planning. Student's oral and graphic presentation of analytical results. Laboratory emphasizes practical uses and computer applications for data analysis.

C R P 274. Planning Analysis and Techniques II. (2-2) Cr. 3. S. *Prereq: 272.* Use of quantitative methods for analysis of population, land use, economic and transportation make-up of a community; activities and location, intensity, and timing of land uses and public services. Student's oral and graphic presentation of analytical results. Laboratory emphasizes practical uses and computer applications for data analysis.

C R P 291. World Cities and Globalization. (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Sophomore classification.* World cities and globalization in developed and developing countries. Topics include globalization, world cities and regions, uneven economic development, the international division of labor, multinational corporations, international environmentalism, tourism, popular culture and place-based identity.

C R P 293. Environmental Planning. (Cross-listed with Dsn S, Env S). (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Comprehensive overview of the field of environmental relationships and the efforts being made to organize, control, and coordinate environmental, aesthetic, and cultural characteristics of land, air, and water.

C R P 320. Urban form. (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 253 or 270, or permission of instructor.* Examines how urban form is shaped, what constitutes good urban form, and what are the trends in emerging urban forms. Descriptive, explanatory and normative theories of urban form, and the relationships between urban form and social, economic, political, cultural, and institutional forms.

C R P 330. Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Major in community and regional planning.* Structured work experience under close supervision of a professional planner. Practical planning experience; relationships between theory and practice, professional responsibilities, and the scope of various planning roles.

C R P 331. Professional Practice Seminar. (Dual-listed with 531). (1-0) Cr. 1. S. *Prereq: Major in community and regional planning.* Preparation for working in a planning office; discussion of expectation of employer; presentations from planning professionals, and discussion of differences/similarities between public and private planning offices. Satisfactory-fail only.

C R P 332. Community Planning Studio I. (2-4) Cr. 4. F. *Prereq: 253, 274.* Application of planning methods and skills to issue identification and investigation. Introduction to problem formulation, study, and analysis in a community setting.

C R P 376. Rural, Urban and Regional Economics. (Cross-listed with Econ). (3-0) Cr. 3. F.S. *Prereq: Econ 101.* Firm location with respect to regional resources, transport, scale economies, externalities, and policies. Measures of local comparative advantage and specialization. Spatial markets. Population location considering jobs, wages, commuting, and local amenities. Business, residential, and farm land use and value. Migration. Other topics may include market failure, regulation, the product cycle, theories of rural and urban development, developmental policy, firm recruiting, local public goods and public finance, schools, poverty, segregation, and crime. Nonmajor graduate credit.

C R P 383. Theory of the Planning Process. (3-0) Cr. 3. S. *Prereq: 253, junior Status.* The nature of planning and its relation to social and economic planning; levels of planning, place of planning in decision making; steps in the planning process, uses and limitation of knowledge in planning, relation of facts and values.

C R P 391. Field Travel. Cr. arr. Repeatable. F.S.SS. *Prereq: CRP major and permission of instructor.* Observation of professional practice and community or regional problems and issues. Satisfactory-fail only.

C R P 410. Professional Work Experience. Cr. R. F.S.SS. *Prereq: Permission of department chair.* Approved professional work experience.

C R P 416. Urban Design and Practice. (Dual-listed with 516). (3-6) Cr. 6. S. *Prereq: 253 or 270.* Principles of urban design and their application to residential and commercial development in studio projects.

C R P 417. Urban Revitalization. (Dual-listed with 517). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 253 or 270.* Planning methods available to further revitalization and preservation efforts, with particular attention to housing and neighborhoods. Relationship between neighborhood change and urban development process; public policy implications.

C R P 425. Growth Management. (Dual-listed with 525). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Junior classification.* Review of techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban, suburban and rural relationships; and land preservation.

C R P 429. International Planning. (Dual-listed with 529). (Cross-listed with Dsn S). (3-0) Cr. 3. S. *Prereq: Junior classification.* Introduction to issues in planning and governance in an international setting. Problems and strategies may include population movement and change, economic globalization, urban growth, rural development, and housing.

C R P 432. Community Planning Studio II. (1-6) Cr. 4. F.S.SS. *Prereq: 332, 383.* Integration of planning methods and theory in dealing with a community planning problem. Analysis of problem and formulation of strategies for implementation. Preparation of a community planning report.

C R P 435. Planning in Small Towns. (Dual-listed with 535). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 253, 270, or junior classification.* Contemporary planning problems in small towns and the design of viable strategies to enhance their social and economic position in today's society.

C R P 442. Site Development. (Dual-listed with 542). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 253, 272.* Introduction to site analysis using landscape architecture and environmental principles, drawing also on basic engineering concepts. Work will evolve from analysis to land development design.

C R P 445. Transportation Policy Planning. (Dual-listed with 545). (3-0) Cr. 3. F. *Prereq: C E 350 or equivalent.* Comprehensive overview of key policy issues related to transportation planning and investment in the United States and abroad. Policy issues explored include safety, environmental impact, sustainable communities, and economic development. Policy analysis and planning are studied in conjunction with each policy issue explored. Issues of concern to state, metropolitan, and local governments.

C R P 451. Introduction to Geographic Information Systems. (Dual-listed with 551). (2-2) Cr. 3. F.S.SS. Introduction to geographic information systems, including discussions of GIS hardware, software, data structures, data acquisition, data presentation, analytical techniques, and implementation procedures. Laboratory emphasizes practical applications and uses of GIS.

C R P 452. Geographic Data Management and Planning Analysis. (Dual-listed with 552). (2-2) Cr. 3. F.S. *Prereq: C R P 451 or equivalent.* Extensive coverage of geo-relational database concept and design, GIS database creation and maintenance, geographic data manipulation and analysis. GIS output generation and geographic data presentation. Laboratory emphasizes practical applications and uses of GIS.

C R P 455. Community Economic Development. (Dual-listed with 555). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Sophomore classification.* The nature and process of economic development in the context of community development. Recent changes and trends and their implications for local and regional development. Selected case studies and applications. Contemporary community economic development issues.

C R P 475. Grant Writing. (Dual-listed with 575). (1-0) Cr. 1. F. *Prereq: 253 or 270 and junior classification.* A short introduction to effective grant writing for the public and non-profit sectors. Includes identifying appropriate funding sources for an organization, identifying goals and objectives, and budgeting.

C R P 481. Regional and State Planning. (Dual-listed with 581). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 253 or 270.* Analysis of theories, policies, and functions at the metropolitan, regional, and state levels with emphasis on area-wide governance structures and strategies for guiding development.

C R P 484. Sustainable Communities. (Dual-listed with 584). (Cross-listed with Dsn S, Env S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Senior classification.* The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

C R P 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on required form.* Investigation of an approved topic commensurate with student's interest and ability. Satisfactory-fail only.
H. Honors

C R P 491. Environmental Law and Planning. (Dual-listed with 591). (Cross-listed with Dsn S, Env S). (3-0) Cr. 3. S. *Prereq: 6 credits in natural sciences.* Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

C R P 492. Planning Law, Administration and Implementation. (3-0) Cr. 3. F. *Prereq: 383.* The basis in constitutional, common, and Statutory law for the powers of plan effectuation. Problems of balancing public and private interests as revealed in the study of leading court cases. Administration of planning agencies and programs.

C R P 494. Senior Seminar in Planning. Cr. arr. Repeatable. F.S.SS. *Prereq: Senior classification, 332 should be taken prior to or concurrently.* An advanced forum for seniors that focuses upon recent trends and important issues affecting planning today. Topics addressed will vary. A demonstration of understanding current issues and their affects upon planning applications is expected.

C R P 498. Portfolio Development and Review. (1-0) Cr. 1. F.S. Should be taken in the final semester of the planning program. Preparation of a portfolio of student work that represents student learning throughout the entire planning program.

Courses primarily for graduate students, open to qualified undergraduate students

C R P 501. Methods I. (3-0) Cr. 3. F. *Prereq: Graduate classification and Stat 401.* Applications of quantitative methods in planning with emphasis on the collection, description, analysis, presentation, and interpretation of planning data. Primary data collection using survey techniques. Secondary data types and sources of planning information for population projection and demographic analysis.

C R P 502. Methods II. (3-0) Cr. 3. S. *Prereq: Graduate classification and 501.* Investigative and participatory methods for citizen involvement and planning research including public meetings and processes, consultation, case studies, and focus groups. Research design for planning practice, and thesis and professional report proposal development.

C R P 504. Why Change Anything?. (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Introduction to a range of approaches to justifying innovations, changes, and interventions proposed by designers, planners, and artists. Reasons for change and their bases in social, philosophical, and design reasoning; and their usefulness in justifying change to different audiences. Investigation of fallacies, ideologies, and contemporary problems in justifications.

C R P 510. Professional Work Experience. Cr. R. F.S.SS. *Prereq: Permission of department chair.* Approved professional work experience.

C R P 511. Introduction to Community and Regional Planning. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Development of planning in the United States; history and evolution of the planning profession and constructs of current practice. Theoretical basis of planning.

C R P 516. Urban Design Practice. (Dual-listed with 416). (3-6) Cr. 6. S. *Prereq: Graduate classification.* Principles of urban design and their application to residential and commercial development in studio project.

C R P 517. Urban Revitalization. (Dual-listed with 417). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Planning methods available to further revitalization and preservation efforts, with particular attention to housing and neighborhoods. Relationship between neighborhood change and urban development process; public policy implications.

C R P 519. Middle Eastern Cities. (3-0) Cr. 3. F. *Prereq: Graduate or senior standing.* Middle Eastern cities introduce a particular continuity between history and contemporary life where in some cases the latter is about re-defining the former. Introduction to basic academic writings on Middle Eastern cities in addition to other contemporary cultural productions of the region. Study of various aspects of Middle Eastern life and the built environments that this life produces.

C R P 521. Land Use Planning. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Theories of the origin and growth of urban places and the dynamics of urban structure and land use. Methods and techniques for making land use plans dealing with orderly, efficient, and equitable development and arrangement of land uses within the planning process. Examination of the interrelationships among land use, transportation, environment, and infrastructure and public facilities.

C R P 523. Economic Analysis and the Financing of Public Planning Projects. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Analytical approaches to local and regional economic change and performance in the context of the changing economic geography of the U.S. Traditional and contemporary approaches to industrial location theory and analysis. Recent developments in public sector finance, capital budgeting, project evaluation and the financing of planning projects and economic development activity.

C R P 525. Growth Management. (Dual-listed with 425). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Graduate classification.* Review of techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban, suburban, rural relationships; and land preservation.

C R P 529. International Planning. (Dual-listed with 429). (Cross-listed with Dsn S). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Introduction to issues in planning and governance in an international setting. Problems and strategies may include population movement and change, economic globalization, urban growth, rural development, and housing.

C R P 530. Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification in community and regional planning.* Practical planning experience. Structured work in range of tasks under close supervision of a professional planner. Relationships between theory and practice, exposure to variety of roles in functioning specialties. Satisfactory-fail only.

C R P 531. Professional Practice Seminar. (Dual-listed with 331). (1-0) Cr. 1. S. *Prereq: Graduate classification.* Preparation for working in a planning office; discussion of expectations of employer; presentations from planning professionals, and discussion of differences and similarities between public and private planning offices. Satisfactory-fail only.

C R P 532. Community Planning Studio. (1-6) Cr. 4. F.SS. *Prereq: 521, 523.* Integration of planning methods and theory in dealing with a community planning problem. Analysis of problem and formulation of strategies for implementation. Preparation of a community planning report.

C R P 535. Planning in Small Towns. (Dual-listed with 435). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Graduate classification.* Contemporary planning problems in small towns and the design of viable strategies to enhance their social and economic position in today's Society.

C R P 542. Site Development. (Dual-listed with 442). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Introduction to site analysis using landscape architecture and environmental principles, but drawing also on basic engineering concepts. Work will evolve from analysis to land development design based on that analysis.

C R P 545. Transportation Policy Planning. (Dual-listed with 445). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Comprehensive overview of key policy issues related to transportation planning and investment in the United States and abroad. Policy issues explored include safety, environmental impact, sustainable communities, and economic development. Tools like policy analysis and planning are studied in conjunction with each policy issue explored. Issues of concern to State, metropolitan, and local governments.

C R P 551. Introduction to Geographic Information Systems. (Dual-listed with 451). (2-2) Cr. 3. F.S.SS. Introduction to geographic information systems, including discussions of GIS hardware, software, data structures, data acquisition, data presentation, analytical techniques, and implementation procedures. Laboratory emphasizes practical applications and uses of GIS.

C R P 552. Geographic Data Management and Planning Analysis. (Dual-listed with 452). (2-2) Cr. 3. F.S. *Prereq: 551.* Extensive coverage of geo-relational database concept and design, GIS database creation and maintenance, geographic data manipulation and analysis. GIS output generation and geographic data presentation. Laboratory emphasizes practical applications and uses of GIS.

C R P 553. Analytical Planning/GIS. (2-2) Cr. 3. S. *Prereq: 451/551.* Integration of exploratory, participatory and predictive spatial analyses and 3D visualization into the planning process. GIS tools and techniques are used to automate decision analysis and facilitate future planning in analyzing and visualizing planning actions. Laboratory emphasizes practical uses of GIS tools and techniques.

C R P 555. Community Economic Development. (Dual-listed with 455). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Graduate classification.* The nature and process of economic development in the context of community development. Recent changes and trends and their implications for local and regional development. Selected case studies and applications. Contemporary community economic development issues.

C R P 561. Seminar in Planning Theory. (3-0) Cr. 3. S. *Prereq: graduate classification.* Current planning theories: comprehensive land use, advocacy, participatory, radical, and transactive planning models. Decision making and organization models as they affect planning practice. Value conflicts and conflict resolution.

C R P 575. Grant Writing. (Dual-listed with 475). (1-0) Cr. 1. F. *Prereq: Graduate classification.* A short introduction to effective grant writing for the public and non-profit sectors. Includes identifying appropriate funding sources for an organization, identifying goals and objectives, and budgeting.

C R P 581. Regional and State Planning. (Dual-listed with 481). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Analysis of theories, policies, and functions at the metropolitan, regional, and state levels with emphasis on area-wide governance structures and strategies for guiding development.

C R P 584. Sustainable Communities. (Dual-listed with 484). (Cross-listed with Dsn S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate classification.* The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

C R P 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form.*
A. Planning Law, Administration and Implementation
B. Economic Development
C. Urban Design
D. Housing and Urban Revitalization
H. Environmental Planning
I. Land Use and Transportation Planning
N. International Planning
O. Spatial Analytical Methods
P. Planning in Small Towns
Q. Diversity and Equity in Planning
R. Geographic Information Systems

C R P 591. Environmental Law and Planning. (Dual-listed with 491). (Cross-listed with Dsn S, L A). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

C R P 592. Land Use and Development Regulation Law. (3-0) Cr. 3. F. *Prereq: Graduate classification.* An in-depth analysis of the legal constructs that shape the practice of planning and plan implementation in the United States. An exploration of how land use regulations are applied to reconcile the competing needs and diverse uses of land. The positive and negative consequences of developing and implementing regulatory controls will be addressed.

C R P 595. Seminar in GIS Applications/Research. (1-0) Cr. 1. F.S. *Prereq: 9 credits in GIS Certificate program.* Discussion and demonstration of current GIS applications and research in multiple disciplines. Satisfactory-fail only.

C R P 599. Professional Planning Report. Cr. arr. Repeatable. F.S.SS. Independent student research on planning topic. The course will serve as a capstone experience for the student, demonstrating ability to integrate planning knowledge and skills in the practical application of the student's abilities on a current planning issue. The completed report must be submitted to and approved by the POS committee as evidence of the mastery of the principles of community and regional planning.

Courses for graduate students

C R P 699. Research. Cr. arr. Repeatable. F.S.SS.

Complex Adaptive Systems

(Interdepartmental Graduate Minor)

Program Co-chairs: K.M. Bryden and J. E. Mayfield

The Complex Adaptive Systems (CAS) minor provides graduate students with an understanding of the interrelationships among the various methodologies often collectively referred to as Artificial Life. Of special importance in the program is the interplay of biological principles and computer simulations in various fields including Economics, Engineering, Mathematics, and Biology.

Graduates understand the ways in which artificial life techniques may be applied to their major field of study. They have an appreciation and understanding of the cross-disciplinary aspects of artificial life techniques. Students who complete a minor in this graduate program are able to describe and report on various artificial life techniques as applied to many fields, even outside their own field of application.

Work in the CAS minor is offered for students pursuing any graduate degree. The primary cooperating departments are Economics; Computer Science; Electrical and Computer Engineering; Mechanical Engineering; Mathematics; Psychology; Ecology, Evolution, and Organismal Biology; and Genetics, Development and Cell Biology.

Each student's Masters Program of Study (POS) must include at least 9 CAS relevant course credits chosen in consultation with the student's POS committee and the CAS program, plus two credits (one credit each time taken) of the CAS seminar and three credits of CAS 503 (see below). Each student's Ph.D. POS must include at least 12 CAS relevant courses credits chosen in consultation with the student's POS committee and the CAS program, plus two credits (one credit each time taken) of the CAS seminar and three credits of CAS 503. Ph.D. students who also minored in CAS at the master's level must take one additional CAS relevant course (3 cr.) and two additional credits of CAS seminar. Courses that satisfy CAS requirements may also be used to satisfy major requirements if such "double counting" is acceptable to the major program.

Interested students may contact the chairperson of the advisory committee for complete lists of courses and of CAS faculty members.

Courses primarily for graduate students, open to qualified undergraduate students

CAS 502. Complex Adaptive Systems Seminar. (Cross-listed with Com S). (1-0) Cr. 1. F.S. *Prereq: Admission to CAS minor.* Understanding core techniques in artificial life is based on basic readings in

complex adaptive systems. Techniques of complex system analysis methods including: evolutionary computation, neural nets, agent based simulations (agent based computational economics). Large-scale simulations are to be emphasized, e.g. power grids, whole ecosystems.

CAS 503. Complex Adaptive Systems Concepts and Techniques. (Cross-listed with Com S). (3-0) Cr. 3. S. *Prereq: Admission to CAS minor or related field.* Survey of complex systems and their analysis. Examples are drawn from engineering, computer science, biology, economics and physics.

Computer Engineering

www.ece.iastate.edu

(Administered by the Department of Electrical and Computer Engineering)

Arun Somani, Chair of Department

Distinguished Professors: Somani, Soukoulis

Distinguished Professors (Emeritus): Brown, Fouad, Lord, Nilsson, Pohm

University Professor: Jacobson

University Professor (Emeritus): Jones

Professors: Ajjarapu, Aluru, J. Bowler, Dalal, Geiger, Kamal, Kothari, Kumar, Kushner, Liu, Luecke, Mccalley, Oliver, Rover, Shinar, Weber

Professors (Emeritus): Anderson, Basart, Brearley, Brockman, Comstock, Fanslow, Hale, Horton, Hsieh, Kopplin, Melsa, Potter, Read, Sheble, Smay, Stewart, Swift, Townsend, Venkata

Professor (Adjunct): Shinar

Professor (Emeritus Adjunct): Hillesland

Professors (Collaborators): Jiles, Lee

Associate Professors: N. Bowler, Chang, Chen, Chu, Davidson, Davis, Dickerson, Dogandzic, Elia, Govindarasu, Guan, S. Kim, Song, Tirthapura, Tuttle, Tyagi, Z. Wang

Associate Professors (Emeritus): Bond, Carlson, Coady, Mericle, Pavlat, Scott, Stephenson

Associate Professors (Adjunct): Biswas, Sosonkina

Associate Professors (Collaborators): Ashlock, Salapaka

Assistant Professors: Aliprantis, Bigelow, Chaudhary, Chung, Daniels, Dong, Fayed, Hornbuckle, Jones, J. Kim, Ma, Neihart, Nguyen, Pandey, Qiao, Ramamoorthy, Stoytchev, Vaidya, Vaswani, L. Wang, Ying, Zambreno, Zhang

Assistant Professor (Adjunct): Amin, Bode

Assistant Professor (Collaborators): Balasubramaniam

Senior Lecturer: Mina, Wiersema

Undergraduate Study

For the undergraduate curriculum in computer engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission of ABET.

The Electrical and Computer Engineering (ECPE) Department at Iowa State University provides undergraduate students with the opportunity to learn electrical and computer engineering fundamentals, to study applications of the most recent advances in state-of-the-art technologies, and to prepare for the practice of computer engineering. The student-faculty interaction necessary to realize this opportunity occurs within an environment that is motivated by the principle that excellence in undergraduate education is enhanced by an integrated commitment to successful, long-term research and outreach programs.

The computer engineering curriculum offers focus areas in software, software systems, embedded systems, networking, information security, computer architecture, and VLSI.

Students may also take elective courses in control systems, electromagnetics, microelectronics, VLSI, power systems, and communications and signal processing.

The objective of the computer engineering program at ISU is that its graduates should demonstrate expertise, engagement, learning, leadership, and teamwork within five years after graduation.

Expertise: Graduates should establish peer-recognized expertise together with the ability to articulate that expertise and use it for problem solving in the analysis, design, and evaluation of computer and software systems, including system integration and implementation, using contemporary practices.

Engagement: Graduates should be engaged in the engineering profession, locally and globally, contributing through the ethical, competent, and creative practice of computer engineering in industry, academia, or the public sector, or graduates may use the program as a foundation for interdisciplinary careers in business, law, medicine, or public service.

Learning: Graduates should demonstrate sustained learning through graduate work or professional improvement opportunities and through self study, and they should demonstrate the ability to adapt in a constantly changing field.

Leadership: Graduates should exhibit leadership and initiative to advance professional and organizational goals, facilitate the achievements of others, and obtain results.

Teamwork: Graduates should demonstrate effective teaming and commitment to working with others of diverse cultural and interdisciplinary backgrounds by applying engineering abilities, communication skills, and knowledge of contemporary and global issues.

As a complement to the instructional activity, the ECPE Department provides opportunities for each student to have experience with broadening activities. Through the cooperative education and internship program, students have the opportunity to gain practical industry experience. See College of Engineering, Cooperative Programs. Students have the opportunity to participate in advanced research activities; and through international exchange programs, students learn about engineering practices in other parts of the world. Well qualified juniors and seniors in computer engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both the bachelor of science and master of science or the bachelor of science and master of business administration degrees. See *Graduate Study* for more information.

Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with major in computer engineering and minor work to students with other majors. Minor work for computer engineering majors is usually selected from a wide range of courses outside computer engineering.

The degree master of science with thesis is recommended for students who intend to continue toward the doctor of philosophy degree or to undertake a career in research and development. The nonthesis master of science degree requires a creative component.

The normal prerequisite to major work in computer engineering is the completion of undergraduate work substantially equivalent to that required of computer engineering students at this university. It is possible for a student to qualify for graduate study in computer engineering even though the student's undergraduate or prior graduate training has been in a discipline other than computer engineering. Supporting work, if required, will depend on the student's background and area of research interest. Prospective students from a discipline other than computer engineering are required to submit, with the application for admission, a statement of the proposed area of graduate study.

The department requires submission of GRE General test scores by applicants. All students whose first language is not English and who have no U.S. degree must submit TOEFL examination scores. Students pursuing the doctor of philosophy must complete the department qualifying process.

The Department of Electrical and Computer Engineering is a participating department in the interdepartmental master of science and doctor of philosophy degree programs in bioinformatics and computational biology. Students interested in these programs may earn their degrees while working under an adviser in electrical and computer engineering.

The Department of Electrical and Computer Engineering is also a participating department in the interdepartmental master of science in information assurance program. Students interested in studying information assurance topics may earn a degree in computer engineering or in information assurance. (See catalog section on Information Assurance.)

Well qualified juniors and seniors in computer engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both bachelor of science and master of science or bachelor of science and master of business administration degrees. Under concurrent enrollment, students are eligible for assistantships and simultaneously take undergraduate and graduate courses. Details are available in the Student Services Office and on the department's web site.

Courses primarily for undergraduate students

Cpr E 166. Professional Programs Orientation. (Cross-listed with E E). Cr. R. F.S. (1-0) Overview of the nature and scope of electrical engineering and computer engineering professions. Overview of portfolios. Departmental rules, student services operations, degree requirements, program of study planning, career options, and student organizations.

Cpr E 185. Introduction to Computer Engineering and Problem Solving I. (2-2) Cr. 3. *Prereq: Credit or enrollment in Math 141.* Introduction to Computer Engineering. Project based examples from computer engineering. Individual interactive skills for small and large groups. Computer-based projects. Solving engineering problems and presenting solutions through technical reports. Solution of engineering problems using the C language.

Cpr E 186. Introduction to Computer Engineering and Problem Solving II. (0-2) Cr. 1. S. *Prereq: 185.* Project based examples from computer engineering. Group skills needed to work effectively in teams.

Group problem solving. Computer based projects. Technical reports and presentations. Students will work on 2 or 3 self-directed team based projects that are representative of problems faced by computer engineers.

Cpr E 281. Digital Logic. (3-2) Cr. 4. F.S. *Prereq: sophomore classification.* Number systems and representation. Boolean algebra and logic minimization. Combinational and sequential logic design. Arithmetic circuits and finite state machines. Use of programmable logic devices. Introduction to computer-aided schematic capture systems, simulation tools, and hardware description languages. Design of a simple digital systems.

Cpr E 288. Embedded Systems I: Introduction. (3-2) Cr. 4. F.S. *Prereq: 281, Com S 207 or Com S 227.* Embedded C programming. Interrupt handling. Memory mapped I/O in the context of an application. Elementary embedded design flow/methodology. Timers, scheduling, resource allocation, optimization, state machine based controllers, real time constraints within the context of an application. Applications laboratory exercises with embedded devices.

Cpr E 294. Program Discovery. (Cross-listed with E E). Cr. R. *Prereq: 166 or E E 166.* The roles of professionals in computer and electrical engineering. Relationship of coursework to industry and academic careers. Issues relevant to today's world. Satisfactory-fail only.

Cpr E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

Cpr E 308. Operating Systems: Principles and Practice. (3-3) Cr. 4. F.S. *Prereq: 381, 310.* Operating system concepts, processes, threads, synchronization between threads, process and thread scheduling, deadlocks, memory management, file systems, I/O systems, security, Linux-based lab experiments. Nonmajor graduate credit.

Cpr E 310. Theoretical Foundations of Computer Engineering. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in Cpr E 288, Com S 228.* Propositional logic and methods of proof; set theory and its applications; Mathematical induction and recurrence relations; functions and relations; and counting; trees and graphs; applications in computer engineering.

Cpr E 329. Software Project Management. (Cross-listed with S E). (3-0) Cr. 3. *Prereq: Com S 309.* Process-based software development. Capability Maturity Model (CMM), Project planning, cost estimation, and scheduling. Project management tools. Factors influencing productivity and success. Productivity metrics. Analysis of options and risks. Version control and configuration management. Inspections and reviews. Managing the testing process. Software quality metrics. Modern software engineering techniques and practices. Nonmajor graduate credit.

Cpr E 330. Integrated Electronics. (Cross-listed with E E). (3-3) Cr. 4. *Prereq: E E 201, credit or enrollment in E E 230, Cpr E 281.* Semiconductor technology for integrated circuits. Modeling of integrated devices including diodes, BJTs, and MOSFETs. Physical layout. Circuit simulation. Digital building blocks and digital circuit synthesis. Analysis and design of analog building blocks. Laboratory exercises and design projects with CAD tools and standard cells. Nonmajor graduate credit.

Cpr E 339. Software Architecture and Design. (Cross-listed with S E). (3-0) Cr. 3. *Prereq: S E 319.* Modeling and design of software at the architectural level. Architectural styles. Basics of model-driven architecture. Object-oriented design and analysis. Iterative development and unified process. Design patterns. Design by contract. Component based design. Product families. Measurement theory and appropriate use of metrics in design. Designing for qualities such as performance, safety, security, reliability, reusability, etc. Analysis and evaluation of software architectures. Introduction to architecture definition languages. Basics of software evolution, reengineering, and reverse engineering. Case studies. Introduction to distributed system software. Nonmajor graduate credit.

Cpr E 370. Toying with Technology. (Cross-listed with Mat E). (2-2) Cr. 3. F.S. *Prereq: C I 201, junior standing in non-engineering major.* A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on laboratory experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Future K-12 teachers will leave the course with complete lesson plans for use in their upcoming careers.

Cpr E 381. Computer Organization and Assembly Level Programming. (3-2) Cr. 4. F.S. *Prereq: 281.* Introduction to computer organization, evaluating performance of computer systems, instruction set design. Assembly level programming: arithmetic operations, control flow instructions, procedure calls, stack management. Processor design. Datapath and control, scalar pipelines, introduction to memory and I/O systems.

Cpr E 394. Program Exploration. (Cross-listed with E E). Cr. R. *Prereq: 294 or E E 294.* Exploration of academic and career fields for electrical and computer engineers. Examination of professionalism in the context of engineering and technology with competencies based skills. Introduction to professional portfolio development and construction. Satisfactory-fail only.

Cpr E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period.

Cpr E 397. Engineering Internship. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* One semester maximum per academic year professional work period.

Cpr E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

Cpr E 412. Formal Aspects of Specification and Verification. (Cross-listed with Com S, S E). (3-0) Cr. 3. *Prereq: Com S 309, S E 319.* Introduction to prepositional/predicate/temporal logic, program verification using theorem proving, model-based verification using model checking, and tools for verification. Nonmajor graduate credit.

Cpr E 416. Software Evolution and Maintenance. (Cross-listed with S E). (3-0) Cr. 3. *Prereq: Com S 309, S E 319.* Fundamental concepts in software evolution and maintenance; practical software evolution processes; legacy systems, program comprehension, impact analysis, program migration and transformation, refactoring. Tools for software evolution and maintenance. Case studies, experimental software projects. Written reports and oral presentation. Nonmajor graduate credit.

Cpr E 418. High Speed System Engineering Measurement and Testing. (Cross-listed with E E). (3-2) Cr. 4. F. *Prereq: E E 230 and 311.* Measurement of high speed systems and mixed signal systems. Measurement accuracy and error. Network analysis and spectrum analysis used in high speed measurement and testing. Test specification process and parametric measurement. Sampling and digital signal processing concepts. Design for testability. Testing equipment. Applications. Nonmajor graduate credit.

Cpr E 425. High Performance Computing for Scientific and Engineering Applications. (Cross-listed with Com S). (3-1) Cr. 3. S. *Prereq: Com S 311, Com S 330, Engl 250, Sp Cm 212.* Introduction to high performance computing platforms including parallel computers and workstation clusters. Discussion of parallel architectures, performance, programming models, and software development issues. Sample applications from science and engineering. Practical issues in high performance computing will be emphasized via a number of programming projects using a variety of programming models and case studies. Oral and written reports. Nonmajor graduate credit.

Cpr E 426. Introduction to Parallel Algorithms and Programming. (Dual-listed with 526). (Cross-listed with Com S). (3-2) Cr. 4. F. *Prereq: Cpr E 308 or Com S 321, Com S 311.* Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms. Nonmajor graduate credit.

Cpr E 431. Basics of Information System Security. (3-0) Cr. 3. S. *Prereq: credit or enrollment in Cpr E 489 or Com S 454.* Introduction to and application of basic mechanisms for protecting information systems from accidental and intentional threats. Basic cryptography use and practice. Computer security issues including authentication, access control, and malicious code. Newtork security mechanisms such as intrusion detection, firewalls, IPSEC, and related protocols. Ethics and legal issues in information security. Other selected topics. Programming and system configuration assignments. Nonmajor graduate credit.

Cpr E 435. Analog VLSI Circuit Design. (Cross-listed with E E). (3-3) Cr. 4. S. *Prereq: 330, E E 332, 324, and either E E 322 or Stat 330.* Basic analog integrated circuit and system design including design space exploration, performance enhancement strategies, operational amplifiers, references, integrated filters, and data converters. Nonmajor graduate credit.

Cpr E 444. Introduction to Bioinformatics. (Dual-listed with 544). (Cross-listed with BCB, Com S, Biol, Gen). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic tree, comparative and functional genomics. Nonmajor graduate credit.

Cpr E 450. Distributed Systems and Middleware. (Dual-listed with 550). (3-0) Cr. 3. *Prereq: 308 or Com S 352.* Fundamentals of distributed computing, software agents, naming services, distributed transactions, security management, distributed object-based systems, web-based systems, middleware-based application design and development, case studies of middleware and internet applications. Nonmajor graduate credit.

Cpr E 454. Distributed and Network Operating Systems. (Dual-listed with 554). (Cross-listed with Com S). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: Com S 311, Com S 352, Engl 250, Sp Cm 212.* Laboratory course dealing with practical issues of design and implementation of distributed and network operating systems and distributed computing environments (DCE). The client server paradigm, interprocess communications, layered communication protocols, synchronization and concurrency control, and distributed file systems. Graduate credit requires additional in-depth study of advanced operating systems. Written reports. Nonmajor graduate credit.

Cpr E 458. Real Time Systems. (Dual-listed with 558). (3-0) Cr. 3. *Prereq: 308 or Com S 352.* Fundamental concepts in real-time systems. Real time task scheduling paradigms. Resource management in uniprocessor, multiprocessor, and distributed real-time systems. Fault-tolerance, resource reclaiming, and overload handling. Real-time channel, packet scheduling, and real-time LAN protocols. Case study of real-time operating systems. Laboratory experiments. Nonmajor graduate credit.

Cpr E 465. Digital VLSI Design. (Cross-listed with E E). (3-3) Cr. 4. S. *Prereq: E E 330.* Digital design of integrated circuits employing very large scale integration (VLSI) methodologies. Technology considerations in design. High level hardware design languages, CMOS logic design styles, area-energy-delay design

space characterization, datapath blocks: arithmetic and memory, architectures and systems on a chip (Soc) considerations. VLSI chip hardware design project. Nonmajor graduate credit.

Cpr E 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Aer E, E E, Engr, I E, Mat E, M E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

Cpr E 488. Embedded Systems Design. (3-3) Cr. 4. *Prereq: 381 or Com S 321.* Embedded microprocessors, embedded memory and I/O devices, component interfaces, embedded software, program development, basic compiler techniques, platform-based FPGA technology, hardware synthesis, design methodology, real-time operating system concepts, performance analysis and optimizations. Nonmajor graduate credit.

Cpr E 489. Computer Networking and Data Communications. (3-2) Cr. 4. F.S. *Prereq: 381 or E E 324.* Modern computer networking and data communications concepts. TCP/IP, OSI protocols, client server programming, data link protocols, local area networks, and routing protocols. Nonmajor graduate credit.

Cpr E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Senior classification in computer engineering.* Investigation of an approved topic.
H. Honors

Cpr E 491. Senior Design Project I and Professionalism. (Cross-listed with E E). (2-3) Cr. 3. F.S. *Prereq: 308 or E E 322, completion of 24 credits in the E E core professional program or 29 credits in the Cpr E core professional program, Engl 314.* Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; design review presentation. First of two-semester team-oriented, project design and implementation experience.

Cpr E 492. Senior Design Project II. (Cross-listed with E E). (1-3) Cr. 2. F.S. *Prereq: 491 or E E 491.* Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in E E 491 or Cpr E 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements; project poster.

Cpr E 494. Portfolio Assessment. (Cross-listed with E E). Cr. R. *Prereq: Credit or enrollment in 491.* Portfolio update and evaluation. Portfolios as a tool to enhance career opportunities.

Cpr E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduate students

Cpr E 501. Analog and Mixed-Signal VLSI Circuit Design Techniques. (Cross-listed with E E). (3-3) Cr. 4. F. *Prereq: 435.* Design techniques for analog and mixed-signal VLSI circuits. Amplifiers; operational amplifiers, transconductance amplifiers, finite gain amplifiers and current amplifiers. Linear building blocks; differential amplifiers, current mirrors, references, cascading and buffering. Performance characterization of linear integrated circuits; offset, noise, sensitivity and stability. Layout considerations, simulation, yield and modeling for high-performance linear integrated circuits.

Cpr E 505. CMOS and BiCMOS Data Conversion Circuits. (Cross-listed with E E). (3-3) Cr. 4. Alt. S., offered 2010. *Prereq: 501.* Theory, design and applications of data conversion circuits (A/D and D/A converters) including: architectures, characterization, quantization effects, conversion algorithms, spectral performance, element matching, design for yield, and practical comparators, implementation issues.

Cpr E 507. VLSI Communication Circuits. (Cross-listed with E E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 330 or 501.* Phase-locked loops, frequency synthesizers, clock and data recovery circuits, theory and implementation of adaptive filters, low-noise amplifiers, mixers, power amplifiers, transmitter and receiver architectures.

Cpr E 511. Design and Analysis of Algorithms. (Cross-listed with Com S). (3-0) Cr. 3. F. *Prereq: Com S 311.* A study of basic algorithm design and analysis techniques. Advanced data structures, amortized analysis and randomized algorithms. Applications to sorting, graphs, and geometry. NP- completeness and approximation algorithms.

Cpr E 525. Numerical Analysis of High-Performance Computing. (Cross-listed with Com S, Math). (3-0) Cr. 3. S. *Prereq: 308, or one of Math 471, 481; experience in scientific programming; knowledge of FORTRAN or C.* Development, analysis, and testing of efficient numerical methods for use on state-of-the-Art High performance computers. Applications of the methods to the student's area of research.

Cpr E 526. Introduction to Parallel Algorithms and Programming. (Dual-listed with 426). (Cross-listed with Com S). (3-2) Cr. 4. F. *Prereq: 308 or Com S 321, Com S 311.* Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms.

Cpr E 528. Probabilistic Methods in Computer Engineering. (3-0) Cr. 3. *Prereq: Com S 311.* The application of randomization and probabilistic methods in the design of computer algorithms, and their efficient implementation. Discrete random variables in modeling algorithm behavior, with applications to sorting, selection, graph algorithms, hashing, pattern matching, cryptography, distributed systems, and massive data set algorithmics.

Cpr E 530. Advanced Protocols and Network Security. (Cross-listed with InfAs). (3-0) Cr. 3. *Prereq: 381.* Detailed examination of networking standards, protocols, and their implementation. TCP/IP protocol suite, network application protocols, IP routing, network security issues. Emphasis on laboratory experiments.

Cpr E 531. Information System Security. (Cross-listed with InfAs). (3-0) Cr. 3. *Prereq: 489 or 530 or Com S 586 or MIS 535.* Computer and network security: basic cryptography, security policies, multilevel security models, attack and protection mechanisms, legal and ethical issues.

Cpr E 532. Information Warfare. (Cross-listed with InfAs). (3-0) Cr. 3. S. *Prereq: 531.* Computer system and network security: implementation, configuration, testing of security software and hardware, network monitoring. Authentication, firewalls, vulnerabilities, exploits, countermeasures. Ethics in information assurance. Emphasis on laboratory experiments.

Cpr E 533. Cryptography. (Cross-listed with Math, InfAs). (3-0) Cr. 3. S. *Prereq: Math 301 or Cpr E 310 or Com S 330.* Basic concepts of secure communication, DES and AES, public-key cryptosystems, elliptic curves, hash algorithms, digital signatures, applications. Relevant material on number theory and finite fields.

Cpr E 534. Legal and Ethical Issues in Information Assurance. (Cross-listed with InfAs, Pol S). (3-0) Cr. 3. S. *Prereq: Graduate classification, Cpr E or InfAs 531.* Legal and ethical issues in computer security. State and local codes and regulations. Privacy issues.

Cpr E 535. Steganography and Watermarking. (Cross-listed with Math, InfAs). (3-0) Cr. 3. S. *Prereq: Cpr E 531 or E E 524 or Math 533/Cpr E 533/InfAs 533.* Basic principles of steganography and watermarking. Algorithms based on spatial domain approaches, transformations of data, statistical approaches. Techniques for images, video, and audio data. Communications models for data hiding. Analysis, detection and recovery of hidden data. Military, commercial and e-commerce applications. Known theoretical results. Software packages for data hiding. Social and legal issues, case studies, and digital rights management issues that affect technological development of steganography and watermarking. Current developments in the area.

Cpr E 536. Computer and Network Forensics. (Cross-listed with InfAs). (3-0) Cr. 3. *Prereq: 381 and 489 or 530.* Fundamentals of computer and network forensics, forensic duplication and analysis, network surveillance, intrusion detection and response, incident response, anonymity and pseudonymity, privacy-protection techniques, cyber law, computer security policies and guidelines, court testimony and report writing, and case studies. Emphasis on hands-on experiments.

Cpr E 537. Wireless Network Security. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 489 or 530.* Introduction to the physical layer and special issues associated with security of the airlink interface. Communication system modeling, wireless networking, base Stations, mobile Stations, airlink multiple access, jamming, spoofing, signal intercept, wireless LANS and modems, cellular, position location, spread spectrum, signal modeling, propagation modeling, wireless security terminology.

Cpr E 541. High-Performance Communication Networks. (3-0) Cr. 3. *Prereq: 489 or 530.* Selected topics from recent advances in high performance networks; next generation internet; asynchronous transfer made; traffic management, quality of service; high speed switching.

Cpr E 542. Optical Communication Networks. (3-0) Cr. 3. S. *Prereq: 489.* Optical components and interfaces; optical transmission and reception techniques; wavelength division multiplexing; network architectures and protocol for first generation, single and multihop optical network; routing and wavelength assignment in second generation wavelength routing networks; traffic grooming, optical network control; access networks; metro networks.

Cpr E 543. Wireless Network Architecture. (3-0) Cr. 3. *Prereq: Credit or enrollment in 489 or 530.* Introduction to the protocol architecture of the data link layer, network layer and transport layer for wireless networking. Operation and management of Medium Access Control in wireless local area networks; recent developments in 802.11 and Bluetooth; wireless ATM; Mobile Internet Protocol; Mobile Transmission Control Protocol; wireless application protocol; ad-hoc wireless networks.

Cpr E 544. Introduction to Bioinformatics. (Dual-listed with 444). (Cross-listed with BCB, Com S, GDCB). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics.

Cpr E 545. Fault-Tolerant Systems. (3-0) Cr. 3. *Prereq: 381.* Faults and their manifestations, errors, and failures; fault detection, location and reconfiguration techniques; time, space, and information (coding) redundancy management; design for testability; self-checking and fail-safe circuits; system-level fault diagnosis; Byzantine agreement; stable storage and RAID; fault-tolerant networks; fault tolerance in real-time systems; reliable software design; checkpointing and rollback recovery; and reliability evaluation techniques and tools.

Cpr E 546. Wireless Sensor Networks. (3-0) Cr. 3. *Prereq: Cpr E 489 or 530.* Selected topics from recent advances in wireless sensor networks, including data-centric routing, query, and storage; data fusion and aggregation; coverage, connectivity, and lifetime of wireless sensor networks; wireless sensor networks deployment and management; security issues; energy-efficiency issues; radio and link characteristics in wireless sensor networks; medium access control protocols and link layer techniques; tracking and localization; geographical routing; robust routing; time synchronization; wireless sensor networks applications. Introduction to TinyOS and the nesC language. Hands-on experiments with Crossbow Motes.

Cpr E 549. Advanced Algorithms in Computational Biology. (Cross-listed with Com S, BCB). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Com S 311 and either Com S 228 or Com S 208.* Design and analysis of algorithms for applications in computational biology, pairwise and multiple sequence alignments, approximation algorithms, string algorithms including in-depth coverage of suffix trees, semi-numerical string algorithms, algorithms for selected problems in fragment assembly, phylogenetic trees and protein folding. No background in biology is assumed. Also useful as an advanced algorithms course in string processing.

Cpr E 550. Distributed Systems and Middleware. (Dual-listed with 450). (3-0) Cr. 3. *Prereq: 308 or Com S 352.* Fundamentals of distributed computing, software agents, naming services, distributed transactions, security management, distributed object-based systems, web-based systems, middleware-based application design and development, case studies of middleware and internet applications.

Cpr E 554. Distributed and Network Operating Systems. (Dual-listed with 454). (Cross-listed with Com S). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: Com S 311, Com S 352.* Laboratory course dealing with practical issues of design and implementation of distributed and network operating systems and distributed computing environments (DCE). The client server paradigm, inter-process communications, layered communication protocols, synchronization and concurrency control, and distributed file systems. Graduate credit requires additional in-depth study of advanced operating systems. Written reports.

Cpr E 556. Scalable Software Engineering. (3-0) Cr. 3. *Prereq: Com S 309.* Study of methods, techniques and tools for design, development and evolution of complex software; aspect–oriented programming, domain-specific software technologies, automation for reliable and scalable software engineering, program analysis, comprehension, and program transformations.

Cpr E 557. Computer Graphics and Geometric Modeling. (Cross-listed with Com S, M E). (3-0) Cr. 3. F.S. *Prereq: M E 421, programming experience in C.* Fundamentals of computer graphics technology. Data structures. Parametric curve and surface modeling. Solid model representations. Applications in engineering design, analysis, and manufacturing.

Cpr E 558. Real-Time Systems. (Dual-listed with 458). (3-0) Cr. 3. *Prereq: 308 or Com S 352.* Fundamental concepts in real-time systems. Real-time task scheduling paradigms. Resource management in uniprocessor, multiprocessor, and distributed real-time systems. Fault-tolerance, resource reclaiming, and overload handling. Real-time channel, packet scheduling, and real-time LAN protocols. Case study of real-time operating systems. Laboratory experiments.

Cpr E 563. Modeling and Optimization of Interconnect in Deep Submicron Design. (3-0) Cr. 3. *Prereq: 465.* Modeling and optimization techniques for high-performance digital and analog interconnect designs. RLC extraction. Interconnect modeling: Elmore delay model, moment computation, asymptotic waveform evaluation, Pade Via Lanczos, pole analysis, transmission lines. Driver modeling. Interconnect optimization: topology optimization, device sizing, wire sizing, buffer insertion, high-performance clock sizing.

Cpr E 564. Synthesis and Optimization of Digital Circuits. (3-0) Cr. 3. S. *Prereq: 381.* Algorithms and techniques to generate application-specific VLSI circuits from high-level behavioral modeling in hardware description languages. Boolean logic representation, two-level and multi-level logic synthesis, sequential logic optimization, hardware models, architectural-level synthesis and optimization, scheduling algorithms, resource sharing and binding.

Cpr E 566. Physical Design of VLSI Systems. (3-0) Cr. 3. *Prereq: 465.* Physical design of VLSI systems. Partitioning algorithms. Placement and floorplanning algorithms. Routing-global and detailed. Layout compaction. Physical design of FPGA's and MCM's. Performance-driven layout synthesis.

Cpr E 567. Bioinformatics I (Fundamentals of Genome informatics). (Cross-listed with Com S, BCB). (3-0) Cr. 3. F. *Prereq: Com S 208; Com S 330; Stat 341; credit or enrollment in Biol 315, Stat 430.* Biology as an information science. Review of algorithms and information processing. Generative models for sequences. String algorithms. Pairwise sequence alignment. Multiple sequence alignment. Searching sequence databases. Genome sequence assembly.

Cpr E 569. Bioinformatics III (Structural Genome Informatics). (Cross-listed with BBMB, Com S, Math, BCB). (3-0) Cr. 3. F. *Prereq: BCB 567, Gen 411, Stat 430.* Algorithmic and Statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

Cpr E 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology). (Cross-listed with BCB, Com S, GDCB,Stat). (3-0) Cr. 3. S. *Prereq: BCB 567, Biol 315, Com S 311 and either 208 or 228, Gen 411, Stat 430.* Algorithmic and statistical approaches in computational functional genomics and systems biology. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Ontology-driven, network based, and probabilistic approaches to nformation integration.

Cpr E 575. Computational Perception. (Cross-listed with Com S, HCI). (3-0) Cr. 3. S. *Prereq: Graduate standing or permission of instructor.* This class covers Statistical and algorithmic methods for sensing, recognizing, and interpreting the activities of people by a computer. This semester we will focus on machine perception techniques that facilitate and augment human-computer interaction. The main goal of the class is to introduce computational perception on both theoretical and practical levels. You will work in small groups to design, implement, and evaluate a prototype of a human-computer interaction system that uses one or more of the techniques covered in the lectures.

Cpr E 581. Computer Systems Architecture. (Cross-listed with Com S). (3-0) Cr. 3. F. *Prereq: 381.* Quantitative principles of computer architecture design, instruction set design, processor architecture: pipelining and superscalar design, instruction level parallelism, memory organization: cache and virtual memory systems, multiprocessor architecture, cache coherency, interconnection networks and message routing, I/O devices and peripherals.

Cpr E 582. Computer Systems Performance. (3-0) Cr. 3. *Prereq: 381, 310 and Stat 330.* Review of probability and stochastic processes concepts; Markovian processes; Markovian queues; renewal theory; semi-Markovian queues; queueing networks, multiprocessor architectures; computer networks; switching systems; case studies.

Cpr E 583. Reconfigurable Computing Systems. (Cross-listed with Com S). (3-0) Cr. 3. *Prereq: Background in computer architecture, design, and organization.* Introduction to reconfigurable computing, FPGA technology and architectures, spatial computing architectures such as systolic and bit serial adaptive network architectures, static and dynamic rearrangeable interconnection architectures, processor architectures incorporating reconfigurabiltiy.

Cpr E 587. Text Mining, Text Processing, and the Internet. (3-0) Cr. 3. *Prereq: Com S 309 or Com S 311.* Mining, retrieval, and other processing of text, including text and hypermedia on the world wide web. Human computer interaction in the context of text and hyper media. Topics of particular interest to enrolled students.

Cpr E 588. Embedded Computer Systems. (3-0) Cr. 3. *Prereq: 308.* Hardware/software systems and codesign. Models of computation for embedded systems. System-level design. Modeling, specification, synthesis, and verification. Hardware/software implementation. Design space exploration. Performance analysis and optimization. Multiprocessor system on chip. Platform-based design. Design methodologies and tools. Case studies and design projects.

Cpr E 589. Multimedia Systems. (3-0) Cr. 3. S. *Prereq: 308 or Com S 352.* Fundamentals concepts in multimedia systems. Resource management issues in distributed/networked multimedia systems, QoS routing and multicasting. Traffic shaping, Task and message scheduling, Internet QoS. Adaptive multimedia applications over the Internet. Operating system support for multimedia. Storage architecture and scalable media servers. Compression techniques, synchronization techniques, processor architectures for multimedia.

Cpr E 590. Special Topics. Cr. arr. Repeatable. Formulation and solution of theoretical or practical problems in computer engineering.

Cpr E 592. Seminar in Computer Engineering. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Projects or seminar in Computer Engineering.

Cpr E 594. Selected Topics in Computer Engineering. (3-0) Cr. 3. Repeatable.

Cpr E 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

Cpr E 626. Parallel Algorithms for Scientific Applications. (Cross-listed with Com S). (3-0) Cr. 3. *Prereq: 526.* Algorithm design for high-performance computing. Applications to numerical simulations, sparse matrix computation, multidimensional tree data structure, and particle-based methods, random numbers and Monte Carlo applications, algorithms, and computational biology.

Cpr E 632. Information Assurance Capstone Design. (Cross-listed with InfAs). (3-0) Cr. 3. *Prereq: 531, 532, 534.* Capstone design course which integrates the security design process. Design of a security policy. Creation of a security plan. Implementation of the security plan. The students will attach each other's secure environments in an effort to defeat the security systems. Students evaluate the security plans and the performance of the plans. Social, political and ethics issues. Student self-evaluation, journaling, final written report, and an oral report.

Cpr E 681. Advanced Topics in Computer Architecture. (Cross-listed with Com S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 581.* Current topics in computer architecture design and implementation. Advanced pipelining, cache and memory design techniques. Interaction of algorithms with architecture models and implementations. Tradeoffs in architecture models and implementations.

Cpr E 697. Engineering Internship. (Cross-listed with E E). Cr. R. Repeatable. *Prereq: Permission of department chair and Engineering Career Services, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

Cpr E 699. Research. Cr. arr. Repeatable.

Computer Science

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Undergraduate Study

Carl Chang, Chair of Department

Professors: Aluru, Bergman, C. Chang, Fernandez-Baca, Honavar, Huang, Kothari, J. Lutz, R. Lutz, Maddux, Miller, Slutzki, Wong

Professors (Emeritus): Brearley, Oldehoeft, Stewart, Thomas

Associate Professors: Aduri, J. Chang , Chaudhuri, Chou, Eulenstein, Gadia, Jia, Miner, Prabhu, Tavanapong, Tyagi, Zhu

Associate Professor (Collaborators): Mayordome

Assistant Professors: Basu, Cai, Harding, Margaritis, Rajan, Ruan, Song, Stoytchev, Tian, T. Zhang, W. Zhang

Senior Lecturers: Lathroup, Mitra

Lecturers: S. Chang, Johnson, Kautz

Undergraduate Study

The curriculum leading to the baccalaureate degree in computer science is designed to prepare students for positions as computer scientists with business, industry, or government, or for graduate study in computer science. The main objectives are to impart to students an understanding of the basics of computer science, to develop proficiency in the practice of computing, and to prepare them for continued professional development.

The following are intended learning outcomes for computer science majors. Seniors will assess these outcomes in a survey conducted before they graduate and feedback thus obtained will be used to improve the curriculum.

A. Impart an understanding of the basics of the discipline. Each graduate will know

A.1 Fundamental principles of computing,
A.2 Basic foundations of Mathematics, Statistics, and physical sciences
A.3 Design and implementation of programs

B. Develop proficiency in the practice of computing. The graduated student will be able to

B.1 formulate and solve problems in computing,
B.2 Understand design and performance requirements of software systems,
B.3 Apply sound principles to the synthesis and analysis of computer systems

C. Prepare for continued professional development. Our students will

C1 Engage in lifelong learning and expect to embrace change,
C.2 Communicate effectively and think critically and creatively, both independently and with others,
C.3 Be aware of social and ethical issues of computers in Society

Students must earn at least a C- in each course taken to fulfill the Degree Program.

Students must take at least 45 credits at the 300 level or higher at Iowa State University.

To complete an undergraduate degree in Computer Science, a student must satisfy the requirements of the College of Liberal Arts and Sciences (see *Liberal Arts and Sciences, Curriculum*) and include the following courses within the group requirements: Phil 343; Sp Cm 212; 14 credits of Math and Statistics including Math 165, Math 166, one Statistics course from Stat 105, 231, 305, 330, 333, or 341, and at least one Math course from Math 265, 266, 304, 307, 314, or 317; a minimum of 13 credits of natural science including Phys 221, 222, and at least one additional natural science course from the following list: A Ecl 312, Anthr 202, 307, BBMB 221, Biol 312, Biol 355, Chem 163-231, Ent 370, Env S 324, Env S 330, FS HN 167, Gen 260, Geol 100-108, 201, 311, 451, 475, Mat E 207, 211, Mteor 206, 301, Psych 310. Communication Proficiency requirement: Engl 150, 250 and one of Engl 302, 305, 309 or 314. The minimum grade accepted in each of the three required English courses is a C-.

Students wishing to pursue the B.S. degree in computer science must first successfully complete the premajor program consisting of the following courses and minimum grade requirements:

Course	Minimum Grade
227	C-
228	C-
Math 165	C-

Students majoring in computer science must successfully complete this premajor program prior to taking any other courses in the Department. Thus, for computer science majors, this premajor serves as a necessary prerequisite to all the other courses offered by the Department.

Computer science majors transferring from other institutions must take at least 15 of their credits at the 300-level or above in our department while in residence at Iowa State.

To graduate with a major in the Computer Science Department, a student must earn at least a C- in each of the courses taken to fulfill the program of study.

A minimum of 44 credits is required for the B.S. degree in computer science. The required courses are: Com S 101, 203, Cpr E 281, Com S 227, 228, 229, 309, 311, 321, 330, 331, 342, 352, 362 or 363. In addition, two advanced-level courses must be selected from the following groups:

Group W: 426, 440, 454, 477, 486

Group B: 401, 409, 416, 417, 425, 430, 455, 461, 472, 474

Group N: 412, 418, Math 421, 471, 481, 426; Cpr E 485, Cpr E 489, M E 557

Courses in Group W require written reports and those in Group B require both oral and written reports. Students must take one course from Group B and one course from any group.

Students must earn a C- or better in each course in the department which is a prerequisite to a course listed in the student's degree program.

Undergraduate Minor. The Computer Science Department offers an undergraduate minor in Computer Science. The minor requires at least 19 credits in computer science courses. Com S 227, 228, and 229, adding up to 10 credits are required. In addition, at least 9 credits should be taken in courses at the 300 level or above.

Undergraduate Curriculum in Software Engineering. The Department of Computer Science together with the Department of Electrical and Computer Engineering also offer a curriculum leading to an undergraduate degree in software engineering. The software engineering curriculum offers emphasis areas in software engineering principles, process, and practice. Students may also take elective courses in computer engineering and computer science.

See Index, Software Engineering. For curriculum information, see also College of Engineering and College of Liberal Arts and Sciences.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with a major in Computer Science. The Doctor of Philosophy degree may also be earned with computer science as a co-major with some other discipline. Additionally, the department offers a minor to students majoring in other departments.

Established research areas include algorithms, artificial intelligence, computational complexity, computer architecture, bioinformatics, computational biology, computer networks, database systems, formal methods, information assurance, machine learning and neural networks, multimedia, operating systems, parallel and distributed computing, programming languages, robotics, and software engineering. There are also numerous opportunities for interdisciplinary research.

Typically, students beginning graduate work in Computer Science have completed a bachelor's degree or equivalent in Computer Science. However, some students with undergraduate majors in other areas, such as Mathematical, physical, or biological science or engineering become successful graduate students in Computer Science.

For the degree Master of Science, a minimum of 30 semester credits is required. A thesis demonstrating research and the ability to organize and express significant ideas in computer science is required.

The purpose of the doctoral program is to train students to do original research in Computer Science. Each student is also required to attain knowledge and proficiency commensurate with a leadership role in the field. The Ph.D. requirements are governed by the student's program of study committee within established guidelines of the department and the graduate college. They include coursework, demonstrated proficiency in four areas of Computer Science, a research skills requirement, a preliminary examination, and a doctoral dissertation and final oral examination. The department recommends that all graduate students majoring in Computer Science teach as part of their training for an advanced degree.

Courses primarily for undergraduate students

Com S 101. Orientation. Cr. R. F.S. Introduction to the procedures and policies of Iowa State University and the Department of Computer Science, test-outs, honorary Societies, etc. Issues relevant to student adjustment to college life will also be discussed. Satisfactory-fail only.

Com S 103. Computer Applications. Cr. 4. F.S.SS. Introduction to computer literacy and applications. Applications: Windows, Internet browser/HTML, word processing, spreadsheets, database management and presentation software. Literacy: history of computing, structure of computers, telecommunications, computer ethics, computer crime, and history of programming languages. No prior computer experience necessary. Course is offered online only. Students must attend an orientation session the first week of class.

Com S 104. Introduction to Computers. (1.5-1) Cr. 2. F.S. Offered first 8 weeks and last 8 weeks. Use of personal computer and workstation operating systems and beginning programming. Project-oriented approach to computer operation and programming, including use of tools to aid in programming. Topics from computer history, using basic Windows and Unix tools, program structure, expression, variables, decision and logic, and iteration. No prior computer experience necessary.

Com S 107. Applied Computer Programming. (3-0) Cr. 3. F.S. Introduction to computer programming for non-majors using a language such as the Visual Basic language. Basics of good programming and algorithm development. Graphical user interfaces.

Com S 201. Computer Programming in COBOL. (3-0) Cr. 3. SS. *Prereq: 107 or 207 or 227.* Computer programming in COBOL. Emphasis on the design, writing, debugging, and testing of business applications programs in a transaction-oriented environment.

Com S 203. Careers in Computer Science. Cr. R. F.S. Computer science as a profession. Introduction to career fields open to computer science majors. Relationship of coursework to careers. Presentations by computer science professionals. Satisfactory-fail only.

Com S 207. Programming I. (3-1) Cr. 3. F.S. *Prereq: Math 150 or placement into Math 140/141/142 or higher.* An introduction to computer programming using an object-oriented programming language. Emphasis on the basics of good programming techniques and style. Extensive practice in designing, implementing, and debugging small programs. Use of abstract data types. Interactive and file I/O. Exceptions/error-handling. This course is designed for nonmajors. Credit may not be applied toward graduation for both Com S 207 and 227.

Com S 208. Programming II. (3-1) Cr. 3. S. *Prereq: 207, credit or enrollment in Math 151, 160, or 165.* Intermediate-level programming techniques. Emphasis on designing, writing, testing, debugging, and documenting medium-sized programs. Data structures and their uses. Dynamic memory usage. Inheritance and polymorphism. Algorithm design and efficiency: recursion, searching, and sorting. Event-driven and GUI programming. The software development process. This course is designed for nonmajors. Credit may not be applied toward the major.

Com S 227. Introduction to Object-oriented Programming. (3-2) Cr. 4. F.S. An introduction to object-oriented design and programming techniques. Symbolic and numerical computation. Recursion and iteration. Modularity procedural and data abstraction, specifications and subtyping. Object-oriented techniques. Imperative programming. Emphasis on principles of programming and object-oriented design through extensive practice in design, writing, running, debugging, and reasoning about programs. This course is designed for majors. Credit may not be applied toward graduation for both Com S 207 and 227.

Com S 228. Introduction to Data Structures. (3-1) Cr. 3. F.S. *Prereq: C- or better in 227, credit or enrollment in Math 165.* An object-oriented approach to data structures and algorithms. Object-oriented analysis, design, and programming, with emphasis on data abstraction, inheritance and subtype polymorphism. Abstract data type specification and correctness. Collections and associated algorithms, such as stacks, queues, lists, trees. Searching and sorting algorithms. Graphs. Data on secondary storage. Analysis of algoritms. Emphasis on object-oriented design, writing and documenting medium-sized programs. This course is designed for majors.

Com S 229. Advanced Programming Techniques. (3-0) Cr. 3. F.S. *Prereq: 228, credit or enrollment in Math 166.* Object-oriented programming experience using a language suitable for exploring advanced topics in programming. Topics include memory management, parameter passing, inheritance, compiling, debugging, and maintaining programs. Significant programming projects.

Com S 252. Linux Operating System Essentials. (2-2) Cr. 3. F. *Prereq: 103 or 207 or 227.* Selected topics include: Linux Distributions, installation, configuration, and management of a Linux based computer system, shell programming, network accessing technologies, package management systems, system security, user, file sharing techniques, interoperation with other computers on the network, and open-source software. This is a hands-on course designed to demonstrate the installation and utilization of the Linux operating system for a personal computer.

Com S 290. Independent Study. Cr. arr. F.S. *Prereq: Permission of instructor.* Satisfactory-fail only.
H. Honors

Com S 309. Software Development Practices. (3-1) Cr. 3. F.S. *Prereq: Com S 228 with C- or better, Com S 229 or Cpr E 211, Engl 250.* A practical introduction to methods for managing software development. Process models, requirements analysis, structured and object-oriented design, coding, testing, maintenance, cost and schedule estimation, metrics. Programming projects. Nonmajor graduate credit.

Com S 311. Design and Analysis of Algorithms. (3-1) Cr. 3. F.S. *Prereq: 228 with C- or better, Math 166, Engl 250, and Com S 330 or Cpr E 310.* Basic techniques for design and analysis of efficient algorithms. Sorting, searching, graph algorithms, computational geometry, string processing and NP-completeness. Design techniques such as dynamic programming and the greedy method. Asymptotic, worst-case, average-case and amortized analyses. Data structures including heaps, hash tables, binary search trees and red-black trees. Programming projects. Credit may not be applied toward graduation for both Com S 311 and 381. Nonmajor graduate credit.

Com S 319. Software Construction and User Interfaces. (Cross-listed with S E). (3-0) Cr. 3. F. Basic theory of grammars, parsing. Language paradigms. State transition and table-based software design. Rapid system prototyping. Review of principles of object orientation, object oriented analysis using UML. Event-driven and clock-driven simulation. Software construction methods. Frameworks and APIs. User interface architecture, evaluation of user interface. Design of windows, menus, and commands. Introduction to format specification and model-based software design. Introduction to domain-specific software engineering. Nonmajor graduate credit.

Com S 321. Introduction to Computer Architecture and Machine-Level Programming. (3-1) Cr. 3. F.S. *Prereq: C- or higher in 228, Cpr E 281 and Engl 250.* Introduction to computer architecture and organization. Emphasis on evaluation of performance, instruction set architecture, datapath and control, memory-hierarchy design, and pipelining. Assembly language on a simulator. Nonmajor graduate credit.

Com S 330. Discrete Computational Structures. (3-1) Cr. 3. F.S. *Prereq: C- or higher in 228, C- or higher in Math 166 and Engl 250.* Concepts in discrete Mathematics as applied to computer science. Logic, proof techniques, set theory, relations, graphs, combinatorics, discrete probability and number theory. Nonmajor graduate credit.

Com S 331. Theory of Computing. (Cross-listed with Ling). (3-1) Cr. 3. F.S. *Prereq: C- or higher in 228, C- or higher in Com S 330 or Cpr E 310, C- or higher in Math 166, and Engl 250.* Models of computation: finite state automata, pushdown automata and Turing machines. Study of grammars and their relation to automata. Limits of digital computation, unsolvability and Church-Turing thesis. Chomsky hierarchy and relations between classes of languages. Nonmajor graduate credit.

Com S 342. Principles of Programming Languages. (3-1) Cr. 3. F.S. *Prereq: 321; 330 or Cpr E 310; either 309, 362 or 363; Engl 250.* Organization of programming languages emphasizing language design concepts and semantics. Study of language features and major programming paradigms, especially functional programming. Programming projects. Nonmajor graduate credit.

Com S 350. Number Theory. (Cross-listed with Math). (3-0) Cr. 3. S. *Prereq: Math 166.* Divisibility, integer representations, primes and divisors, linear diophantine equations, congruences, and multiplicative functions. Applications to cryptography. Nonmajor graduate credit.

Com S 352. Introduction to Operating Systems. (3-1) Cr. 3. F.S. *Prereq: 229, and 321; Engl 250.* Survey of operating system issues. Introduction to hardware and software components including: processors, peripherals, interrupts, management of processes, threads and memory, deadlocks, file systems, protection, virtual machines and system organization, and introduction to distributed operating systems. Programming projects. Nonmajor graduate credit.

Com S 362. Object-Oriented Analysis and Design. (3-0) Cr. 3. F.S. *Prereq: 228 with C- or better, Engl 250.* Object-oriented requirements analysis and systems design. Design notations such as the Unifed Modeling Language. Design Patterns. Group design and programming with large programming projects. Nonmajor graduate credit.

Com S 363. Introduction to Database Management Systems. (3-0) Cr. 3. F.S. *Prereq: 228 with C- or better, Engl 250.* Relational, object-oriented, and semistructured data models and query languages. SQL, ODMG, and XML standards. Database design using entity-relationship model, data dependencies and object definition language. Application development in SQL-like languages and general purpose host languages with application program interfaces. Information integration using data warehouses, mediators and wrappers. Programming Projects. Nonmajor graduate credit.

Com S 398. Cooperative Education. Cr. R. *Prereq: Permission of department chair.* Required of all cooperative students. Students must register for this course prior to commencing each work period.

Com S 401. Projects in Computing and Business Applications. (2-2) Cr. 3. F. *Prereq: Engl 250, Sp Cm 212, Com S 309, and either 362 or 363.* Applications of software development methods (requirements collection and analysis, software design, project management, documentation and testing), programming techniques, database designs and administration, network application programming to solve computing needs in business settings. A study of practical applications of emerging technologies in computing. Emphasis on semester-long team programming projects. Lab assignments. Oral and written reports. Nonmajor graduate credit.

Com S 409. Software Requirements Engineering. (Dual-listed with 509). (Cross-listed with S E). (3-0) Cr. 3. F. *Prereq: Com S 309, Engl 250, Sp Cm 212.* The requirements engineering process, including identification of stakeholders, requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Non-functional requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports, and oral presentations will be required. Nonmajor graduate credit.

Com S 412. Formal Aspects of Specification and Verification. (Cross-listed with Cpr E, S E). (3-0) Cr. 3. *Prereq: Com S 309, 319.* Introduction to prepositional/predicate/temporal logic, program verification using theorem proving, model-based verification using model checking, and tools for verification. Nonmajor graduate credit.

Com S 417. Software Testing. (Cross-listed with S E). (3-0) Cr. 3. S. *Prereq: Com S 309, 319, Engl 250, Sp Cm 212.* Comprehensive study of software testing, principles, methodologies, management strategies and techniques. Test models, test design techniques (black box and white-box testing techniques), integration, regression, system testing methods, and software testing tools. Nonmajor graduate credit.

Com S 418. Introduction to Computational Geometry. (Dual-listed with 518). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 311 or permission of instructor.* Introduction to data structures, algorithms, and analysis techniques for computational problems that involve geometry. Line segment intersection, polygon triangulation, 2D linear programming, range queries, point location, arrangements and duality, Voronoi diagrams and Delaunay triangulation, convex hulls, robot motion

planning, visibility graphs. Other selected topics. Programming assignments. Nonmajor graduate credit.

Com S 421. Logic for Mathematics and Computer Science. (Cross-listed with Math). (3-0) Cr. 3. S. *Prereq: Math 301 or 307 or 317 or Com S 330.* Propositional and predicate logic. Topics selected from Horn logic, equational logic, resolution and unification, foundations of logic programming, reasoning about programs, program specification and verification, model checking and binary decision diagrams. Nonmajor graduate credit.

Com S 425. High Performance Computing for Scientific and Engineering Applications. (Cross-listed with Cpr E). (3-1) Cr. 3. S. *Prereq: 311, 330, Engl 250, Sp Cm 212.* Introduction to high performance computing platforms including parallel computers and workstation clusters. Discussion of parallel architectures, performance, programming models, and software development issues. Sample applications from science and engineering. Practical issues in high performance computing will be emphasized via a number of programming projects using a variety of programming models and case studies. Oral and written reports. Nonmajor graduate credit.

Com S 426. Introduction to Parallel Algorithms and Programming. (Dual-listed with 526). (Cross-listed with Cpr E). (3-2) Cr. 4. F. *Prereq: Cpr E 308 or Com S 321, Com S 311.* Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms. Nonmajor graduate credit.

Com S 430. Advanced Programming Tools. (3-1) Cr. 3. F. *Prereq: 311, 362 or 363, Engl 250, Sp Cm 212.* Topics in advanced programming techniques and tools widely used by industry (e.g., event-driven programming and graphical user interfaces, standard libraries, client/server architectures and techniques for distributed applications). Emphasis on programming projects in a modern integrated development environment. Oral and written reports. Nonmajor graduate credit.

Com S 433. Computational Models of Nanoscale Self-Assembly. (Dual-listed with 533). (3-0) Cr. 3. S. *Prereq: C- or higher in 331 or consent of the instructor.* Modeling and analysis of natural and engineered systems that spontaneously assemble themselves from small components. Topics include biomolecular self-assembly, tile assembly models, computation via self-assembly, distributed folding, origami models, and self-repair. Emphasis on Mathematical methods of describing, simulating, programming, and verifying the behaviors of self-assembling systems. Graduate credit requires a written or oral report on current research. Nonmajor graduate credit.

Com S 440. Principles and Practice of Compiling. (Dual-listed with 540). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: 331, 342, Engl 250, Sp Cm 212.* Theory of compiling and implementation issues of programming languages. Programming projects leading to the construction of a compiler. Projects with different difficulty levels will be given for 440 and 540. Topics: lexical, syntax and semantic analyses, syntax-directed translation, runtime environment and library support. Written reports. Nonmajor graduate credit.

Com S 444. Introduction to Bioinformatics. (Dual-listed with 544). (Cross-listed with BCB, Biol, Cpr E, Gen). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics. Nonmajor graduate credit.

Com S 454. Distributed and Network Operating Systems. (Dual-listed with 554). (Cross-listed with Cpr E). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: 311, 352, Engl 250, Sp Cm 212.* Laboratory course dealing with practical issues of design and implementation of distributed and network operating systems and distributed computing environments (DCE). The client server paradigm, inter-process communications, layered communication protocols, synchronization and concurrency control, and distributed file systems. Graduate credit requires additional in-depth study of advanced operating systems. Written reports. Nonmajor graduate credit.

Com S 455. Simulation: Algorithms and Implementation. (Dual-listed with 555). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 311 and 330, Stat 330, Engl 150, Sp Cm 212.* Introduction to discrete-event simulation with a focus on computer science applications, including performance evaluation of networks and distributed systems. Overview of algorithms and data structures necessary to implement simulation software. Discrete and continuous stochastic models, random number generation, elementary Statistics, simulation of queuing and inventory systems, Monte Carlo simulation, point and interval parameter estimation. Graduate credit requires additional in-depth study of concepts. Oral and written reports. Nonmajor graduate credit.

Com S 461. Principles and Internals of Database Systems. (Dual-listed with 561). (3-1) Cr. 3. F. *Prereq: 311, Engl 250, Sp Cm 212 and Com S 363.* Models for structured and semistructured data. Algebraic, first order, and user-oriented query languages. Database schema design. Physical storage, access methods, and query processing. Transaction management, concurrency control, and crash recovery. Database security. Information integration using data warehouses, mediators, wrappers, and data mining. Parallel and distributed databases, and special purpose databases. Oral and written reports. Nonmajor graduate credit.

Com S 471. Computational Linear Algebra and Fixed Point Iteration. (Cross-listed with Math). (3-0) Cr. 3. Alt. F., offered 2009. S. *Prereq: Math 265 and either Math 266, or 267; knowledge of a programming language.* Computational error, solutions of linear systems, least squares, similarity methods for eigenvalues, solution of nonlinear equations in one and several variables. Nonmajor graduate credit.

Com S 472. Principles of Artificial Intelligence. (Dual-listed with 572). (3-1) Cr. 3. F. *Prereq: 311, 330 or Cpr E 310, Stat 330, Engl 250, Sp Cm 212, Com S 342 or comparable programming experience.* Specification, design, implementation, and selected applications of intelligent software agents and multi-agent systems. Computational models of intelligent behavior, including problem solving, knowledge representation, reasoning, planning, decision making, learning, perception, action, communication and interaction. Reactive, deliberative, rational, adaptive, learning and communicative agents and multiagent systems. Artificial intelligence programming. Graduate credit requires a research project and a written report. Oral and written reports. Nonmajor graduate credit.

Com S 474. Elements of Neural Computation. (3-1) Cr. 3. Alt. F., offered 2010. *Prereq: 311, 330 or Cpr E 310, Stat 330, Math 165, Engl 250, Sp Cm 212, Com S 342 or comparable programming experience.* Introduction to theory and applications of neural computation and computational neuroscience. Computational models of neurons and networks of neurons. Neural architectures for associative memory, knowledge representation, inference, pattern classification, function approximation, stochastic search, decision making, and behavior. Neural architectures and algorithms for learning including perceptions, support vector machines, kernel methods, bayesian learning, instance based learning, reinforcement learning, unsupervised learning, and related techniques. Applications in Artificial Intelligence and cognitive and neural modeling. Hands-on experience is emphasized through the use of simulation tools and laboratory projects. Oral and written reports. Nonmajor graduate credit.

Com S 477. Problem Solving Techniques for Applied Computer Science. (Dual-listed with 577). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 228; 330 or Cpr E 310, Math 166, Math 307 or Math 317, or consent of the instructor.* Selected topics in applied Mathematics and modern heuristics that have found applications in areas such as geometric modeling, graphics, robotics, vision, human machine interface, speech recognition, computer animation, etc. Polynomial interpolation, roots of polynomials, resultants, solution of linear and nonlinear equations, approximation, data fitting, fast Fourier transform, linear programming, nonlinear optimization, Lagrange multipliers, genetic algorithms, integration of ODEs, curves, curvature, Frenet formulas, cubic splines, and Bezier curves. Programming components. Written report for graduate credit. Nonmajor graduate credit.

Com S 481. Numerical Solution of Differential Equations and Interpolation. (Cross-listed with Math). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 265 and either Math 266 or 267; knowledge of a programming language.* Polynomial and spline interpolation, orthogonal polynomials, least squares, numerical differentiation and integration, numerical solution of ordinary differential equations. Nonmajor graduate credit.

Com S 486. Fundamental Concepts in Computer Networking. (3-0) Cr. 3. S. *Prereq: 352.* An introduction to fundamental concepts in the design and implementation of computer communication in both the wired and wireless networks, their protocols, and applications. Layered network architecture in the Internet, applications, transport, Socket APIs, network, and data link layers and their protocols, multimedia networking, and network security. Nonmajor graduate credit.

Com S 490. Independent Study. Cr. arr. Repeatable. F.S. *Prereq: 6 credits in computer science, permission of instructor.* No more than 9 credits of Com S 490 may be counted toward graduation. Satisfactory-fail only. H. Honors

Courses primarily for graduate students, open to qualified undergraduate students

Com S 502. Complex Adaptive Systems Seminar. (Cross-listed with CAS). (1-0) Cr. 1. F.S. *Prereq: Admissions to CAS minor.* Understanding core techniques in artificial life are based on basic readings in complex adaptive systems. Understand techniques of complex system analysis methods including: Evolutionary computation, Neural nets, Agent based simulations (Agent based Computational Economics). Large-scale simulations are to be emphasized, e.g. power grids, whole ecosystems.

Com S 503. Complex Adaptive Systems Concepts and Techniques. (Cross-listed with CAS). (3-0) Cr. 3. S. *Prereq: Admission to CAS minor or related field.* Survey of complex systems and their analysis. Examples are drawn from engineering, computer science, biology, economics and physics.

Com S 509. Software Requirements Engineering. (Dual-listed with 409). (3-0) Cr. 3. F. *Prereq: 309.* The requirements engineering process including identification of stakeholders requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Non-functional requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports, and oral presentations will be required.

Com S 511. Design and Analysis of Algorithms. (Cross-listed with Cpr E). (3-0) Cr. 3. F. *Prereq: Com S 311.* A study of basic algorithm design and analysis techniques. Advanced data structures, amortized analysis and randomized algorithms. Applications to sorting, graphs, and geometry. NP-completeness and approximation algorithms.

Com S 512. Formal Methods in Software Engineering. (3-0) Cr. 3. S. *Prereq: 311, 330.* A study of formal techniques for specification and verification of software systems. Topics include temporal logic, propositional and predicate logic, model checking, process algebra, theorem proving. Tools providing automated support for these techniques will also be discussed.

Com S 515. Software System Safety. (3-0) Cr. 3. F. *Prereq: 309 or 311, 342.* An introduction to the analysis, design, and testing of software for safety-critical and high-integrity systems. Analysis techniques, formal verification, fault identification and recovery, model checking, and certification issues. Emphasizes a case-based and systematic approach to software's role in safe systems.

Com S 518. Introduction to Computational Geometry. (Dual-listed with 418). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 311 or permission of instructor.* Introduction to data structures, algorithms, and analysis techniques for computational problems that involve geometry. Line segment intersection, polygon triangulation, 2D linear programming, range queries, point location, arrangements and duality, Voronoi diagrams and Delaunay triangulation, convex hulls, robot motion planning, visibility graphs. Other selected topics. Programming assignments. A scholarly report must be submitted for graduate credit.

Com S 525. Numerical Analysis of High Performance Computing. (Cross-listed with Cpr E, Math). (3-0) Cr. 3. S. *Prereq: Cpr E 308, or one of Math 471, 481; experience in scientific programming; knowledge of FORTRAN or C.* Development, analysis, and testing of efficient numerical methods for use on current state-of-the-Art High performance computers. Applications of the methods to the students' areas of research.

Com S 526. Introduction to Parallel Algorithms and Programming. (Dual-listed with 426). (Cross-listed with Cpr E). (3-2) Cr. 4. F. *Prereq: Cpr E 308 or Com S 321, Com S 311.* Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms.

Com S 531. Theory of Computation. (3-0) Cr. 3. S. *Prereq: 331.* A systematic study of the fundamental models and analytical methods of theoretical computer science. Computability, the Church-Turing thesis, decidable and undecidable problems, and the elements of recursive function theory. Time complexity, logic, Boolean circuits, and NP-completeness. Role of randomness in computation.

Com S 533. Computational Models of Nanoscale Self-Assembly. (Dual-listed with 433). (3-0) Cr. 3. S. *Prereq: C- or higher in 331 or consent of the instructor.* Modeling and analysis of natural and engineered systems that spontaneously assemble themselves from small components. Topics include biomolecular self-assembly, tile assembly models, computation via self-assembly, distributed folding, origami models, and self-repair. Emphasis on Mathematical methods of describing, simulating, programming, and verifying the behaviors of self-assembling systems. Graduate credit requires a written or oral report on current research.

Com S 540. Principles and Practice of Compiling. (Dual-listed with 440). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: 331, 342, Engl 250, Sp Cm 212.* Theory of compiling and implementation issues of programming languages. Programming projects leading to the construction of a compiler. Projects with different difficulty levels will be given for 440 and 540. Topics: lexical, syntax and semantic analyses, syntax-directed translation, runtime environment and library support. Written reports.

Com S 541. Programming Languages. (3-1) Cr. 3. F. *Prereq: 342 or 440.* Survey of the goals and problems of language design. Formal and informal studies of a wide variety of programming language features including type systems. Creative use of functional and declarative programming paradigms.

Com S 544. Introduction to Bioinformatics. (Dual-listed with 444). (Cross-listed with BCB, Cpr E, GDCB). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics.

Com S 549. Advanced Algorithms in Computational Biology. (Cross-listed with BCB, Cpr E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 311 and either 228 or 208.* Design and analysis of algorithms for applications in computational biology, pairwise and multiple sequence alignments, approximation algorithms, string algorithms including in-depth coverage of suffix trees, semi-numerical string algorithms, algorithms for selected problems in fragment assembly, phylogenetic trees and protein folding. No background in biology is assumed. Also useful as an advanced algorithms course in string processing.

Com S 550. Evolutionary Problems for Computational Biologists. (Cross-listed with BCB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Com S 311 and some knowledge of programming.* Discussion and analysis of basic evolutionary principles and the necessary knowledge in computational biology to solve real world problems. Topics include character and distance based methods, phylogenetic tree distances, and consensus methods, and approaches to extract the necessary information from sequence-databases to build phylogenetic trees.

Com S 551. Computational Techniques for Genome Assembly and Analysis. (Cross-listed with BCB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 311 and some knowledge of programming.* Huang. Introduction to practical sequence assembly and comparison techniques. Topics include global alignment, local alignment, overlapping alignment, banded alignment, linear-space alignment, word hashing, DNA-protein alignment, DNA-cDNA alignment, comparison of two sets of sequences, construction of contigs, and generation of consensus sequences. Focus on development of sequence assembly and comparison programs.

Com S 552. Principles of Operating Systems. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 352.* A comparative study of high-level language facilities for process synchronization and communication. Formal analysis of deadlock, concurrency control and recovery. Protection issues including capability-based systems, access and flow control, encryption, and authentication. Additional topics chosen from distributed operating systems, soft real-time operating systems, and advanced security issues.

Com S 554. Distributed and Network Operating Systems. (Dual-listed with 454). (Cross-listed with Cpr E). (3-1) Cr. 3. Alt. S., offered 2011. *Prereq: 311, 352.* Laboratory course dealing with practical issues of design and implementation of distributed and network operating systems and distributed computing environments (DCE). The client server paradigm, inter-process communications, layered communication protocols, synchronization and concurrency control, and distributed file systems. Graduate credit requires additional in-depth study of advanced operating systems. Written reports.

Com S 555. Simulation: Algorithms and Implementation. (Dual-listed with 455). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Com S 311 and 330, Stat 330.* Introduction to discrete-event simulation with a focus on computer science applications, including performance evaluation of networks and distributed systems. Overview of algorithms and data structures necessary to implement simulation software. Discrete and continuous stochastic models, random number generation, elementary Statistics, simulation of queuing and inventory systems, Monte Carlo simulation, point and interval parameter estimation. Graduate credit requires additional in-depth study of concepts. Oral and written reports.

Com S 556. Analysis Algorithms for Stochastic Models. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Com S 331, Math 307, and Stat 330.* Introduction to the use of stochastic models to study complex systems, including network communication and distributed systems. Data structures and algorithms for analyzing discrete-State models expressed in high-level formalisms. State space and reachability graph construction, model checking, Markov chain construction and numerical solution, computation of performance measures, product-form models, approximations, and advanced techniques.

Com S 557. Computer Graphics and Geometric Modeling. (Cross-listed with M E, Cpr E). (3-0) Cr. 3. F.S. *Prereq: 421, programming experience in C.* Fundamentals of computer graphics technology. Data structures. Parametric curve and surface modeling. Solid model representations. Applications in engineering design, analysis, and manufacturing

Com S 558. Introduction to the 3D Visualization of Scientific Data. (Cross-listed with Geol, HCI). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate-student standing in the Mathematical or natural sciences.* Introduction to visualizing scientific information with 3D computer graphics and their foundation in human perception. Overview of different visualization techniques and examples of 3D visualization projects from different disciplines (natural sciences, medicine, engineering). Class project in interactive 3D visualization using the OpenDX, VTK or a similar system.

Com S 561. Principles and Internals of Database Systems. (Dual-listed with 461). (3-1) Cr. 3. F. *Prereq: Graduate classification.* Models for structured and semistructured data. Algebraic, first order, and user-oriented query languages. Database schema design. Physical storage, access methods, and query processing. Transaction management, concurrency control, and crash recovery. Database security. Information integration using data warehouses, mediators, wrappers, and data mining. Parallel and distributed databases, and special purpose databases. Oral and written reports. Satisfactory-fail only.

Com S 562. Implementation of Database Systems. (3-0) Cr. 3. F. *Prereq: 461 or 561.* Implementation topics and projects are chosen from the following: Storage architecture, buffer management and caching, access methods, design, parsing and compilation of query languages and update operations, application programming interfaces (APIs), user interfaces, query optimization and processing, and transaction management for relational, object-oriented, semistructured (XML), and special purpose database models; client-server architectures, metadata and middleware for database integration, web databases.

Com S 567. Bioinformatics I (Fundamentals of Genome Informatics). (Cross-listed with BCB, Cpr E). (3-0) Cr. 3. F. *Prereq: Com S 208; Com S 330; Stat 341; credit or enrollment in Biol 315, Stat 430.* Biology as an information science. Review of algorithms and information processing. Generative models for sequences. String algorithms. Pairwise sequence alignment. Multiple sequence alignment. Searching sequence databases. Genome sequence assembly.

Com S 568. Bioinformatics II (Advanced Genome Informatics). (Cross-listed with BCB, GDCB, Stat). (3-0) Cr. 3. S. *Prereq: BCB 567, BBMB 301, Biol 315, Stat 430, credit or enrollment in Gen 411.* Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

Com S 569. Bioinformatics III (Structural Genome Informatics). (Cross-listed with BBMB, BCB, Math, Cpr E). (3-0) Cr. 3. F. *Prereq: BCB 567, Gen 411, Stat 430.* Algorithmic and Statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

Com S 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology). (Cross-listed with BCB, GDCB, Stat, Cpr E). (3-0) Cr. 3. S. *Prereq: BCB 567, Biol 315, Com S 311 and either 208 or 228, Gen 411, Stat 430.* Algorithmic and

Statistical approaches in computational functional genomics and systems biology. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Ontology-driven, network based, and probabilistic approaches to information integration.

Com S 572. Principles of Artificial Intelligence. (Dual-listed with 472). (3-1) Cr. 3. F. *Prereq: 311, 331, Stat 330, Com S 342 or comparable programming experience.* Specification, design, implementation, and selected applications of intelligent software agents and multi-agent systems. Computational models of intelligent behavior, including problem solving, knowledge representation, reasoning, planning, decision making, learning, perception, action, communication and interaction. Reactive, deliverative, rational, adaptive, learning and communicative agents. Artificial intelligence programming. Graduate credit requires a research project and a written report. Oral and written reports.

Com S 573. Machine Learning. (3-1) Cr. 3. S. *Prereq: 311, 362, Stat 330.* Algorithmic models of learning. Design, analysis, implementation and applications of learning algorithms. Learning of concepts, classification rules, functions, relations, grammars, probability distributions, value functions, models, skills, behaviors and programs. Agents that learn from observation, examples, instruction, induction, deduction, reinforcement and interaction. Computational learning theory. Data mining and knowledge discovery using artificial neural networks, support vector machines, decision trees, Bayesian networks, association rules, dimensionality reduction, feature selection and visualization. Learning from heterogeneous, distributed, dynamic data and knowledge sources. Learning in multi-agent systems. Selected applications in automated knowledge acquisition, pattern recognition, program synthesis, bioinformatics and Internet-based information systems. Oral and written reports.

Com S 574. Intelligent Multiagent Systems. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 330; Com S 331; 572, 573, 472, or 474.* Specification, design, implementation, and applications of multi-agent systems. Intelligent agent architectures; infrastructures, languages and tools for design and implementation of distributed multi-agent systems; Multi-agent organizations, communication, interaction, cooperation, team formation, negotiation, competition, and learning. Selected topics in decision theory, game theory, contract theory, bargaining theory, auction theory, and organizational theory. Selected topics in knowledge representation and ontologies. Agent-based systems and the Semantic Web. Applications in distributed intelligent information networks for information retrieval, information integration, inference, and discovery from heterogeneous, autonomous, distributed, dynamic information sources.

Com S 575. Computational Perception. (Cross-listed with Cpr E, HCI). (3-0) Cr. 3. S. *Prereq: Graduate standing or permission of instructor.* Statistical and algorithmic methods for sensing, recognizing, and interpreting the activities of people by a computer. Focuses on machine perception techniques that facilitate and augment human-computer interaction. Introduce computational perception on both theoretical and practical levels. You will work in small groups to design, implement, and evaluate a prototype of a human-computer interaction system that uses one or more of the techniques covered in the lectures.

Com S 577. Problem Solving Techniques for Applied Computer Science. (Dual-listed with 477). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 228; 330 or Cpr E 310, Math 166, Math 307 or Math 317, or consent of the instructor.* Selected topics in applied Mathematics and modern heuristics that have found applications in areas such as geometric modeling, graphics, robotics, vision, human machine interface, speech recognition, computer animation, etc. Homogeneous coordinates and transformations, perspective projection, quaternions and rotations, polynomial interpolation, roots of polynomials, resultants, solution of linear and nonlinear equations, approximation, data fitting, Fourier series and fast Fourier transform, linear programming, nonlinear optimization, Lagrange multipliers, parametric and algebraic curves, curvature, Frenet formulas, Bezier curves. Programming components. A scholarly report is required for graduate credit.

Com S 581. Computer Systems Architecture. (Cross-listed with Cpr E). (3-0) Cr. 3. F. *Prereq: Cpr E 381.* Quantitative principles of computer architecture design, instruction set design, processor architecture: pipelining and superscalar design, instruction level parallelism, memory organization: cache and virtual memory systems, multiprocessor architecture, cache coherency, interconnection networks and message routing, I/O devices and peripherals.

Com S 583. Reconfigurable Computing Systems. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Background in computer architecture, design, and organization.* Introduction to reconfigurable computing, FPGA technology and architectures, spatial computing architectures such as systolic and bit serial adaptive network architectures, static and dynamic rearrangeable interconnection architectures, processor architectures incorporating reconfigurabiltiy.

Com S 586. Computer Network Architectures. (3-0) Cr. 3. F. *Prereq: 511, 552 or Cpr E 489.* Design and implementation of computer communication networks: layered network architectures, local area networks, data link protocols, distributed routing, transport services, network programming interfaces, network applications, error control, flow/congestion control, interconnection of heterogeneous networks, TCP/IP, ATM networks, multimedia communications, IP and application multicast, overlay networks, network security and web computing.

Com S 587. Principles of Distributed and Network Programming. (3-0) Cr. 3. F. *Prereq: 352 or Cpr E 489 or equivalent.* Programming paradigms for building modern distributed applications, including multithreaded client-server programming, distributed object frameworks and programming languages. Directory services. Web-based computing. Mobile computing. Peer-to-Peer computing. Network multimedia applications. Reliability and manageability of networked systems, including aspects of distributed system security, verification of concurrent systems, and network management.

Com S 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Satisfactory-fail only.

Com S 592. Research Colloquia. Cr. 1. F.S. *Prereq: Graduation classification.* Attend Computer Science Research Colloquia. Written summary is required. Satisfactory-fail only.

Com S 596. Genomic Data Processing. (Cross-listed with BCB, GDCB). (3-0) Cr. 3. F. *Prereq: Some knowledge of programming.* Study the practical aspects of genomic data processing with an emphasis on hand-on projects. Students will carry out major data processing steps using bioinformatics tools. Topics include base-calling, raw sequence cleaning and contaminant removal; shotgun assembly procedures and EST clustering methods; genome closure strategies and practices; sequence homology search and function prediction; annotation and submission of GenBank reports; and data collection and dissemination through the Internet. Useful post-genomic topics like microarray design and data analysis will also be covered.

Com S 598. Graduate Internship. Cr. R. Repeatable. F.S.SS. *Prereq: Graduate Classification.* Supervised internship working in professional settings appropriate to the student's degree program. Academic work under faculty supervision.

Com S 599. Creative Component. Cr. arr. Creative component for nonthesis option of Master of Science degree. Satisfactory-fail only.

Courses for graduate students

Com S 610. Seminar. Cr. arr. Satisfactory-fail only.

Com S 611. Advanced Topics in Analysis of Algorithms. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: 511, 531.* Advanced algorithm analysis and design techniques. Topics include graph algorithms, algebraic algorithms, number-theoretic algorithms, randomized and parallel algorithms. Intractable problems and NP-completeness. Advanced data structures.

Com S 612. Distributed Algorithms. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 511 or 531.* The theory of distributed computation. Algorithms, lower bounds and impossibility results. Leader Elections, mutual exlusion, consensus and clock synchronization algorithms. Synchronous, asynchronous and partially synchronous distributed systems models. Shared memory and message passing systems. Fault-tolerance and randomization. Broadcast and multicast. Wait-free object simulations. Distributed shared memory.

Com S 625. Issues in Parallel Programming and Performance. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 511.* Parallel solutions of numerical and non-numerical problems, implementation of parallel programs on parallel machines, performance and other computational issues in parallel programming.

Com S 626. Parallel Algorithms for Scientific Applications. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: 526.* Algorithm design for high-performance computing. Applications to numerical simulations, sparse matrix computation, multidimensional tree data structure, and particle-based methods, random numbers and Monte Carlo applications, algorithms, and computational biology.

Com S 631. Advanced Topics in Computational Complexity. (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 531.* Advanced study in the quantitative theory of computation. Time and space complexity of algorithmic problems. The structure of P, NP, PH, PSPACE, and other complexity classes, especially with respect to resource-bounded reducibilities and complete problems. Complexity relative to auxiliary information, including oracle computation and relativized classes, randomized algorithms, advice machines, Boolean circuits. Kolmogorov complexity and randomness.

Com S 633. Advanced Topics in Computational Randomness. (3-0) Cr. 3. Repeatable. Alt. F., offered 2009. *Prereq: 531.* Advanced study of the role of randomness in computation. Randomized algorithms, derandomization, and probabilistic complexity classes. Kolmogorov complexity, algorithmic information theory, and algorithmic randomness. Applications chosen from cryptography, interactive proof systems, computational learning, lower bound arguments, mathematical logic, and the organization of complex systems.

Com S 634. Theory of Games, Knowledge and Uncertainty. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 330.* Fundamentals of Game Theory: individual decision making, strategic and extensive games, mixed strategies, backward induction, Nash and other equilibrium concepts. Discussion of Auctions and Bargaining. Repeated, Bayesian and evolutionary games. Interactive Epistemology: reasoning about knowledge in multiagent environment, properties of knowledge, agreements, and common knowledge. Reasoning about and representing uncertainty, probabilities, and beliefs. Uncertainty in multiagent environments. Aspects and applications of game theory, knowledge, and uncertainty in other areas, especially Artificial Intelligence and Economics, will be discussed.

Com S 641. Advanced Topics in Programming Language Semantics. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: 531, 541.* Operational and other Mathematical models of programming language semantics. Type systems and their soundness. Applications of semantics on areas such as program correctness, language design or translation.

Com S 652. Advanced Topics in Distributed Operating Systems. (3-0) Cr. 3. Repeatable. Alt. F., offered 2009. *Prereq: 552.* Concepts and techniques for network and distributed operating systems: Communications protocols, processes and threads, name and object management, synchronization, consistency and replications for consistent distributed data, fault tolerance, protection and security, distributed file systems, design of reliable software, performance analysis.

Com S 657. Advanced Topics in Computer Graphics. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 228, I E/M E/Cpr E/Com S 557.* Modern lighting models: Rendering Equation, Spherical Harmonics, LaFortune, Cook-Torrance. Non-polygonal primitives: volumes, points, particles. Textures: filtering, reflections creation. Graphics hardware: pipeline, performance issues, programmability in vertex and fragment path. Per-pixel lighting. Nonphotorealistic rendering. Radiosity; Ray tracing.

Com S 661. Advanced Topics in Database Systems. (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 461 or 561.* Advanced topics chosen from the following: database design, data models, query systems, query optimization, incomplete information, logic and databases, multimedia databases; temporal, spatial and belief databases, semistructured data, concurrency control, parallel and distributed databases, information retrieval, data warehouses, wrappers, mediators, and data mining.

Com S 672. Advanced Topics in Computational Models of Learning. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: Com S 572 or 573 or 472 or 474.* Selected topics in Computational Learning Theory (PAC learning, Sample complexity, VC Dimension, Occam Learning, Boosting, active learning, Kolomogorov Complexity, Learning under helpful distributions, Mistake Bound Analysis). Selected topics in Bayesian and nformation Theoretic Models (ML, MAP, MDL, MML). Advanced Statistical methods for machine learning. Selected topics in reinforcement learning.

Com S 673. Advanced Topics in Computational Intelligence. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: Com S 572 or 573 or 472 or 474.* Advanced applications of artificial intelligence in bioinformatics, distributed intelligent information networks and the Semantic Web. Selected topics in distributed learning, incremental learning, multi-task learning, multi-strategy learning; Graphical models, multi-relational learning, and causal inference; Statistical natural language processing; modeling the internet and the web; automated scientific discovery; neural and cognitive modeling.

Com S 681. Advanced Topics in Computer Architecture. (Cross-listed with Cpr E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 581.* Current topics in computer architecture design and implementation. Advanced pipelining, cache and memory design techniques. Interaction of algorithms with architecture models and implementations. Tradeoffs in architecture models and implementations.

Com S 686. Advanced Topics in High-Speed Networks. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 586.* Advanced topics in IP networks and optical networks. QoS routing and scheduling, multicast, multiprotocol label switching (MPLS), traffic engineering. Optical network architectures, routing and wavelength assignment algorithms, optical multicast, traffic grooming, optical burst switching, lightpath protection/restoration schemes, and IP over WDM.

Com S 699. Research. Cr. arr. Repeatable. *Prereq: Approval of instructor.* Satisfactory-fail only.

Construction Engineering

(Administered by the Department of Civil, Construction and Environmental Engineering)

James Alleman, Chair of Department

Distinguished Professor: Klaiber

Distinguished Professors (Emeritus): Baumann, Cleasby, Handy

University Professor (Emeritus): Lohnes

Professors: Alleman, Fanous, Jaselskis, Kannel, Maze, Nambisan, Ong, Pometto, Porter, Sarkar, Schaefer, Souleyrette, Van Leeuwen, Wipf

Professors (Emeritus): Bergeson, Brewer, Carstens, Greimann, Hardy, Jellinger, Kao, Lee, Mashaw, Mickle, Morgan, Northup, Oulman, Sander

Professor (Collaborator): Surampalli

Associate Professors: Abendroth, Baenziger, Bhandari, Ellis, Gu, Hallmark, Jahren, Koziel, Rehmann, Sritharan, Strong, Sung, Wang, White, Williams

Associate Professors (Emeritus): Chase, Mercier, Sheeler, Ward

Assistant Professors: Aslock, Bolluyt, Ceylan, Gkritza, Grewell, Kandil, Rouse, Shane

Assistant Professors (Adjunct): Phares, Schlorholtz, Smadi, Taylor

Assistant Professors (Collaborators): Boyle, Khanal, Ozsoy

Instructors (Adjunct): Amenson, Gaunt

Senior Lecturers: Cormicle, Sirotiak, Walton

Lecturers: Baker, Cackler, Hawkins, Hunacek, Mescher, Perkins, Smith, Stout

Clinician: Gopalakrishnan

Undergraduate Study

For undergraduate curriculum in construction engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission of ABET.

Construction engineering is a curriculum administered by the Department of Civil, Construction and Environmental Engineering. For details of the curriculum in construction engineering leading to the degree bachelor of science, see the *College of Engineering, Curricula.* General objectives, which are common to all departments in engineering, are stated in the *College of Engineering, Objectives of Curricula in Engineering.* The curriculum in construction engineering is designed with the objective to prepare students for life-long careers in the constantly changing technical and managerial environment of the construction industry. Students who successfully complete the curriculum will be prepared for entry into the field or for further study at the graduate level in construction engineering or related fields of study, such as law, business and other engineering disciplines.

Construction engineers need to possess strong fundamental knowledge of engineering design and management principles, including knowledge of business procedures, economics, and human behavior. Graduates of this curriculum may expect to engage in design of temporary structures, coordination of project design, systems design, cost estimating, planning and scheduling, company and project management, materials procurement, equipment selection, and cost control. With the emergence of design-build construction, the role of the construction engineer is expanding the need for trained professionals that understand both aspects of the project delivery environment. The curriculum offers opportunities to study emphases concerned with building, heavy, mechanical or electrical construction. The process of construction involves the organization, administration, and coordination of labor resource requirements, temporary and permanent materials, equipment, supplies and utilities, money, technology and methods. These must be integrated in the most efficient manner possible to complete construction projects on schedule, within the budget, and according to the standards of quality and performance specified by the project owner or designer. The curriculum blends engineering, management and business sciences into a study of the processes of construction whereby designer's plans and specifications are converted into physical structures and facilities. To achieve this, a construction engineering graduate should have:

- confidence.
- initiative.
- leadership ability.
- the ability to think critically, systematically, and generatively.
- an understanding of the engineering and architectural design process.
- proficiency in construction engineering and the design of construction processes which includes the ability to:
  - apply knowledge of mathematics, science, and engineering.
  - design and conduct experiments, as well as to analyze and interpret data.
  - identify, formulate, and solve engineering problems.
  - design a system, component, or process to meet desired needs.
- an understanding of:
  - the overall construction process.
  - the estimating process.
  - the planning and scheduling process.
  - risk assessment.
  - contracts and laws.
  - business and management.
  - ethical reasoning.
  - contemporary issues in the industry.
  - construction engineering and the industry's impact on Society.- business and construction engineering terminology.
- an ability to:
  - function in multi-disciplinary teams.
  - communicate orally, graphically and in writing.
- a desire for life-long learning and intellectual and professional growth.
- an awareness of modern techniques, skills and technologies for construction.

The curriculum develops the ability of students to be team workers, creative thinkers, and effective communicators. This is achieved by providing students with opportunities to:

- interact with practicing professionals.
- gain work experience during summer jobs, internship, and cooperative education assignments that emphasize the knowledge required of construction engineers.
- develop leadership skills by participating in student organizations.
- develop, analyze, and interpret alternative solutions to open-ended problems.
- study abroad.

The construction industry is becoming increasingly global. Courses in humanities, social sciences, U.S. diversity, and international perspectives are included in the curriculum to broaden the student's perspective of the work environment. In addition, the department has several exchange program opportunities for students to participate in study-abroad programs. Interested and qualified students have the opportunity to participate in the cooperative education program or internship

program to supplement academic work with work experience. See *Cooperative Education Programs, College of Engineering*.

Construction engineering students are encouraged to participate in life-long learning, continuous professional development, and to achieve professional engineer registration and/or registration as a certified professional constructor. Qualified construction engineering students within 30 credits of completing their undergraduate degree may apply for concurrent enrollment in the Graduate College. See *Civil Engineering Graduate Study* for more information.

Graduate Study

An area of specialization in construction engineering and management is offered within the graduate program of the Department of Civil, Construction and Environmental Engineering. See *Civil Engineering, Courses and Programs*.

Courses are offered for minor work to students taking major work in other curricula or in interdepartmental programs.

Courses primarily for undergraduate students

Con E 121. Cornerstone Learning Community: Orientation to Academic Life. (0-2) Cr. 1. F. Integration of first-year and transfer students into the engineering profession and the Construction Engineering program. Assignments and activities completed both individually and in learning teams involving teamwork, academic preparation, and study skills. Teamwork topics include interdisciplinary teamwork, skills for academic success and diversity issues. Introduction to organization of program, department, college, and university. Overview of faculty, staff, policies, procedures and resources.

Con E 122. Cornerstone Learning Community: Orientation to Professional Life. (0-2) Cr. 1. S. Continuation of Con E 121. Integration of first-year and transfer students into the engineering profession. Career preparation, professional ethics, construction research. Introduction to construction industry professionals including how they interact with engineers in other disciplines. Continued introduction to program, department, college, and university organization. Overview of faculty, staff, policies, procedures and resources.

Con E 221. Contractor Organization and Management of Construction. (4-0) Cr. 4. F.S. *Prereq: Completion of basic program.* Entry level course for construction engineering: integration of significant engineering, economics, and management issues related to efficient construction company operations. Time value of money; methods of evaluating alternative projects; organization; operations; construction company administration; project administration; project management systems; construction contracts; integrated delivery systems (design/build and others); marketing; insurance and bonding; construction safety; labor law; labor relations; productivity; motivation and leadership; contract documents; interpretation and utilization of drawings, specifications, agreements, bidding forms, general conditions, subcontracts, shop drawings and related documents.

Con E 241. Construction Materials and Methods. (2-3) Cr. 3. F.S. *Prereq: 221.* Introduction to materials and methods of building construction and to construction drawings. Foundation, structural framing, floor, roof, and wall systems. Blueprint reading and quantity takeoff techniques.

Con E 251. Mechanical/Electrical Materials and Methods. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 241.* Introduction to the materials and methods for mechanical and electrical construction systems and drawings. HVAC, water and waste water, power distribution, lighting, and fire protection. Blueprint reading and quantity takeoff. Specialty contractor organization and management.

Con E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

Con E 322. Construction Equipment and Heavy Construction Methods. (2-3) Cr. 3. F.S. *Prereq: 241.* Selection and acquisition of construction equipment. Application of engineering fundamentals and economics to performance characteristics and production of equipment. Heavy construction methods and economic applications. Nonmajor graduate credit.

Con E 340. Concrete and Steel Construction. (2-3) Cr. 3. F.S. *Prereq: E M 324, credit or enrollment in Con E 322.* Planning and field engineering for concrete and steel construction. Design and applications of concrete formwork to construction. Erection of structural steel. Emerging industry themes. Nonmajor graduate credit.

Con E 352. Mechanical Systems in Buildings. (3-0) Cr. 3. F.S. *Prereq: 251, Phys 222.* Comprehensive coverage of mechanical systems, plumbing, fire protection, vertical transportation. Analysis techniques and design principles for each system. Required comprehensive design project for a major building project.

Con E 353. Electrical Systems in Buildings. (2-0) Cr. 2. F.S. *Prereq: Phys 222 and credit or enrollment in 352.* Comprehensive coverage of building electrical systems including power, lighting, fire alarm, security and communications. Analysis techniques and design principles for each system. Required comprehensive design project for a major building project.

Con E 380. Engineering Law. (3-0) Cr. 3. F.S. *Prereq: Junior classification.* Introduction to law and judicial procedure as they relate to the practicing engineer. Contracts, professional liability, professional ethics, licensing, bidding procedures, intellectual property, products liability, risk analysis. Emphasis on development of critical thinking process, abstract problem analysis and evaluation. Nonmajor graduate credit.

Con E 381. Bidding Construction Projects I. (0-3) Cr. 1. F. *Prereq: Permission from the instructor.* Team development of construction process designs and cost estimates for transportation construction projects under closely simulated conditions. Examine project sites, consult with construction industry mentors, obtain subcontractor and supplier quotations, and submit bids. Offered in the following specialities:
A. Heavy and Highway
B. Building
C. Mechanical
D. Electrical
E. Mechanical and Electrical
F. Miscellaneous

Con E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period. Students must register for this course before commencing work.

Con E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* Professional work period, one semester maximum per academic year. Students must register for this course before commencing work.

Con E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

Con E 421. Construction Estimating. (2-3) Cr. 3. F.S. *Prereq: 241, Junior classification.* Conceptual estimating. Bid preparation for buildings, highways, heavy, mechanical trades. Estimating costs for material, labor, equipment, overhead, and profit. Quantity surveys, unit costs, production rates, and pricing methods. Subcontract bid analysis and bid procedure. Cost analysis and cost control. Electronic quantity take off methods. Nonmajor graduate credit.

Con E 441. Construction Planning, Scheduling, and Control. (2-2) Cr. 3. F.S. *Prereq: Credit or enrollment in 421.* Integration of previous construction coursework into the planning, scheduling, and management of time, costs, and other resources. Emphasis on preparation and analysis of network schedules. Comprehensive planning and scheduling project. Computer project management applications. Nonmajor graduate credit.

Con E 481. Bidding Construction Projects II. (0-3) Cr. 1. F. *Prereq: Permission from the instructor.* Similar to Con E 381, except students with previous experience attempt projects with larger scope or lead students with less experience.
A. Heavy and Highway
B. Building
C. Mechanical
D. Electrical
E. Mechanical and Electrical
F. Miscellaneous

Con E 487. Construction Engineering Design I. (1-2) Cr. 2. F.S. *Prereq: Con E 340 (B, H), 352 (B, E, M), 353 (B, E, M), 421, 441. Student must be within two semesters of graduation.* The integrated delivery of project services including preliminary engineering design process, constructability review, interaction with the client, identification of engineering problems, developments of a proposal, identification of design criteria, cost estimating, planning and scheduling, application of codes and standards, development of feasible alternatives, selection of best alternative, and delivery of oral presentations.

Con E 488. Construction Engineering Design II. (1-5) Cr. 3. F.S. *Prereq: Con E 380. Coreq: 487.* Application of team design concepts to a construction engineering project. Project planning. Detailed analysis. Advanced cost and schedule applications. Contract negotiation. Development of a complete project history. Technical presentations (oral and written).

Con E 490. Independent Study. Cr. 1-5. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Individual study in any phase of construction engineering. Preenrollment contract required.

Con E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Criminal Justice Studies

(Interdepartmental Undergraduate Program)

Matthew J. DeLisi, Program Coordinator

The criminal justice studies minor, a cross-disciplinary course of study in the College of Liberal Arts and Sciences, offers an opportunity for students to learn about the components of the criminal and juvenile justice systems, to become acquainted with the issues and problems affecting these systems, to apply theoretical concepts to real world problems, and to plan a career in criminal or juvenile justice.

Students who declare a minor in criminal justice studies are required to complete 15 credits of course work. Students must take five of the following six courses: CJ St 240, 241, 320, 332, 340 or 341. Students are also required to complete a minimum of 3 credits of internship experience (CJ St 460). Completion of the minor requires 18 total credits.

Courses primarily for undergraduate students

CJ St 240. Introduction to the U.S. Criminal Justice System. (3-0) Cr. 3. F. Provides systematic overview of law, police organization and behavior, prosecution and defense, sentencing, the judiciary, community corrections, penology, and capital punishment. The course demonstrates the role of discretion in all of these agencies as well as the Sociological influences of age, race, gender, and social class on criminal justice system processes.

CJ St 241. Youth and Crime. (Cross-listed with Soc). (3-0) Cr. 3. F. *Prereq: Soc 130 or 134.* An examination of delinquency that focuses on the relationship between youth as victims and as offenders, social and etiological features of delinquency, the role of the criminal justice system, delinquents' rights, and traditional and alternative ways of dealing with juvenile crime.

CJ St 320. American Judicial Process. (Cross-listed with Pol S). (3-0) Cr. 3. S. *Prereq: Pol S 215.* An overview of the American judicial process. Emphasis on specific topics such as application of constitutional rights to the states (particularly the Fourth, Fifth, Sixth, and Fourteenth Amendments), mechanics of judicial opinions, constitutional Philosophies of Supreme Court Justices, decisions of first impression, and the value and scope of precedent.

CJ St 332. Philosophy of Law. (Cross-listed with Phil). (3-0) Cr. 3. F.S. *Prereq: Phil 201 or 230.* Extent of our obligation to obey the law; what constitutes just punishment; how much of the immoral should be made illegal? Relation of these questions to major theories of law and the state. Discussion of such concepts as coercion, equality, and responsibility. Nonmajor graduate credit.

CJ St 340. Deviant and Criminal Behavior. (Cross-listed with Soc). (3-0) Cr. 3. S.SS. *Prereq: Soc 130 or 134.* Theory and research on the etiology of types of social deviance; issues relating to crime, antisocial behavior and social policies designed to control deviant behavior.

CJ St 341. Criminology. (Cross-listed with Soc). (3-0) Cr. 3. F. *Prereq: Soc 130 or 134.* The nature of crime and criminology; the concept of crime; Statistics and theories of criminality; major forms of crime; official responses to crime and control of crime.

CJ St 351. Police and Society. (Cross-listed with Soc). (3-0) Cr. 3. F.S.SS. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of law enforcement in the United States. Theory and research on police history, function, and organization; constitutional issues of policing; and critical topics, such as community policing, officer discretion and decision-making, corruption, use of force, and racial profiling. The course illustrates the interconnections between communities, police organizations, citizens, and criminal offenders.

CJ St 352. Punishment, Corrections, and Society. (Cross-listed with Soc). (3-0) Cr. 3. F.S.SS. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of corrections in the United States. Theory and research on probation, parole, intermediate sanctions, prison, inmate Society, inmate behavior and misconduct, capital punishment, recidivism, correctional treatment, rehabilitation, and offender reintegration into Society.

CJ St 402. White-Collar Crime. (Cross-listed with Soc). (3-0) Cr. 3. S.SS. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of white-collar crime as a form of deviance. Theory and research on occupational, corporate, and organizational offending; prevalence, costs, and consequences of white-collar crime; predictors and correlates of white-collar crime; and political, business, and public policy responses to white-collar crime.

CJ St 403. Criminal Offenders. (3-0) Cr. 3. F.S. *Prereq: 240 or 241.* Introduction and overview of criminal offenders. Theory and research on epidemiology, offender typologies, etiology of violence, recidivism, societal costs, correctional supervision, treatment, and prevention of serious antisocial behavior.

CJ St 460. Criminal and Juvenile Justice Practicum. (Cross-listed with Soc). Cr. arr. Repeatable. F.S.SS. *Prereq: Junior or senior classification; permission of criminal justice studies coordinator; major or minor in Sociology, or criminal justice studies minor.* Study of the criminal and juvenile justice systems and social control processes. Supervised placement in a police department, prosecutor's office, court, probation and parole department, penitentiary, juvenile correctional institution, community-based rehabilitation program, or related agency.

Cross Disciplinary Studies

The College of Liberal Arts and Sciences administers a number of Cross Disciplinary Studies, Interdepartmental Studies, and Certificate Programs which enable students to develop individual programs of study toward majors and minors in a range of disciplines. Information on the requirements for these programs is available in the Academic Advising Office, College of Liberal Arts and Sciences, located in Catt Hall. (see Index, Liberal Arts and Sciences Cross Disciplinary Studies)

Curriculum and Instruction

www.edu.ci.hs.iastate.edu

Carl Smith, Interim Chair of Department

Distinguished Professors (Emeritus): Moyer, Rasmussen

University Professor: Thompson

University Professors (Emeritus): Brown, D. Williams

Professors: Abelson, Andre, Blount, Greenbowe, Martin, G. Miller, W. Miller, Mokhtari, Owen, Phye, Smith, Stuart, Whaley

Professors (Emeritus): Barnhart, Bath, Baum, Breiter, Brun, Burkhalter, Carter, Charles, Coulson, Daly, Dilts, Downs, Duffelmeyer, Henney, Hoerner, Hunter, Keller, McCormick, Rudolph, Schneider, Shhloerke, Smith, Tanner, Thomas, Volker, Williams, Zbaracki

Associate Professors: Allen, Bloom, Caldwell, Carlson, Clough, Foegen, Fuhler, Gentzler, Hargrave, Hausafus, Leigh, Munsen, Niederhauser, Olsen, Payne, Schilling, Torrie

Associate Professors (Emeritus): Amos, Ebert

Associate Professor (Adjunct): Rosenbusch

Assistant Professors: Bang, Blumenfeld, Bruna, Correia, Drake, Esters, Lee, Norton-Meier, Schmidt, Seymour

Assistant Professors (Emeritus): Chatfield, Tartakov

Assistant Professors (Adjunct): Andreotti, McShay

Lecturers: Achter, Billings, Bossard, Breitsprecker, Coldiron, Erickson, Fairchild, Kinley, Land, Laws, Lind, Linduska, Millen, Nelson, Norris, Olson, Sheldon, Stoppel, Swenson, Taylor, Timm, Turner, Tvrdik, Vermeer, Wiebold

Missions and Goals

The mission of the Department of Curriculum and Instruction is to serve the people of Iowa, the Nation, and the World through discovery, learning, and engagement efforts that enhance and develop human potential and equity through education and that promote understanding of learning, teaching, and education as disciplines. In our discovery mission, we strive

- to conduct the highest quality research and scholarship that significantly contribute to educational theory and practice and
- to be known locally, nationally, and internationally as a department of distinction.

In our learning mission, we strive to be a recognized high quality teacher preparation department that

- prepares highly effective teachers and educational leaders;
- prepares graduate students and post doctoral professionals who become leaders in their respective fields; and
- conducts significant ongoing research and evaluation on the process of effective teacher preparation.

In our engagement mission, we strive to develop partnerships within and beyond the university that

- enhance the quality and effectiveness of education in practice and
- serve our discovery and learning missions.

Undergraduate Study

The Department of Curriculum and Instruction provides the professional education coursework that leads to licensure of pre-service teachers. Students major in early childhood education - birth through third grade or elementary education - K-6. Students who are interested in teaching at the secondary level (5-12) major in a specific discipline and complete the courses necessary for their teaching license. Early childhood education and elementary education majors must complete a professional course sequence: C I 201, 204, 332, 406 and Sp Ed 250. Secondary education students must complete a professional course sequence: C I 202, 204, 333, 406 and Sp Ed 450. Some secondary licensure areas also require C I 426.

The department offers a minor in digital learning that may be earned by completing the following courses: C I 201 or 202; Com S 107 or Com S 207 or Cpr E/Mat E 370; C I 280A; 280B; 302; 403; and 407.

The Department of Curriculum and Instruction offers courses that can lead to a reading endorsement for grades K-8 or grades 5-12. Students seeking a K-8 endorsement should see a Curriculum and Instruction academic adviser. The 5-12 endorsement is offered collaboratively with the English Department. Students seeking this endorsement should see an adviser in the English Department. Copies of transcript(s) can also be sent to the Licensure Analyst in the Student Services Office to receive a list of courses needed for an Iowa State University Reading endorsement. Prerequisites for the reading endorsement courses are listed in the catalog course descriptions.

Early Childhood Education

The curriculum in Early Childhood Education is planned for students preparing to teach young children and work with their families. This program leads to careers in working with young children who are typically developing and those with special needs from birth through age eight. Graduates in this curriculum may teach in early childhood (preschool and primary) classrooms or home based programs, with emphasis on inclusive services. Graduates may be employed by either public or private agencies or schools. This curriculum has been approved by the Iowa Department of Education and meets requirements for the early childhood education unified teacher license, which permits individuals to teach general and special education for children from birth through age eight. The program is an interdepartmental major administered by the Department of Curriculum and Instruction and the Department of Human Development and Family Studies within the College of Human Sciences.

Early Childhood Education majors must satisfy a world language requirement for graduation. For detailed information, see College of Human Sciences - Curriculum in Early Childhood Education.

Students who enroll in Early Childhood Education must make application to and be accepted into the teacher education program prior to enrolling

in advanced courses. All early childhood education students, including those seeking a double major, must meet general education requirements for teacher licensure. Iowa State University is in compliance with the Iowa Department of Education's mandate for a performance based system of teacher training. Following this same type of system, the State of Iowa has developed and implemented a competency system to evaluate the performance of all teachers. A detailed list of the eleven Iowa State University Teacher Education Standards and the eight State of Iowa Teaching Standards, along with other information about the University Teacher Education Program, can be found at www.teacher.hs. iastate.edu/, the teacher education website. information is also available from the student's academic adviser.

Students in early childhood education must meet the performance outcome standards for teacher licensure. Standards are assessed in coursework through designated performance indicators such as assignments, projects, or practicum participation. These standards assessments are based on the early childhood content standards for endorsement 100 in the State of Iowa. These include competencies in (1) child growth, development, and learning, (2) developmentally appropriate learning environment and curriculum implementation, (3) health, safety, and nutrition, (4) family and community collaboration, and (5) professionalism. Pre-student teaching field experiences and student teaching experience in at least two different settings is required. Students will receive both formative and summative evaluations of their progress toward meeting these outcomes throughout their program at Iowa State University

Elementary Education

For the undergraduate curriculum in elementary education, leading to the degree bachelor of science, see College of Human Sciences.

The curriculum in elementary education is planned for students preparing to teach at the elementary school level. This program leads to careers in working with school-aged children, kindergarten through sixth grade. Graduates in this curriculum may teach in elementary classrooms in either public or private school districts.

Endorsements in art, English/language arts, English as a Second Language (ESL), health, history, music, basic science, social studies, mathematics, special education (Instructional Strategist I: Mild/Moderate Disabilities K-8), and speech communication/theater are available for elementary education students. An endorsement for teaching world languages in elementary schools is available through the Department of World Languages and Cultures.

Elementary Education majors must satisfy a world language requirement for graduation. For detailed information, see College of Human Sciences - Curriculum in Elementary Education.

Students who enroll in elementary education must make application to and be accepted into the teacher education program prior to enrolling in advanced elementary education courses. For admission and licensure requirements, see College of Human Sciences. Every student must meet the performance outcome standards for teacher licensure. These standards will be assessed in each course. Students will receive both formative and summative evaluations of their progress toward meeting these standards throughout their program at Iowa State University. A detailed explanation of the standards and assessment process may be found on the department's website (www.ci.hs.iastate.edu/). The same information is also available from the student's academic adviser.

Graduates of the elementary education program will be able to demonstrate through professional practice their understanding of academic disciplines, teaching and learning, the nature of the student, and how to adapt instruction for diversity. More specifically, graduates will be able to demonstrate their understanding of concepts and structures of disciplines, tools of inquiry, how students learn and develop, and the effects of individual differences on learning. Graduates will be able to demonstrate a broad range of instructional strategies, including knowledge of technology applicable to instruction. In their teaching, graduates will demonstrate the ability to stimulate active inquiry with collaboration and supportive interaction among their students. In appropriate settings graduates will demonstrate their ability to develop professional relationships with colleagues, parents, and agencies that support students and their learning.

Secondary Education

For specific requirements for each area of specialization, see Teacher Education and curricula for the college in which the chosen degree major is sought.

Students seeking recommendations for a license to teach in the secondary schools must be admitted to the teacher education program and pursue a program that includes the professional core: C I 202, 204, 333, 406, 426, and Sp Ed 450; special methods; and student teaching in the area of specialization. Note: Students seeking licensure in agriculture and science do not take C I 426. Students seeking a teaching license in physical education must see an advisor in the Department of Kinesiology in the College of Human Sciences. All students who are recommended by Iowa State University for teacher licensure must meet the requirements of the teacher education program and be recommended by the College of Human Sciences. Each student must meet the performance outcome standards for teacher licensure. Each standard will be assessed in every major. Students will receive both formative and summative evaluations of their progress toward meeting these outcomes throughout their program at Iowa State University. A detailed explanation of the standards and assessment process may be found at www.teacher.hs.iastate.edu. For more information, students should contact the academic advisers in their major. Each student will be enrolled in the department in which he or she plans to major, and must meet the graduation requirements of that department and the college in which it is located.

Graduate Study

The Department of Curriculum and Instruction offers work for the degrees Master of Science, Master of Education, and Doctor of Philosophy with a major in education and minor work to students taking major work in other departments. Within the education major in the Department of Curriculum and Instruction a student may earn an education degree with no area of specialization (master's and doctorate) or specialize in elementary education (master's only), historical, philosophical, and comparative studies in education (master's only), special education (master's only), or curriculum and instructional technology (master's and doctorate). The specialization in elementary education (advanced study for licensed teachers) is designed to prepare candidates for teaching and curricular leadership positions in elementary settings. The specialization in historical, philosophical, and comparative studies in education is designed to provide graduate students experiences in analyzing educational problems and issues, critiquing policies that affect education in Society, and making connections between educational practice and learning. The special education specialization is designed to prepare candidates as practitioners and researchers in the field of mild/moderate disabilities or behavioral disorders/learning disabilities. The specialization in curriculum and instructional technology is designed to prepare candidates as researchers and practitioners in the fields of curriculum and instructional technology.

Students may also opt not to select an area of specialization. These students are asked to select a focus area for their graduate study. Focus areas include educational psychology, world language education, literacy education, mathematics education, multicultural education and international curriculum studies, and science education. See the Curriculum and Instruction web site at http://www.ci.hs.iastate.edu/for more information on these focus areas.

A minor is available in curriculum and instructional technology at both the master's and doctoral level. Information about the minors can be found on the web at http://www.ci.hs.iastate.edu/prspstud/grad/Grad2/Degrees.php.

A Master of Arts in Teaching degree program leading to teacher licensure (science only) is available to students who currently have a bachelor's degree in science (or a closely related field). A teacher licensure program in mathematics education is also available to graduate students (Department of Curriculum and Instruction). Teacher licensure at the graduate level is also offered in agricultural education (College of Agriculture and Life Sciences) and family and consumer sciences (College of Human Sciences). The Department of Curriculum and Instruction provides the professional education coursework. Students in a graduate teacher licensure program must complete Sp Ed 501, C I 505, 506, 529, and HPC 504. Mathematics licensure students also take C I 526.

Graduate level teaching endorsements are offered through the Department of Curriculum and Instruction. Graduate students who seek a teaching endorsement in special education, but do not wish to pursue a master's degree can incorporate those courses from a professional certificate program. Endorsement programs include Instructional Strategist I: Mild/Moderate Disabilities (K-8 or 5-12), or Instructional Strategist II: Behavior Disorders/Learning Disabilities, and special education consultant. A graduate level reading endorsement is also available.

Prerequisite to major graduate work in education is preparation substantially equivalent to the completion of one of the undergraduate curricula in education offered at Iowa State University, or graduate preparation in a discipline to be used as a teaching field in a community college or university, and adequate proof that the student ranks above average in scholastic ability and promise of professional competence.

The world language requirement, if any, for the Ph.D. degree will be determined by the student's program of study committee. If no world language is required, the total program must consist of a minimum of 78 semester credits, at least 12 of which must be earned outside the education major, and at least 16 of which must be earned outside the area of specialization. Statistics and research methods may not be included in the 16 credits. Should world language be included, the program of study committee may adjust the minimum program requirement downward, but in no instance may the program of study be less than 72 semester credits. Students whose native language is not English may substitute competence

in English. All applicants for the Ph.D. must submit Graduate Record Examination (GRE) scores.

Other graduate programs related to education (including General Graduate Studies) may be planned for students on the basis of previous education and experiences as well as future plans and needs. Students should refer to Agricultural Education and Studies, Family and Consumer Sciences Education, Kinesiology, Educational Leadership and Policy Studies, and General Graduate Studies or to graduate level course offerings within other departments.

Curriculum and Instruction (C I)

Courses primarily for undergraduate students

C I 115. First Year Orientation. Cr. R. F. Overview of elementary education curricular opportunities, transitions to college and community life, and university procedures. Required of all first-semester freshmen majoring in elementary education.

C I 201. Digital Learning in the PK-6 Classroom. (2-2) Cr. 3. F.S.Alt. SS., offered 2011. Overview of ways to use instructional technologies to support instruction in PK-6 settings. Focus on pedagogical approaches that integrate technologies to support learning in the content areas. Laboratory experiences include development of activities to use tool software, interactive multimedia, webpage development, digital video and other technologies to facilitate learning and teaching.

C I 202. Digital Learning in the 7-12 Classroom. (2-2) Cr. 3. F.S.Alt. SS., offered 2010. Overview of ways to use instructional technologies to support instruction in 7-12 settings. Focus on pedagogical approaches that integrate technologies to support learning in the content areas. Laboratory experiences include development of activities to use tool software, interactive multimedia, webpage development, digital video and other technologies to facilitate learning and teaching.

C I 204. Social Foundations of American Education. (3-0) Cr. 3. F.S.SS. Goals of schooling, including the roles of teachers today; historical development of schools; educational reforms and alternative forms; and current Philosophical issues. Human relations aspects of teaching and discussions about teaching as a career.

C I 208. Early Childhood Education Orientation. (Cross-listed with HD FS). Cr. 1. F.S. Overview of early childhood education (birth-grade 3) teacher licensure requirements. Program planning and university procedures. Required of all students majoring in early childhood education. Satisfactory-fail only.

C I 215. Sophomore Orientation. Cr. R. F.S. Review of elementary education requirements. Program planning. Required of all sophomores majoring in elementary education.

C I 219. Orientation to Teacher Education for Mathematics, Science and History/Social Sciences Majors. Cr. R. F.S. *Prereq: Students seeking teacher licensure in mathematics, science or history/social sciences in grades 7-12.* Overview of Mathematics, science, and history/social sciences secondary education (grades 7-12), teacher licensure requirements in Iowa and other states. Program and career planning.

C I 245. Strategies in Teaching. (2-0) Cr. 2. F.S. *Prereq: 204; HD FS 220 or 221 or 226 (or concurrent enrollment in one of these courses); concurrent enrollment in C I 268; eligibility for admission to teacher education program.* Introduction to elementary education teaching strategies, classroom management, and curriculum organization. Open to students in the elementary education curriculum or the early childhood education curriculum.

C I 268. Strategies Practicum. (0-2) Cr. 1. F.S. *Prereq: 204.* Clinical experience, to be taken concurrently with 245. Satisfactory-fail only.

C I 280. Pre-Student Teaching Experience. (1-8) Cr. arr. Repeatable. F.S.SS. *Prereq: 280A may be taken alone. For enrollment in 280B-I, 280A must be either a prerequisite or taken concurrently.* Field experience in area educational settings. 2 1/2-hour blocks of time needed for field experience. C I 280 may be taken more than once for credit toward graduation.
A. Teacher Aide. Cr. 1 or 2
B. Educational Computing. Cr. 1 or 2 (2 credits by permission only)
C. Native American Tutoring. Cr. 1
D. Museum Education. Cr. 1
E. Multicultural Youth Experience. Cr. 1 or 2
F. International Student. Cr. 1 or 2 (Permission of instructor required)
I. Mild/Moderate Disabilities. Cr. 1 (concurrent with Sp Ed 330).
L. Early Field Experience. Cr. .5
M. Secondary Science. Cr. 1 or 2
N. CoHort Field Experience. Cr. 1 (permission of department required)
O. Art Education Field Experience. Cr. 1 (Permission of department required)

C I 290. Independent Study. Cr. arr. *Prereq: 6 credits in education, permission of department chair.*

C I 302. Principles and Practices of Digital Learning. (2-2) Cr. 3. F.S. *Prereq: 201 or 202, 245, 268.* Advanced integration of educational technologies into K-12 teaching and learning; designing classroom applications for tool software; implementing technology-based lessons with K-12 students; issues and trends in classroom technology use.

C I 315. Transfer Orientation. Cr. 1. F.S. Overview of elementary education requirements, curricular opportunities, and university procedures. Program planning. Required of all transfer students majoring in elementary education. Satisfactory-fail only.

C I 332. Educational Psychology of Young Learners. (3-0) Cr. 3. F.S. *Prereq: Psych 230 or HD FS 102, open only to majors in Early Childhood Education or Elementary Education.* Psychological theory relevant to classroom learning, cognition, motivation, classroom management and assessment for children from birth to grade 6. Implications of theory for teaching children and for assessing learning in educational settings with young and grade school aged children.

C I 333. Educational Psychology. (Cross-listed with Psych). (3-0) Cr. 3. F.S. *Prereq: Psych 230 or HD FS 102, application to the teacher education program or major in psychology.* Classroom learning with emphasis on theories of learning and cognition, and instructional techniques. Major emphasis on measurement theory and the classroom assessment of learning outcomes.

C I 347. Nature of Science. (Dual-listed with 547). (3-0) Cr. 3. *Prereq: 280M; concurrent enrollment in 418 or instructor permission.* The intersection of issues in the history, philosophy Sociology, and psychology of science and their application to and impact on science teaching and learning, science teacher education, and science education research.

C I 377. The Teaching of Reading and Language Arts in the Primary Grades (K-3). (4-0) Cr. 4. F.S.SS. *Prereq: admission to teacher education program, C I 245, Sp Ed 250, HD FS 240, 226 (El Ed majors) or 221 (ECE majors); concurrent enrollment in 448, 468A, 468C (El Ed majors) or 438, 468F, 468G, Sp Ed 368, HD FS 343 (ECE majors).* Theories, teaching strategies, and instructional materials pertinent to teaching reading, writing, listening, and speaking to children in kindergarten through third grade.

C I 378. The Teaching of Reading and Language Arts in the Intermediate Grades (4-6). (4-0) Cr. 4. F.S.SS. *Prereq: 377; concurrent enrollment in 449, 468B, 468D.* Theories and processes of literacy. Application through reading and writing across the curriculum, integration of language arts, literature-based instruction, and metacognitive strategies.

C I 395. Teaching Reading in Middle and Secondary Schools. (Dual-listed with 595). (3-0) Cr. 3. F. *Prereq: 204 and junior standing.* Analysis and application of strategies to enhance students' literacy development in middle and secondary school settings.

C I 401. Middle School Student Growth and Development. (3-0) Cr. 3. *Prereq: Psych 230.* Study of the physical, emotional, intellectual, and social development of 10 to 15 year old middle school students, with emphasis on implications for schools and teachers. Includes strategies for classroom management and working with parents. Issues of risk, resiliency, substance abuse, suicide, and sexuality will also be examined.

C I 402. Middle School Curriculum Design. (3-0) Cr. 3. *Prereq: 401, admission to teacher education.* Emphasis on the middle school components of interdisciplinary teaming, curriculum frameworks, teacher-based guidance and assessment.

C I 403. Design and Development of Digital Learning Environments. (2-2) Cr. 3. F.S. *Prereq: 302.* Application of principles of instructional design and cognitive theories to development of digital learning environments. Development of expertise with contemporary technologies and approaches to learning. Analysis and discussion of research related to effective use of multimedia in education.

C I 406. Multicultural Foundations of School and Society: Introduction. (3-0) Cr. 3. F.S.SS. *Prereq: 201 or 202, 332 or 333, junior classification, admission to teacher education program.* Awareness and nature of cultural pluralism; need for multicultural education; multicultural concepts and theories; cultural groups - their perceptions, needs, and contributions; problems and issues regarding ethnocentrism, prejudice, and discrimination based on race, ethnicity, socioeconomic class, sex/gender, sexual identity, and language in the school environment; curriculum infusion and transformation, multicultural interaction, design and execution of teaching strategies.

C I 407. Principles and Practices of Distance Learning. (Dual-listed with 507). (2-2) Cr. 3. F.SS. *Prereq: 201 or 202; convenient access to the Web.* Review of flexible and distance learning (FDL) cases in a variety of contexts and pedagogic styles, research into relevant topics. Identification of underlying principles and frameworks for best practice in this field. Offered in FDL modes, utilizing telecommunications and the Internet.

C I 416. Supervised Student Teaching - Elementary. Cr. arr. F.S. *Prereq: GPA 2.5; full admission to teacher education; senior classification; 378, 443, 448, 449; reservation required.* Supervised teaching experience in the elementary grades.
A. Primary grades (K-3).
B. Intermediate grades (4-6).
C. World Language.
D. International Student Teaching - Primary grades.
E. International Student Teaching - Intermediate grades.

C I 417. Student Teaching. (Dual-listed with 517). (Cross-listed with Engl, WLC, Music). Cr. arr. F.S. *Prereq: GPA 2.5; Admission to teacher education, approval of coordinator during semester before student teaching.* Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.
A. Social Studies-Middle School
B. Physical Sciences
C. Mathematics
D. Biological Sciences
E. English and Literature (Same as Engl 417E)
G. World Language (Same as WLC 417G)
J. Earth Sciences
K. Music-Secondary (Same as Music 417K)
L. Music-Elementary (Same as Music 417L)
M. Science-Basic
N. International Student Teaching
P. Social Studies-High School

C I 418. Secondary Science Methods I: A Research-Based Framework for Teaching Science. (Dual-listed with 518). (2-0) Cr. 2. F. *Prereq: 280M; concurrent enrollment in 347 and 468J.* Development of a research-based framework for teaching science that includes student goals, congruent student actions, the character and role of science inquiry, teaching

behaviors and strategies, contemporary learning theories, and self evaluation.

C I 419. Secondary Science Methods II. (Dual-listed with 519). (2-0) Cr. 2. S. *Prereq: 418 or 518, undergraduate students must register concurrently for 468K.* Advancing a research-based framework for teaching science in a variety of school settings, emphasizing the teacher's role, the development and revision of science curriculum, exceptional learners, content area reading strategies, management strategies, technology and student assessment.

C I 420. Bilingualism, Bilingual Education, and U.S. Mexican Youth. (Dual-listed with 520). (3-0) Cr. 3. F. *Prereq: 406.* Introduction to research on bilingualism and examination of the social, historical, and political contexts of bilingual education in U.S. schools. Attention to policy environment, school program structure, mode of classroom instruction, family and community context, and attainment of bilingualism and biculturalism for U.S. Mexican youth.

C I 426. Principles of Secondary Education. (Dual-listed with 526). (3-0) Cr. 3. F.S.SS. *Prereq: 202, senior classification, admission to teacher education program.* The curriculum, human relations, student evaluation, support services, classroom management, organization of schools, legal aspects of schools, professionalism, and career planning.

C I 433. Teaching Social Studies in the Primary Grades. (2-0) Cr. 2. F.S. *Prereq: 377, HD FS 221; concurrent enrollment in 438, 439, Sp Ed 355, 455.* Study, development, and application of current methods for providing appropriate social studies learning experiences for primary grade children. Instructional strategies, curriculum content, and formal and informal assessment strategies for diverse learners.

C I 438. Teaching Mathematics in the Primary Grades. (2-0) Cr. 2. F.S. *Prereq: HD FS 221; Math 195; concurrent enrollment in 377, 433, 439, 468A, 468G, Sp Ed 355, 455.* Study, development, and application of current methods for providing appropriate Mathematics learning experiences for primary grade children. Formal and informal assessment strategies and instructional methods for diverse learners.

C I 439. Teaching Science in the Primary Grades. (2-0) Cr. 2. F.S. *Prereq: 377, HD FS 221; concurrent enrollment in 433, 438, 468I, Sp Ed 355, 455.* Study, development, and application of current methods for providing appropriate science learning experiences and processes for primary grade children. Formal and informal assessment strategies and instructional methods for diverse learners.

C I 443. The Teaching of social Studies. (3-0) Cr. 3. F.S.SS. *Prereq: 377.* Study, development, and application of current methods, curriculum materials, and assessment strategies for providing appropriate social studies learning experiences for primary and intermediate grade children.

C I 448. Teaching Children Mathematics. (3-0) Cr. 3. F.S. *Prereq: Math 195, 196; concurrent enrollment in 377, 468A, 468C.* Study, development, and application of current methods for providing appropriate Mathematical learning experiences for primary and intermediate children. Includes critical examination of factors related to the teaching and learning of Mathematics.

C I 449. The Teaching of Science. (3-0) Cr. 3. F.S. *Prereq: 377, concurrent enrollment in 378, 468B, 468D, junior classification.* Procedures for teaching science to children. Emphasis on developmental implications, teaching processes and methods, current programs, and assessment of learning in science.

C I 450. Ethnicity and Learning. (Dual-listed with 550). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 332 or 333, 406.* Examination of cultural relevance in education. Development and application of strategies and techniques for implementing multicultural goals and multiethnic perspectives in PreK-12 school classroom settings.

C I 452. Corrective Reading. (Dual-listed with 552). (3-0) Cr. 3. F.S.SS. *Prereq: 378 or equivalent; undergraduate students must register concurrently for Sp Ed 365, 436; graduate students must have a teaching license.* Identification, analysis and correction of reading problems in five areas: print knowledge, integration of print knowledge, oral reading fluency, vocabulary, and comprehension

C I 456. Integrating Technology into the Reading and Language Arts Curriculum. (Dual-listed with 556). (3-0) Cr. 3. F.SS. *Prereq: 201 or 202, 377.* Methods and strategies used to integrate technology into the reading and language arts curriculum. Use and evaluation of reading and language arts software for elementary classrooms.

C I 468. Supervised Practicum in Teaching. Cr. arr. F.S.SS. *Prereq: Admission to teacher education program.* Observation, application of current methods, and instructional experiences with children in a supervised elementary classroom while engaged in other elementary methods courses.
A. Primary Grades, Reading & Language Arts. Cr. 1
B. Intermediate Grades, Reading & Language Arts. Cr. 1
C. Mathematics. Cr. 1
D. Science. Cr. 1
E. World Language. Cr. 1
F. Primary Grades, Literacy, Inclusive. Cr. 1
G. Primary Grades, Mathematics, Inclusive. Cr. 1
I. Primary Grades, Science, Inclusive. Cr. 1
J. Secondary Science I. Cr. 2
K. Secondary Science II. Cr. 2.
R. Reading Endorsement (Permission of department required; concurrent enrollment in 378) Cr. 1.

C I 480. Field Experience for Secondary Teaching Preparation. (Cross-listed with MUSIC). Cr. arr. Repeatable. F.S. *Prereq: Permission of area coordinator required prior to enrollment.* Observation and participation in a variety of school settings after admission to the teacher preparation program. (S/F grading may be used in some offerings of some sections.)
A. History/Social Sciences
C. Mathematics
K. Music (Same as Music 480K)

C I 486. Methods in Elementary School World Language Instruction. (Cross-listed with WLC, Ling). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language.* Current educational methods and their application in the elementary school classroom. Special emphasis on planning, evaluation, and teaching strategies. Nonmajor graduate credit.

C I 487. Methods in Secondary School World Language Instruction. (Cross-listed with WLC, Ling). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language, admission to the teacher education program.* Theories and principles of contemporary world language learning and teaching. Special emphasis on designing instruction and assessments for active learning.

C I 490. Independent Study. Cr. arr. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester.*
A. Music Education. (Same as Music 490A.)
B. Vocational and Educational Guidance
C. Curriculum Construction
D. Principles of Education
E. Methods of Teaching
F. Educational Psychology
G. Instructional Technology
H. Honors
I. Foundations of Educational Statistics
J. Multicultural Education
K. History/Social Sciences
L. Literacy Education
M. Mathematics Education
N. World Language
O. Foundations of Education

C I 494. Practice and Theory of Teaching Literature in the Secondary Schools. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Engl 310, 397, 9 other credits in English beyond 250, Psych 333, admission to teacher education program.* Portfolio review. Current theories and practices in the teaching of literature to secondary school students. Integrating literary study and writing. Preparation and selection of materials. Classroom presentation. Unit planning. (Taken concurrently with C I 280, Cr. 2, and Sp Ed 450)

C I 495B. Teaching Speech. (Cross-listed with Sp Cm). (3-0) Cr. 3. F. *Prereq: Sp Cm 313; 9 credits in speech communication; minimum grade point average of 2.5 in speech communication courses.* Problems, methods, and materials related to teaching speech, theatre, and media in secondary schools.

C I 497. Teaching Secondary School Mathematics. (Cross-listed with Math). (3-0) Cr. 3. F. *Prereq: 15 credits in college Mathematics; if in a teacher licensure program, concurrent enrollment in C I 426 or 526.* Theory and methods for teaching Mathematics in grades 7-12. Includes critical examination of instructional strategies, curriculum materials, learning tools, assessment methods, National Standards in Mathematics Education, and equity issues.

C I 498. Methods of Teaching History/Social Sciences. (3-0) Cr. 3. F.S. *Prereq: Concurrent enrollment in 480A; Admission to teacher education and 30 credits in subject-matter field.* Theories and processes of teaching and learning secondary history/social sciences. Emphasis on development and enactment of current methods, assessments, and curriculum materials for providing appropriate learning experiences.

Courses primarily for graduate students, open to qualified undergraduate students

C I 501. Foundations of Digital Learning. (3-0) Cr. 3. F.SS. *Prereq: Graduate classification.* Educational Philosophies and theories of instructional technology. Application of research to the production and use of instructional technology for learning and teaching. Equipment operation.

C I 503. Designing Effective Learning Environments. (3-0) Cr. 3. F. *Prereq: 501.* Introduction to theories and models of instructional design. Design decision-making based on the analysis of performance problems and instructional inputs. Practical experience with the design and development of instructional strategies and evaluation principles.

C I 504. Evaluating Digital Learning Environments. (Cross-listed with HCI). (3-0) Cr. 3. S. *Prereq: 501.* Principles and procedures for analysis, review, and assessment of instructional technology interventions in education and corporate settings. Evaluation methods for planning, organizing, and conducting evaluative studies are applied.

C I 505. Using Technology in Learning and Teaching. (3-0) Cr. 3. F.S.SS. *Prereq: Graduate classification.* Teaching and learning using computers. Selection and evaluation of software and hardware for teaching and learning. Research on computers. Tool software. Telecommunications. Trends in computer-based instruction.

C I 506. Multicultural Foundations of School and Society: Advanced. (3-0) Cr. 3. F.S.SS. *Prereq: 6 graduate credits in education.* Theories, legal bases, and principles of multicultural education. Pluralism and contributing cultures in the United States; presence and contributions of cultural group diversity with implications for educational programs, curriculum development, classroom instruction, materials utilization and development; problems and issues regarding ethnocentrism, prejudice, and discrimination based on race, ethnicity, socioeconomic class, sex/gender, sexual identity, and language in the school environment; curriculum infusion and transformation, multicultural interaction, design and execution of teaching strategies and techniques; inquiry and research on multicultural education issues.

C I 507. Principles and Practices of Distance Learning. (Dual-listed with 407). (2-2) Cr. 3. F.SS. *Prereq: 501, convenient access to the Web.* Review of flexible and distance learning (FDL) cases in a variety of contexts and pedagogic styles, research into relevant topics. Identification of underlying principles and frameworks for best practice in this field. Offered in FDL modes, utilizing telecommunications and the Internet.

C I 508. Algebra in the K-12 Classrooms. (3-0) Cr. 3. F. *Prereq: 448, 497, or graduate Status.* Focus on Algebraic concept explorations and associated procedures. Use of research-based strategies and appropriate technologies to apply fundamental ideas of patterning, coordinate graphing, and relationships among variables into K-12 classrooms. Additional topics facilitate critical examination of K-12 curriculum, pedagogy, and assessment.

C I 509. Geometry in the K-12 Classrooms. (3-0) Cr. 3. S. *Prereq: 448, 497, or graduate Status.* Euclidean and non-Euclidean geometry explorations with a focus on pedagogical issues in the K-12 classroom. Use of research-based strategies and appropriate technologies to teach geometry in K-12 classrooms. Additional topics from discrete Mathematics, history and Philosophy of geometry and fractal geometries.

C I 511. Technology Diffusion, Leadership and Change. (3-0) Cr. 3. S. *Prereq: Admission to graduate study, 501 or equivalent and 505 or equivalent.* Introduction to practices and principles of technology diffusion, leadership and strategic change in education. Frameworks and strategies for professional development and organizational change; current issues such as the digital divide.

C I 512. Research Trends in Digital Learning. (3-0) Cr. 3. F. *Prereq: Admission to graduate study and at least two courses in research and foundations of instructional technology.* Critical review of current research trends to uncover underlying educational technology. Engagement with current projects' techniques and analyses for qualitative and quantitative approaches, including the application of technology for the dissemination of scholarship. Designed as a capstone course to consolidate graduate students' knowledge of current research in curriculum and instructional technology for students in M.S. and Ph.D. programs.

C I 513. Mathematical Problem Solving in K-12 Classrooms. (3-0) Cr. 3. F. *Prereq: 6 credits of Mathematics, 448 or 497 or 597 or permission of instructor.* Strategies for improving problem solving skills across all strands of Mathematics (e.g., geometry, algebra, number theory) will be emphasized. Issues surrounding the appropriate role of problem solving in K-12 Mathematics classrooms will also be discussed, including distinctions among teaching "about," "for," and "through" problem solving.

C I 514. Introduction to the Purposes and Complexities of Science Teaching. (1-2) Cr. 2. SS. *Prereq: Admission to M.A.T. program.* Introduction to critical issues facing science education, science education goals reflecting contemporary purposes of schooling, and how people learn science.

C I 515. Action Research in Education. (3-0) Cr. 3. S. *Prereq: Admission to graduate study, one course in research methods, educational inquiry, statistics, educational psychology, or instructional design.* Philosophy and methods of conducting and communicating action research. Current issues in action research. Use of action research to improve education. Designed primarily for individuals involved in teaching or development of educational materials or student in M.Ed. programs.

C I 516. Antiracist Curriculum Development and Implementation. (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 9 credits in education.* Introduction to historical, sociological, philosophical and pedagogical foundations of antiracist/multicultural education. Examination of causes of racism, other forms of discrimination, and intergroup conflict from different theoretical perspectives and experiential exercises.

C I 517. Student Teaching. (Dual-listed with 417). Cr. arr. F.S. *Prereq: Full admission to teacher education, approval of coordinator during semester before student teaching.* Supervised student teaching in the liberal arts at the secondary level.
B. Physical Sciences
C. Mathematics
D. Biological Sciences
J. Earth Sciences
M. Science - Basic

C I 518. Science Methods I: A Research-Based Framework for Teaching Science. (Dual-listed with 418). (2-0) Cr. 2. F. *Prereq: 514; concurrent enrollment in 547 and 591D.* Development of a research-based framework for teaching science that includes student goals, congruent student actions, the character and role of science inquiry, teaching behaviors and strategies, contemporary learning theories, and self-evaluation.

C I 519. Secondary Science Methods II. (Dual-listed with 419). (2-0) Cr. 2. S. *Prereq: 418 or 518, concurrent enrollment in 591D.* Advancing a research-based framework for teaching science in a variety of school settings; emphasizing the teacher's role, the development and revision of science curriculum, exceptional learners, content area reading strategies, management strategies, technology, and student assessment.

C I 520. Bilingualism, Bilingual Education, and U.S. Mexican Youth. (Dual-listed with 420). (3-0) Cr. 3. F. *Prereq: 506.* Introduction to research on bilingualism and examination of the social, historical, and political contexts of bilingual education in U.S. schools. Attention to policy environment, school program structure, mode of classroom instruction, family and community context, and attainment of bilingualism and biculturalism for U.S. Mexican youth.

C I 523. Teaching Mathematics to Struggling Elementary Learners. (3-0) Cr. 3. SS. *Prereq: 438 or 448.* Instructional methods and assessment techniques for elementary students struggling to learn Mathematics. Emphasis on current research and practices for at-risk students and students with disabilities.

C I 524. Design and Development of Media. (2-0) Cr. 2. S. *Prereq: 501; graduate classification.* Principles of the design and production of instructional media; visual development and the creation of various traditional media and emerging technologies. Laboratory experiences in the production of several instructional media.

C I 526. Principles of Secondary Education. (Dual-listed with 426). (3-0) Cr. 3. F.S.SS. *Prereq: 6 credits in education.* The curriculum, human relations, student evaluation, support services, classroom management, organization of schools, legal aspects of schools, professionalism and career planning.

C I 529. Educational Psychology and the Secondary Classroom. (3-0) Cr. 3. SS. *Prereq: Bachelor's degree; admission into a graduate level teacher licensure program.* Analysis of psychological research theory related to learning, cognition, motivation, individual differences, and teaching techniques. Student and classroom assessment to facilitate positive learning outcomes. Adaption and differentiation of instruction to meet individual learners' needs. This course can only be used for teacher licensure programs. It is not acceptable for use in meeting the non-licensure M.Ed., M.S. or Ph.D. requirements.

C I 533. Educational Psychology of Learning, Cognition, and Memory. (Cross-listed with Psych). (3-0) Cr. 3. F. *Prereq: 333 or teacher licensure.* Learning, cognition, and memory in educational/training settings.

C I 541. How People Learn: Implications for Teaching Science. (3-0) Cr. 3. *Prereq: Bachelor's degree.* Current learning theories within science education and their application to science classrooms. Examination of models which assist the implementation of these theories of learning.

C I 546. Advanced Pedagogy in Science Education. (3-0) Cr. 3. S.SS. *Prereq: Bachelor's degree.* Critical examination of pedagogy, emphasizing teacher behaviors and strategies, methods of self-assessment, action research, and current issues and trends in science education.

C I 547. Nature of Science. (Dual-listed with 347). (3-0) Cr. 3. F. *Prereq: Concurrent enrollment in 518 or permission of instructor.* The intersection of issues in the history, philosophy, sociology, and psychology of science and their application to and impact on science teaching and learning, science teacher education, and science education research.

C I 548. Restructuring Science Activities. (3-0) Cr. 3. S.SS. *Prereq: Admission to teacher education or teaching license.* Modification of laboratory activities and other everyday science activities so they are more congruent with how students learn, the nature of science, and the National Science Education Standards.

C I 550. Ethnicity and Learning. (Dual-listed with 450). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification and completion of 506 or permission of instructor.* Examination of cultural relevance in education. Development and application of strategies and techniques for implementing multicultural goals and multiethnic perspectives in PreK-12 school classroom settings.

C I 551. Foundations of Reading and Language Arts. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Teaching license.* Analyzing, discussing, and researching the theory and practice of current literacy issues.

C I 552. Corrective Reading. (Dual-listed with 452). (3-0) Cr. 3. F.S.SS. *Prereq: 378 or equivalent; undergraduate students must register concurrently for Sp Ed 365, 436; graduate students must have a teaching license.* Identification, analysis, and correction of reading problems in five areas: print knowledge, integration of print knowledge, oral reading fluency, vocabulary, and comprehension.

C I 553. Reading for Adolescents with Mild/Moderate Disabilities. (3-0) Cr. 3. SS. *Prereq: Teaching license.* Instructional strategies for enhancing the comprehension and retention of students with mild/moderate disabilities, in conjunction with content-area reading material.

C I 554. Reading and Responding to Children's Literature. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Senior Status or teaching license.* Research and discussion of issues surrounding the classroom use of literature for children and young adults including censorship, diversity, selection, and the influences of technology.

C I 556. Integrating Technology into the Reading and Language Arts Curriculum. (Dual-listed with 456). (3-0) Cr. 3. F.SS. *Prereq: Teaching license.* Methods and strategies used to integrate technology into the reading and language arts curriculum. Use and evaluation of reading and language arts software for elementary classrooms.

C I 567. Teaching Mathematics to Struggling Secondary Learners. (Cross-listed with Sp Ed). (3-0) Cr. 3. *Prereq: Secondary teaching experience.* Instructional methods and assessment techniques for secondary students struggling to learn Mathematics. Particular emphasis on current research, practices, and trends in mathematics interventions for at-risk students and students with disabilities.

C I 570. Toying with Technology for Practicing Teachers. (Cross-listed with M S E). (2-0) Cr. 2. SS. *Prereq: C I 201 or 202, non-engineering major.* A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Other technological advances with K-12 applications will be explored. K-12 teachers will leave the course with complete lesson plans for use in their classrooms.

C I 578. Pedagogy, Equality of Opportunity, and the Education of Blacks in the United States. (3-0) Cr. 3. *Prereq: Graduate or senior level Status or permission of instructor.* This course takes a nonlinear, reflective view of the historical, social, economic, political, and legal contexts of the education of African Americans in the U.S. Educational theories and Philosophies, Critical Race Theory and Black Feminist Thought form the framework for investigating broad-based, multiple issues of education for African Americans in the U.S. as they are situated in the prevailing dominant views.

C I 588. Supervised Tutoring in Reading. (2-2) Cr. 3. F.S.SS. *Prereq: Graduate Status, teaching license and concurrent enrollment in or completion of one course*

in corrective reading; diagnosis and correction of reading problems. Using formal and informal diagnostic procedures to plan and implement individualized reading instruction. Field experience in tutoring and a related research project.

C I 590. Special Topics. Cr. arr. F.S. *Prereq: 9 graduate credits in education.*
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

C I 591. Supervised Field Experience. (0-2) Cr. arr. F.S.SS. *Prereq: 15 graduate credits in special area.* Supervised on-the-job field experience in special area.
B. World Language Education
C. Elementary Education
D. Secondary Education
F. Multicultural Education

C I 593. Workshops. Cr. arr. F.S. *Prereq: 9 graduate credits in education.*
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

C I 594. Contemporary Curriculum Theory and Principles. (3-0) Cr. 3. F. *Prereq: Graduate standing.* Theoretical and historical perspectives of contemporary curriculum; social, cultural, and epistemological aspects of curriculum theory; political, critical-race, feminist, economic, and postmodernist approaches to understanding curriculum and schooling in the U.S.

C I 595. Teaching Reading in Middle and Secondary Schools. (Dual-listed with 395). (3-0) Cr. 3. F. *Prereq: Graduate Status and teaching license.* Analysis and application of strategies to enhance students' literacy development in middle and secondary school settings. Research paper related to a course topic.

C I 596. Curriculum Problems and Inquiry. (3-0) Cr. 3. S. *Prereq: Graduate standing.* Analysis of contemporary problems of schooling and curriculum; use of qualitative inquiry to study diverse school policies and social problems influencing public education. Emphasis on strategies for teaching for social justice.

C I 597. Teaching Secondary School Mathematics. (3-0) Cr. 3. F. *Prereq: 15 credits in college Mathematics; if in a teacher licensure program, concurrent enrollment in C I 426 or 526.* Theory and methods for teaching Mathematics in grades 7-12. Includes critical examination of instructional strategies, curriculum materials, learning tools, assessment methods, National Standards in Mathematics Education, and equity issues.

C I 599. Creative Component. Cr. arr. F.S.SS. *Prereq: 9 graduate credits in education.*
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

Courses for graduate students

C I 603. Advanced Learning Environments Design. (Cross-listed with HCI). (3-0) Cr. 3. S. *Prereq: 503.* Exploration of advanced aspects of the instructional design process. Application of analysis, design, development and production, evaluation, implementation, and project management principles. Focus on the production and use of instructional technology with an emphasis on the instructional design consulting process. Theory and research in instructional technology provides the foundation for design decisions.

C I 610. Digital Learning in Teacher Education. (2-0) Cr. 2. F. *Prereq: 505.* Research on using technology in teacher education programs. Application examples studied. Field component involving relating material from class to a teacher education situation.

C I 611. Philosophical Foundations of Digital Learning. (3-0) Cr. 3. *Prereq: 12 graduate credits in curriculum and instruction.* Exploration of Philosophies of science that serve as foundations for research and practice in instructional technology, including positivism, post-positivism, interpretivism/constructivism, and critical theory. The roles of language, nature of truth and reality, and acceptable ways of knowing are explored in terms of their implications for instructional technology design, delivery, research, and scholarship.

C I 612. Socio-psychological Foundations of Digital Learning. (3-0) Cr. 3. *Prereq: 12 graduate credits in curriculum and instruction.* Exploration of theories of learning and associated instructional models that are the foundation for research and practice in education and educational technology, including behaviorism, information processing theory, and cognitive science. Emphasis on cognitive and social constructivist paradigms and the creation and use of constructivist learning environments supported by technology.

C I 615. Seminar. (0-2) Cr. 1. F.S. Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

C I 671. Discourse in Classrooms. (Cross-listed with Ling). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: graduate classification.* Explores both foundational and current literature on discourse in K-12 classrooms; focuses on both discourse as a classroom phenomenon and discourse as an analytic tool for doing research in classrooms; and provides a close look at enacted and hidden curricula through an examination of interactions and communication patterns.

C I 690. Advanced Special Topics. Cr. arr. Repeatable. *Prereq: 9 graduate credits in education.*
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

C I 699. Research. Cr. arr. Repeatable. *Prereq: 9 graduate credits in education.*
A. Curriculum
B. Instructional Technology
C. Science Education
D. Secondary Education
F. Multicultural Education
G. Mathematics Education
I. Elementary Education
J. World Language Education
K. Educational Psychology
L. Social Studies Education
M. Literacy Education

Historical, Philosophical, and Comparative Studies in Education (H P C)

David Owen, Program Coordinator

This program provides graduate experiences in historical, philosophical, and comparative studies in education. Students develop facility in analyzing educational problems and issues, critiquing policies that affect education in Society, and making connections between educational practice and learning.

Work is offered toward the master of science with thesis or nonthesis option, and the master of education. These degree programs and classes are of benefit to classroom teachers, educational theorists, administrators, university personnel, youth workers, religious educators, and others who seek to understand better the numerous bases of contemporary systems of education. Study in this field also complements work in other areas of specialization in education.

Courses primarily for graduate students, open to qualified undergraduate students

H P C 504. Studies in the Foundations of American Education. (3-0) Cr. 3. F. *Prereq: Admission to graduate licensure program in teacher education or permission of instructor.* An exploration of the social, historical, and Philosophical context of American education today. Emphasis is given to reflection on the varying perspectives on the goals of schooling, roles of teachers, curricular and pedagogical issues, and educational policy and reform proposals. Note: This course does not meet the requirements of the M.Ed., M.S., or Ph.D. core.

H P C 581. Philosophy of Education. (3-0) Cr. 3. SS. *Prereq: Graduate classification.* The bases of American educational theory and practice. Philosophical analysis of the viewpoints on education of selected individuals and groups.

H P C 584. Classics of Educational Philosophy. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Intensive study of influential statements of educational purpose, organization, curriculum, practice, and problems in the development of Western education.

H P C 585. Comparative Education: Traditions. (3-0) Cr. 3. *Prereq: Graduate classification.* Analysis of the cultural traditions of education outside the United States. Emphasis is given to an examination of the principles upon which selected national educational systems have been built. Special attention given to noneuropean traditions.

H P C 588. History of American Education. (3-0) Cr. 3. *Prereq: Graduate classification.* Historical analysis of selected educational policies, such as equal educational opportunity, governance, discipline, and teacher education. Biographies, school records, and government reports are examined. Antecedents to current issues are stressed.

H P C 590. Special Topics. Cr. arr. F.S. *Prereq: 9 graduate credits in education.*
A. History of Education
B. Philosophy of Education
C. Comparative Education

H P C 591. Supervised Field Experience. Cr. arr. *Prereq: 6 graduate credits in special area.* Supervised on-the-job field experience in special areas.

H P C 599. Creative Component. Cr. arr. F.S.

H P C 615. Seminar. (1-3) Cr. arr. Repeatable.
B. Philosophy of Education
C. Comparative Education

H P C 690. Advanced Special Topics. Cr. arr. Repeatable. F.S. Advanced special topics

H P C 699. Research. Cr. arr. Repeatable.

Special Education (Sp Ed)

Courses primarily for undergraduate students

Sp Ed 250. Education of the Exceptional Learner in a Diverse Society. (3-0) Cr. 3. F.S. *Prereq: C I 204.* An overview of students with diverse learning needs. Emphasis on early identification, educational services and strategies in inclusive settings, and preparation for community living in a heterogeneous Society.

Sp Ed 330. Introduction to Instruction for Students with Mild/Moderate Disabilities. (3-0) Cr. 3. F. *Prereq: 250, concurrent enrollment in C I 280I, 377.* Educational services and programming for students with mild/moderate disabilities examined from an historical perspective. Current trends, issues, impact of federal and state laws, and identification procedures. Characteristics of students with mild/moderate disabilities.

Sp Ed 339. Collaborative Partnerships in Special Education. (3-0) Cr. 3. F. *Prereq: Concurrent enrollment in 330.* Collaborative skills used in education of students with mild/moderate disabilities. Includes collaboration between general and special education teachers, parents, paraeducators, and other education professionals and agencies.

Sp Ed 355. Classroom Assessment in Inclusive Primary Settings. (2-0) Cr. 2. F.S. *Prereq: Concurrent enrollment in 455; C I 433, 438, 439, 468G, 468I.* Examination and application of strategies for determining special educational needs, planning and evaluating instructional programs, and monitoring student progress.

Sp Ed 365. Classroom Assessment for Special Education. (3-0) Cr. 3. S. *Prereq: 330. Form*al and informal diagnostic instruments. Determination of special education needs. Planning, adaptation, and formative evaluation of instructional programs for students with mild/moderate disabilities.

Sp Ed 368. Teaching in Inclusive Primary Settings. (1-0) Cr. 1. F.S. *Prereq: Concurrent enrollment in C I 377, 468F.* Federal and state law. Service delivery models. Issues related to providing instruction that meets the needs of diverse learners in inclusive primary settings.

Sp Ed 415. Supervised Student Teaching. Cr. arr. F.S. *Prereq: Full admission to teacher education, senior classification, 355, 455.* Reservation required. Student teaching experience in inclusive primary grade classrooms.

Sp Ed 416. Supervised Student Teaching. Cr. arr. F.S. *Prereq: Full admission to teacher education, senior classification, student in elementary education section. 330, 365, 436, 439, 457; C I 280, 478.* Reservation required.

Sp Ed 436. Instructional Methods for Students with Mild/Moderate Disabilities. (3-0) Cr. 3. S. *Prereq: C I 245, concurrent enrollment in 365.* Evidence-based instructional strategies/techniques in academic areas and materials for individual instruction and classroom management for elementary students with mild/moderate disabilities.

Sp Ed 450. Teaching Secondary Students with Exceptionalities in the General Education Classroom. (2-2) Cr. 3. F.S. Overview of characteristics and needs of exceptional youth and appropriate service delivery options. Legal foundations for special education. Emphasis on co-teaching models, differentiated instruction, accommodations for instruction and assessment, and collaboration among professionals and parents.

Sp Ed 455. Instructional Methods for Inclusive Primary Settings. (2-0) Cr. 2. F.S. *Prereq: Concurrent enrollment in 355; C I 433, 438, 439, 468G, 468I.* Evidence-based instructional strategies and techniques in academic areas that support the learning of students with diverse learning needs. Emphasis on accommodations and alternative teaching strategies to meet individual student needs.

Sp Ed 457. Teaching Exceptional Learners in the General Classroom. (3-0) Cr. 3. F. *Prereq: 250, C I 245.* Evidence-based teaching strategies and instructional accommodations for inclusive education. Emphasis on managing challenging behavior. Nonmajor graduate credit. Nonmajor graduate credit.

Sp Ed 459. Field Experience and Practicum-Students with Mild/Moderate Disabilities. (0-2) Cr. 1. *Prereq: 365, 436, concurrent enrollment in 460.* Observation and involvement with students with mild/moderate disabilities in a resource room program. Satisfactory-fail only.

Sp Ed 460. Special Education Capstone. (1-0) Cr. 1. F. *Prereq: 436, concurrent enrollment in 459.* Discussion and application of evidence-based instructional strategies/techniques in academic and behavioral areas with students who have mild/moderate disabilities. Discussion of issues related to education of students with mild/moderate disabilities.

Sp Ed 490. Independent Study. Cr. arr. F.S. *Prereq: 12 credits in elementary education, permission of department chair.*

Courses primarily for graduate students, open to qualified undergraduate students

Sp Ed 501. Teaching Students with Exceptionalities in General Education. (3-0) Cr. 3. SS. *Prereq: Baccalaureate degree.* Overview of characteristics and needs of exceptional children/youth and appropriate service delivery options. Emphasis on accommodations and modifications for instruction and assessment and collaboration among professionals and parents.

Sp Ed 510. Foundations in Mild/Moderate Disabilities. (3-0) Cr. 3. S. *Prereq: 501 or equivalent.* Historical and legal foundations for special education. Characteristics, prevalence, and etiology of mild/moderate disabilities. Historical and contemporary models of programming for students with disabilities.

Sp Ed 511. Foundations of Behavioral Disorders and Learning Disabilities. (3-0) Cr. 3. S. Study of theory, interventions and special education service delivery models to students with moderate/severe behavior/learning disabilities in the public schools and residential settings.

Sp Ed 515. Assessment of Children and Youth with Disabilities. (3-0) Cr. 3. F. *Prereq: 510 or 511. Form*al and informal methods of assessment for identification/eligibility. IEP development, and progress monitoring. Formative evaluation of academic and behavioral skills, including curriculum-based measurement and functional behavioral assessment.

Sp Ed 517. Research in Special Education. (2-0) Cr. 2. SS. *Prereq: 510, 515.* Critical review of recent literature in education and related behavioral sciences as applied to education of students with disabilities.

Sp Ed 520. Instructional Methods for Mild/Moderate Disabilities. (3-0) Cr. 3. *Prereq: 510, 515.* Evidence-based instructional methods for meeting the academic and behavioral needs of students with mild/moderate disabilities. Includes methods, strategies, and behavior management techniques appropriate for students with mild or moderate disabilities.

Sp Ed 530. Evidence-based Practices in Behavior Disorders. (3-0) Cr. 3. S. *Prereq: 511, 515.* Current research on evidence-based interventions designed to improve the behavior and social skills of students with moderate/severe behavior disorders. Particular emphasis on positive behavioral supports and behavior change strategies.

Sp Ed 540. Evidence-based Practices in Learning Disabilities. (3-0) Cr. 3. S. *Prereq: 511, 515.* Current research on evidence-based interventions designed to improve the academic performance of students with moderate/severe learning disabilities. Particular emphasis on methods for improving reading, written expression, and mathematics, as well as performance in content-area instruction.

Sp Ed 553. Reading for Adolescents with Mild/Moderate Disabilities. (Cross-listed with C I). (3-0) Cr. 3. SS. *Prereq: Teaching license.* Instructional strategies for enhancing the comprehension and retention of students with mild/moderate disabilities, in conjunction with content-area reading material.

Sp Ed 555. Career Education and Transition for Youth with Disabilities. (2-0) Cr. 2. SS. *Prereq: 510 or 511.* Examination of the academic, personal, social, employability, and daily living skills needed for a satisfactory adult life. Exploration of curricula, programs, and services to meet these needs.

Sp Ed 560. Classroom Management/Behavioral Support. (3-0) Cr. 3. F. *Prereq: Teaching license.* Emphasis on positive behavioral supports and understanding behavior and its context through a functional behavioral approach. Design and development of carefully planned behavioral intervention programs for groups and individual students in general and special education settings.

Sp Ed 564. Collaborative Consultation. (3-0) Cr. 3. F. *Prereq: 510, 515, 520 or 530 or 540.* Models of consultation. Characteristics and methods to promote effective collaboration with families, paraprofessionals, other school personnel, and representatives of other agencies. Includes specific attention to IEP development as a collaborative process.

Sp Ed 565. Role of the Consultant. (1-0) Cr. 1. *Prereq: 564.* Explore role of the educational consultant in different settings (State department, area education agency, school district, private). Examine roles in relationship to models (mental health, collaborative, organization).

Sp Ed 567. Teaching Mathematics to Struggling Secondary Learners. (Cross-listed with C I). (3-0) Cr. 3. *Prereq: Secondary teaching experience.* Instructional methods and assessment techniques for secondary students struggling to learn mathematics. Particular emphasis on current research, practices, and trends in mathematics interventions for at-risk students and students with disabilities.

Sp Ed 570. Systems-Level Services for Youth with Behavioral and Learning Disabilities. (3-0) Cr. 3. SS. *Prereq: 511.* Overview of systems (education, juvenile justice, mental health, families, communities) that serve students with special education needs. Emphasis on how these systems work to provide needed programs and services for youth with behavioral and learning disabilities.

Sp Ed 590. Special Topics. Cr. arr. F.S. *Prereq: 15 credits in education, permission of department chair.*

Sp Ed 591. Supervised Field Experience. (0-2) Cr. arr. F.S. *Prereq: 15 graduate credits in special area, admission to the graduate program in special education.* Supervised on-the-job field experience in special areas.
G. Mild/Moderate Disabilities, K-6;
H. Mild/Moderate Disabilities, 7-12;
K. Behavior Disorders/Learning Disabilities, K-12

Sp Ed 599. Creative Component. Cr. arr. F.S.SS. *Prereq: 15 credits in education.*

Courses for graduate students

Sp Ed 615. Seminar. (1-0) Cr. 1. Repeatable. Selected topics in special education. Analysis of current special education research potential. Evaluation of impact upon the profession. Implications for additional research.

Sp Ed 699. Research. Cr. arr. *Prereq: 15 credits in education.*

Design Studies

(Interdepartmental Undergraduate Program)

Kate Schwennsen, Program Coordinator

The Design Studies program brings together courses that deal with the integrated study of the conceptualization, production, visible form, uses, and history of artifacts, buildings, and environments as well as the common qualities and connections among the design fields. Students in any college may elect to take a minor in Design Studies.

Core Design Program

Several Design Studies courses are part of the Core Design Program, which is required for all undergraduate students in the College of Design.

Minor—Design Studies

The undergraduate minor in Design Studies is constructed to facilitate design awareness among interested students and to provide a vehicle for interdisciplinary study within the College of Design. This minor is open to all undergraduate students at Iowa State University.

Additional information is available in the Student Programs and Services Office, 297 College of Design.

Minor—Digital Media

To familiarize students with the use of digital media in the design process, the College of Design offers an undergraduate Minor in Digital Media. This minor is open only to undergraduate students in the College of Design.

Detailed information is available in the Student Programs and Services Office, 297 College of Design.

Courses primarily for undergraduate students

Dsn S 102. Design Studio I. (1-6) Cr. 4. F.S. A core design studio course exploring the interaction of two-and three-dimensional design. Emphasis on fundamental skills and ideas shared across design disciplines. Investigation of creative process, visual order and materials, and development of critical thinking through studio projects and lectures. Includes study of precedents, contemporary design practices and disciplines in their cultural contexts.

Dsn S 110. Design Exchange Seminar I. (0-2) Cr. 1. F. *Prereq: Member of Design Exchange Learning Community.* Orientation to the College of Design. Introduction to the design disciplines and studio pedagogy. Satisfactory-fail only.

Dsn S 111. Design Exchange Seminar II. (0-2) Cr. 1. S. *Prereq: Member of the Design Exchange Learning Community.* Development and clarification of career and academic plans. Satisfactory-fail only.

Dsn S 115. Design Collaborative Seminar. (1-0) Cr. 0.5. *Prereq: Member of Design Collaborative Learning Community.* Orientation to the College of Design. Introduction to the design disciplines and studio pedagogy. Satisfactory-fail only.

Dsn S 131. Design Representation. (1-6) Cr. 4. F.S. An introduction to drawing through lecture and studio experiences. Focus on creative problem solving and communication in order to give visual form to ideas. Emphasis on perceptual, conceptual, and evaluative abilities through experiences that build eye, brain, and hand coordination. Explorations include drawing from observation and memory, working at various scales and duration, and using a variety of media and processes.

Dsn S 181. Origins and Evolution of Modern Design. (Cross-listed with Art H). (3-0) Cr. 3. F.S. History of designed artifacts, their creators, and their cultural environments in Western Europe and America from the beginning of the Industrial Revolution to the present.

Dsn S 183. Design Cultures. (3-0) Cr. 3. F.S. A broad-based exploration of the dynamic relationship between design and culture, employing case study method to investigate particular examples of cultural production in contemporary Society. Design processes and design works are presented as culturally, economically, environmentally, historically, ideologically, politically, and socially grounded events and artifacts.

Dsn S 221. History of Western Architecture I. (Cross-listed with Arch). (3-0) Cr. 3. F. Introductory survey with emphasis on the cultural, visual, natural, and constructed context. Ancient through Renaissance.

Dsn S 222. History of Western Architecture II. (Cross-listed with Arch). (3-0) Cr. 3. S. Introductory survey with emphasis on the cultural, visual, natural, and constructed context. Renaissance to present.

Dsn S 270. Forces Shaping Our Metropolitan Environment. (Cross-listed with C R P). (3-0) Cr. 3. S. Must be taken prior to completing 9 credits in C R P. Introduction to the social, political, physical, and economic forces as they shape metropolitan areas. A comprehensive picture of metropolitan development showing important roles other urban disciplines play in the planning process and the interrelationships of the disciplines.

Dsn S 274. The Social and Behavioral Landscape. (Cross-listed with L A). (3-0) Cr. 3. S. Exploration of social and behavioral factors pertinent to design of the domestic, civic, and commercial landscape. Focus on working familiarity with design principles as they relate to the behavior and activities of people across a broad demographic and cultural spectrum; application of these principles to design of outdoor environments. Lectures and discussions, including group exercises and field trips.

Dsn S 280. History of Art I. (Cross-listed with Art H). (3-0) Cr. 3. F. Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts; from prehistoric through Gothic. H. Honors. Cr. 4.

Dsn S 281. History of Art II. (Cross-listed with Art H). (3-0) Cr. 3. S. Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts; from the Renaissance to the twentieth century. H. Honors. Cr. 4.

Dsn S 291. World Cities and Globalization. (Cross-listed with C R P). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Sophomore classification.* World cities and globalization in developed and developing countries. Topics include globalization, world cities and regions, uneven economic development, the international division of labor, multinational corporations, international environmentalism, tourism, popular culture and place-based identity.

Dsn S 292. Introduction to Visual Culture Studies. (Cross-listed with ART). (3-0) Cr. 3. F.S. *Prereq: Open to all majors.* An introduction to various topics in visual culture studies. The lecture course will provide students with a creative and intellectual context in which to study historical and contemporary instances of the visual in culture. Individual lectures examine significant trends in the visual arts, mass media, scientific imagery, visual communications, and other areas related to visual literacy and visual representation in local and global contexts. Cross cultural viewpoints and issues of diversity will be presented in relation to visual culture and related fields.

Dsn S 293. Environmental Planning. (Cross-listed with C R P, Env S). (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Comprehensive overview of the field of environmental relationships and the efforts being made to organize, control, and coordinate environmental, aesthetic, and cultural characteristics of land, air, and water.

Dsn S 301. Study Abroad Preparation Seminar. (1-0) Cr. 1. Repeatable. F.S. Cultural introduction to host country, introduction to faculty sponsor and program of study, the particulars of traveling and living abroad, and financial and logistical preparations. Guest lectures. Required of all students planning to participate in a College of Design study abroad program for 9 or more credits. Satisfactory-fail only.

Dsn S 302. Design Leadership Seminar. (1-2) Cr. 2. Repeatable. *Prereq: Selection as a peer mentor for the Core Design program. For students* serving as peer mentors for the Core Design Program, under faculty supervision. Development of teaching and leadership skills within the context of design education experiences. Satisfactory-fail only.

Dsn S 303. Design Ambassadors. (1-2) Cr. arr. Repeatable. *Prereq: Admittance into one of the professional programs in the College of Design.* Opportunity to strengthen leadership, communication and presentation skills. Introduction to student development theory. Students participate in collaborative projects focused on prospective design students. Satisfactory-fail only.

Dsn S 310. Practical Experience. Cr. R. *Prereq: Permission of adviser or Coordinator of Design Studies.* Independent educational enrichment through practical experience. Students must register for this course prior to commencing each term. Available only to students taking course loads of eleven credits or less.

Dsn S 320. Urban form. (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: C R P 253 or 270, or permission of instructor.* Examines how urban form is shaped, what constitutes good urban form, and what are the trends in emerging urban forms. Descriptive, explanatory and normative theories of urban form, and the relationships between urban form and social, economic, political, cultural, and institutional forms.

Dsn S 351. Solar Home Design. (Cross-listed with Arch). (3-0) Cr. 3. S. *Prereq: Arch 202.* Architectural design and technical analysis of residential structures with emphasis on energy construction and solar energy utilization.

Dsn S 371. Landscape Architectural History: 1750 to Present. (Cross-listed with L A). (3-0) Cr. 3. S. Investigation of landscape design concepts and trends as observed over time, from approximately 1750 to the present, with emphasis on the United States and Europe. Examination of significant figures and outstanding works (sites, gardens, landscapes, monuments, subdivisions, city plans, etc.) of varied geographic regions. Analysis of the social, economic, political, and technical forces contributing to the development of landscape design styles, vocabulary, and literature. Lectures, readings, projects, research papers.

Dsn S 373. Landscape Architectural History: Pre-history to 1750. (Cross-listed with L A). (3-0) Cr. 3. F. Investigation of international landscape design concepts and trends as observed over time, from pre-history to the mid 18th century. Examination of significant figures and outstanding works (sites, gardens, landscapes, monuments, subdivisions, city plans, etc.) of varied geographic regions. Analysis of the social, economic, political, and technical forces contributing to the development of landscape design styles, vocabulary, and literature. Lectures, readings, projects, research papers.

Dsn S 382. Art and Architecture of Asia. (Dual-listed with 582). (Cross-listed with Art H). (3-0) Cr. 3. Introduction to the history of art and architecture in China, Korea, and Japan before the modern era. Visual materials selected based on important themes that are critical in understanding East Asian culture and art tradition. Museum field trip expenses to be paid by students. Nonmajor graduate credit.

Dsn S 383. Greek and Roman Art. (Dual-listed with 583). (Cross-listed with Art H, Cl St). (3-0) Cr. 3. Greek art from Neolithic and Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West. Nonmajor graduate credit.

Dsn S 385. Renaissance Art. (Dual-listed with 585). (Cross-listed with Art H). (3-0) Cr. 3. European art including painting, sculpture, architecture, and crafts;

thirteenth through sixteenth centuries. Nonmajor graduate credit.

Dsn S 394. Women/Gender in Art. (Dual-listed with 594). (Cross-listed with Art H, W S). (3-0) Cr. 3. Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture. Nonmajor graduate credit.

Dsn S 397. Internship Search Seminar. (1-0) Cr. 1. F. *Prereq: Sophomore classification or above in one of the College of Design degree programs.* A structured environment to set realistic learning goals, research potential sites, develop a strategy, develop essential job search materials and skills for finding an internship. Successfully obtaining an internship either for credit or non credit is encouraged but not required. Satisfactory-fail only.

Dsn S 404. Advanced Landscape Architectural Design. (Cross-listed with L A). (1-15) Cr. 6. Repeatable. S. *Prereq: L A 401.* Advanced forum for the demonstration of sophistication in landscape architectural design. Experimentation and innovation are encouraged.

Dsn S 417. Urban Revitalization. (Dual-listed with 517). (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: C R P 253 or 270.* Planning methods available to further revitalization and preservation efforts, with particular attention to housing and neighborhoods. Relationship between neighborhood change and urban development process; public policy implications.

Dsn S 425. Growth Management. (Dual-listed with 525). (Cross-listed with C R P). (3-0) Cr. 3. F. *Prereq: Junior classification.* Review of techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban, suburban and rural relationships; and land preservation.

Dsn S 426. Topics in Native American Architecture. (Cross-listed with Am In, Arch). (3-0) Cr. 3. Repeatable. F.S. *Prereq: Junior classification.* History, theory, and principles of Native American/American Indian Architecture, landscape Architecture and planning considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of Arch 426 may be applied to degree program. Nonmajor graduate credit.

Dsn S 429. International Planning. (Dual-listed with 529). (Cross-listed with C R P). (3-0) Cr. 3. S. *Prereq: Junior classification.* Introduction to issues in planning and governance in an international setting. Problems and strategies may include population movement and change, economic globalization, urban growth, rural development, and housing.

Dsn S 442. Site Development. (Dual-listed with 542). (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: C R P 253, 272.* Introduction to site analysis using landscape Architecture and environmental principles, drawing also on basic engineering concepts. Work will evolve from analysis to land development design.

Dsn S 446. Interdisciplinary Design Studio. (Dual-listed with 546). (0-12) Cr. arr. Repeatable. *Prereq: Junior classification in a curriculum in the College of Design and permission of instructor.* Advanced interdisciplinary design projects.

Dsn S 478. Topical Studies in Landscape Architecture. (Dual-listed with 578). (Cross-listed with L A). Cr. arr. Repeatable. F.S.SS. *Prereq: L A 371 or senior classification or graduate standing.* Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.
A. Landscape Design
B. Planting Design
C. Construction
D. History, Theory, Criticism
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social, Behavioral
N. Natural Resources

Dsn S 481. Art and Architecture of India. (Dual-listed with 581). (Cross-listed with Art H). (3-0) Cr. 3. Survey of Indian-style art and Architecture through history. Examine how art and Architecture developed in the Indian world has come to define the Indian identity religiously, culturally, socially, and politically. Nonmajor graduate credit.

Dsn S 484. Sustainable Communities. (Dual-listed with 584). (Cross-listed with C R P, Env S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Senior classification.* The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

Dsn S 487. Nineteenth Century Art. (Dual-listed with 587). (Cross-listed with Art H). (3-0) Cr. 3. European and American art and Architecture from 1780 to 1900 focusing on the major movements of western Europe: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism. Nonmajor graduate credit.

Dsn S 488. Modern and Contemporary Art and Theory I. (Dual-listed with 588). (Cross-listed with Art H). (3-0) Cr. 3. F. Visual arts and critical theory from Impressionism to Abstract Expressionism. Nonmajor graduate credit.

Dsn S 489. Sequential Art. (Dual-listed with 589). (Cross-listed with Art H). (3-0) Cr. 3. F.SS. An art-historical survey of comic strips, comic books, and graphic novels from their origins in the 19th century to the present.

Dsn S 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on required form prior to semester of enrollment.* Independent investigation of a topic of special interest to the student.
A. History
B. Technology
C. Communications
D. Design
E. Entrepreneurship
F. Social/Behavioral
H. Honors

Dsn S 491. Environmental Law and Planning. (Dual-listed with 591). (Cross-listed with C R P, Env S). (3-0) Cr. 3. S. *Prereq: 6 credits in natural sciences.* Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

Dsn S 492. Special Topics: Italian Culture. Cr. 1. Repeatable. F.S.SS. *Prereq: Enrollment in the College of Design Rome Study Abroad Program or in Dsn S 301.* Introduction to Italian contemporary culture, including language, fashion, politics, media, and social mores. Taught the semester prior and during study in Rome for students in the College of Design Rome program.

Dsn S 495. Modern and Contemporary Art and Theory II. (Dual-listed with 595). (Cross-listed with Art H). (3-0) Cr. 3. Visual arts and critical theory from Abstract Expressionism to the present. Nonmajor graduate credit.

Dsn S 496. History of Photography. (Dual-listed with 596). (Cross-listed with Art H). (3-0) Cr. 3. Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an Art Historical perspective, emphasizing causative factors, cultural influences, and major masters and schools. Nonmajor graduate credit.

Dsn S 498. Selected Topics in Art History. (Dual-listed with 598). (Cross-listed with Art H). (3-0) Cr. 3. Repeatable. Specialized study in the history or criticism of art and design. Course primarily for graduate students open to qualified undergraduate students.

Courses primarily for graduate students, open to qualified undergraduate students

Dsn S 504. Why Change Anything?. (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Introduction to a range of approaches to justifying innovations, changes, and interventions proposed by designers, planners, and artists. Reasons for change and their bases in social, philosophical, and design reasoning; and their usefulness in justifying change to different audiences. Investigation of fallacies, ideologies, and contemporary problems in justifications.

Dsn S 517. Urban Revitalization. (Dual-listed with 417). (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate Classification.* Planning methods available to further revitalization and preservation efforts, with particular attention to housing and neighborhoods. Relationship between neighborhood change and urban development process; public policy implications.

Dsn S 525. Growth Management. (Dual-listed with 425). (Cross-listed with C R P). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Graduate classification.* Review of techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban, suburban, rural relationships; and land preservation.

Dsn S 528. Topical Studies in Architecture. (Cross-listed with Arch). (3-0) Cr. arr. Repeatable. F.S.SS. *Prereq: Arch 221, 222 or senior classification or graduate standing.*
A. Studies in Architecture and Culture
B. Technology
C. Communications
D. Design
E. Practice

Dsn S 529. International Planning. (Dual-listed with 429). (Cross-listed with C R P). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Introduction to issues in planning and governance in an international setting. Problems and strategies may include population movement and change, economic globalization, urban growth, rural development, and housing.

Dsn S 542. Site Development. (Dual-listed with 442). (Cross-listed with C R P). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Introduction to site analysis using landscape Architecture and environmental principles, but drawing also on basic engineering concepts. Work will evolve from analysis to land development design based on that analysis.

Dsn S 546. Interdisciplinary Design Studio. (Dual-listed with 446). (0-12) Cr. arr. Repeatable. *Prereq: Admission to a graduate program in the College of Design and permission of instructor.* Advanced interdisciplinary design projects.

Dsn S 558. Sustainability and Green Architecture. (Cross-listed with Arch). (3-0) Cr. 3. F. *Prereq: Graduate standing.* Issues of Sustainability as related to living patterns and city design, population, pollution and use and availability of natural resources for the built environment; Issues of Green Architecture as it relates to building material selection, systems of building materials, the environment of the United States and the World, Architects and examples of buildings with green or sustainable designations.

Dsn S 567. Preservation, Restoration, and Rehabilitation. (Cross-listed with Arch). (3-0) Cr. 3. S. *Prereq: Senior classification.* Construction standards and procedures for preserving, restoring, reconstructing, and rehabilitating existing buildings following the guidelines of the National Park Service and the

National Trust for Historic Preservation. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Dsn S 571. Design for All People. (Cross-listed with Arch, Geron). (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Principles and procedures of universal design in response to the varying ability level of users. Assessment and analysis of existing buildings and sites with respect to standards and details of accessibility for all people, including visually impaired, mentally impaired, and mobility restricted users. Design is neither a prerequisite nor a required part of the course. Enrollment open to students majoring in related disciplines. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Dsn S 575. Contemporary Urban Design Theory. (Cross-listed with Arch). (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Current urban design theory and its application to urban problems. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Dsn S 578. Topical Studies in Landscape Architecture. (Dual-listed with 478). (Cross-listed with L A). (3-0) Cr. arr. Repeatable. F.S.SS. *Prereq: Senior Classification or graduate standing.* Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.
A. Landscape Design
B. Planting Design
C. Construction
D. History, Theory, Criticism
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social/Behavioral
N. Natural Resources

Dsn S 581. Art and Architecture of India. (Dual-listed with 481). (Cross-listed with Art H). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Survey of Indian-style art and Architecture through history. Examine how art and Architecture developed in the Indian world has come to define the Indian identity religiously, culturally, socially, and politically.

Dsn S 582. Art and Architecture of Asia. (Dual-listed with 382). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Introduction to the history of art and Architecture in China, Korea, and Japan before the modern era. Visual materials selected based on important themes that are critical in understanding East Asian culture and art tradition. Museum field trip expenses to be paid by students.

Dsn S 583. Greek and Roman Art. (Dual-listed with 383). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Greek art from Neolithic and Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West.

Dsn S 584. Sustainable Communities. (Dual-listed with 484). (Cross-listed with C R P). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate classification.* The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

Dsn S 585. Renaissance Art. (Dual-listed with 385). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* European art including painting, sculpture, Architecture, and crafts; thirteenth through sixteenth centuries.

Dsn S 587. Nineteenth Century Art. (Dual-listed with 487). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* European and American art and Architecture from 1780 to 1900, focusing on the major movements of western Europe: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism.

Dsn S 588. Modern and Contemporary Art and Theory I. (Dual-listed with 488). (Cross-listed with Art H). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Visual arts and critical theory from Impressionism to Abstract Expressionism.

Dsn S 589. Sequential Art. (Dual-listed with 489). (Cross-listed with Art H). (3-0) Cr. 3. F.SS. *Prereq: Graduate classification, permission of instructor.* An art-historical survey of comic strips, comic books, and graphic novels from their origins in the 19th century to the present.

Dsn S 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on required form prior to semester of enrollment.* Independent investigation of a topic of special interest to the student.

Dsn S 591. Environmental Law and Planning. (Dual-listed with 491). (Cross-listed with C R P, L A). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Environmental law and policy as applied in planning at the local and State levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

Dsn S 594. Women/Gender in Art. (Dual-listed with 394). (Cross-listed with Art H, W S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture.

Dsn S 595. Modern and Contemporary Art and Theory II. (Dual-listed with 495). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Visual arts and critical theory from Abstract Expressionism to the present.

Dsn S 596. History of Photography. (Dual-listed with 496). (Cross-listed with Art H). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an Art Historical perspective, emphasizing causative factors, cultural influences, and major masters and schools.

Dsn S 598. Selected Topics in Art History. (Dual-listed with 498). (Cross-listed with Art H). (3-0) Cr. 3. Repeatable. *Prereq: Graduate classification, permission of instructor.* Specialized study in the history or criticism of art and/or design.

Dietetics

(Interinstitution Graduate program)

Participating faculty:
Iowa State University:

Colorado State University: Mary Harris

Kansas State University: Deborah D. Canter

Michigan State University: Shoerr

Montana State University: Christina Campbell

North Dakota State University: Ardith Brunt

Oklahoma State University: Nancy Betts

South Dakota State University: Kendra Kattelmann

University of Kansas Medical Center: Linda Griffith

University of Nebraska: Marilyn Schnepf

"Dietetics" is an interinstitutional distance education program offered through the Web. The student selects a home institution, which grants the degree. After admission at tht home institution, the student takes courses from each of the ten institutions: Iowa State University, Colorado State University, Kansas State University,Michigan State University, Montana State University, North Dakota State University, Oklahoma State University, South Dakota State University: Kendra Kattelman, University of Kansas Medical Center, and University of Nebraska.

At Iowa State University, Dietetics is a specialization within the Master of Family and Consumer Sciences degree program (MFCS-Diet) that consists of 36 credits. This is a non-thesis option and a special project or creative component is required. Students typically complete the program in 6-8 semesters while employed full-time. Admission is limited to those who are Registered Dietitians or Registration-eligible Dietitians. A computer with minimum specifications, web access, and an email address are required for completing the program.

Admission procedures: Admission to the MFCS-Diet program requires exactly the same procedures as admission to the Graduate College. See. Graduate College section of this catalog.

Registration: Students choosing to receive their degree from Iowa State University complete all the admissions, registration and fee payment processes through ISU.

The department cooperates in the interinstitution Master of Family and Consumer Sciences program to offer a specialization in Dietetics. The Master of Family and Consumer Sciences-Dietetics is designed for the Registered Dietitian or Registration-eligible Dietitian. The 36 credit program is non-thesis and seeks to develop research skills, stimulate independent thought, and provide up-to-date knowledge in foods, nutrition, and foodservice/ business management. This program prepares individuals to integrate and apply the principles from the biomedical sciences, human behavior, and management to design and lead effective food and nutrition programs in a variety of settings. Students may build a program of study from offerings of the partner institutions such as human nutrition, nutrient metabolism, biostatistics, health promotion/disease prevention, foodservice systems management, food science, lifespan nutrition, wellness, entrepreneurship, nutrition education, nutritional assessment and food safety. The online program is tailored for credentialed, practicing dietetics professionals who seek to enhance their knowledge in a specific area of dietetics practice or retool for new career opportunities in dietetics practice.

Diet 511. Research Methods. (3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* An overview of diverse research approaches focusing on methods for collecting and analyzing quantitative and qualitative data. www only. Only one of Diet 511 or FCEdS 511 may count toward graduation.

Diet 530. Nutrition in Wellness. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Addresses wellness promotion through nutrition. Nutritional risk and protective factors will be examined in relation to public health and individual nutrition. www only.

Diet 532. Maternal and Child Nutrition. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Critical examination of behavioral, physiological, and public health issues impacting dietary and nutritional factors that support normal growth and development. Content focuses on early stages of the life cycle: gestation, lactation, infancy, preschool, school age, and adolescence. www only.

Diet 534. Nutrition Education in the Community. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Principles and practices of teaching individuals and groups to translate nutrition knowledge into action. Emphasis on research in and evaluation of nutrition education. www only.

Diet 538. Nutrition: A Focus on Life Stages. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Explores influence of normal physiological stresses on nutritional needs throughout the life span. Evaluates dietary intake and identification of appropriate community nutrition services in on-line discussions. Specific considerations, such as the influence of age and cultural heritage, are incorporated. www only.

Diet 540. Nutrition and Physical Activity in Aging. (Cross-listed with Geron). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* WWW only. Basic physiologic changes during aging and their impacts in health and disease. The focus will be on successful aging with special emphasis on physical activity and nutrition. Practical application to community settings is addressed.

Diet 544. Pediatric Clinical Nutrition. (3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Examines the physiological, biochemical and nutritional aspects of disease processes relevant to infants and children up to 18 years of age. Discussion of medical nutrition therapy for a variety of medical conditions in this population including inborn errors of metabolism, food hypersensitivity, obesity, and diseases of the major organ Systems. www only.

Diet 546. Phytochemicals. (3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Overview of phytochemicals (non-nutritive biologically active compounds) from fruits, vegetables, cereals and oilseeds. Covers recent findings of chemistry, physiological functions, and potential health implications of phytochemicals. www only.

Diet 548. Professional Development Assessment. (Cross-listed with FS HN). (1-0) Cr. 1. F.S.SS. *Prereq: Enrollment in GPIDEA MFCS in Dietetics.* Web-based course providing information and practice for student to assess and evaluate own professional development and continuing professional education needs. Completion of professional 5-year plan. Satisfactory-fail only.

Diet 550. Finance and Cost Controls. (3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Overview of the fundamental knowledge of hospitality managerial accounting, cost controls, and financial management. Important topics include financial statement analysis, cost concepts, cost-volume-profit analysis, calculating and controlling food and beverage costs, pricing, and capital budgeting. www only.

Diet 554. Statistics. (3-0) Cr. 3. S.SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Tools used to make statistical decisions. Major emphasis on explanation and understanding of important concepts involved; basic theme is understanding of data and methods used to analyze such data. www only. Only one of Diet 554 or Stat 401, 495, 542 may count toward graduation.

Diet 556. Advanced Nutrition: Micronutrients. (3-0) Cr. 3. S. *Prereq: BBMB 404 or BBMB 420 or equivalent; enrollment in GP-IDEA MFCS in Dietetics.* Integration of the molecular, cellular and physiological aspects of vitamins and minerals in mammalian systems. Interactions among nutrients, metabolic consequences of deficiencies or excesses, relevant polymorphisms, major research methodologies, and current topics related to micronutrients and non-nutrient components. www only. Only one of Diet 556 or NutrS 502 may count toward graduation.

Diet 558. Advanced Nutrition: Macronutrients. (3-0) Cr. 3. F. *Prereq: BBMB 404 or BBMB 420 or equivalent; enrollment in GP-IDEA MFCS in Dietetics.* Integration of the molecular, cellular and physiological aspects of macronutrients and energy metabolism in mammalian systems. Dietary energy, carbohydrates, fiber, lipids, proteins, their interactions, metabolic consequences, and major research methodologies. www only. Only one of Diet 558 or NutrS 501 may count toward graduation.

Diet 560. Medical Nutrition and Disease. (3-0) Cr. 3. F.S.SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Pathophysiology of selected acute and chronic disease states and their associated medical problems. Specific attention directed to medical nutrition needs of patients in the treatment of each disease state. www only. Only two of Diet 560 or NutrS 561, 564 may count toward graduation.

Diet 565. Malnutrition in Low-Income Countries. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Identification and assessment of malnutrition in low-income countries. Social, cultural, political, economic, and geographic determinants of malnutrition. Protein-energy malnutrition, vitamin and mineral deficiencies. Intervention approaches; international efforts and local sustainability. www only.

Diet 566. Nutrition Counseling and Education Methods. (2-2) Cr. 3. F.S. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Dual listed with FS HN 466. Application of counseling and learning theories with individuals and groups in community and clinical settings. Includes discussion and experience in building rapport, assessment, diagnosis, intervention, monitoring, evaluation, and documentation. Literature review of specific counseling and learning theories. www only.

Diet 567. Nutrition for Dietitians. (Cross-listed with FS HN). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 360; BBMB 301, undergraduate course in physiology; enrollment in GP-IDEA MFCS in Dietetics.* Study of the current scientific literature to evaluate current trends and issues in nutrition science and Dietetic practice. Emerging areas of research investigating the role of nutrients in health and disease in humans will be explored. Emphasis on the impact of emerging research on nutrition recommendations and interventions designed to promote human health. www only.

Diet 568. Entrepreneurship in Dietetics. (3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Definition and discussion of entrepreneurship and its importance to economic and business environment. www only.

Diet 570. Nutrition and Human Performance. (3-0) Cr. 3. S. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Develop an understanding of nutrition based on knowledge of the biochemical and physiological process and functions of specific nutrients in meeting nutritional requirements. Emphasis on the relationship of optimal nutrition and physical efficiency and performance. www only.

Diet 572. Environmental Scanning and Analysis of Current Issues in Dietetics. (3-0) Cr. 3. S. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Overview of current topics, issues, and trends in Dietetics practice. www only.

Diet 573. Administration of Health Care Organizations. (3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* A comprehensive review of today's health care institutions and their response to the economics, social, ethical, political, legal, technological, and ecological environments. www only.

Diet 595. Proposal and Grant Writing for the Working Professional. (Cross-listed with FS HN). (1-0) Cr. 1. Alt. F., offered 2009. *Prereq: enrollment in GP-IDEA MFCS in Dietetics.* Grant proposal preparation experiences including writing and critiquing of proposals and budget planning. Designed for the working professional. www only. Satisfactory-fail only.

Ecology and Evolutionary Biology

www.grad-college.iastate.edu/EEB/

(Interdepartmental Graduate Major)

Supervisory Committee: G.Courtney, Chair; A. Bronikowski; J. Dekker; J. Downing; J. Nason; D. Otis

The ecology and evolutionary biology (EEB) interdepartmental major is offered through a faculty housed in ten departments of the university. Faculty from the departments of Agronomy, Anthropology; Ecology, Evolution and Organismal Biology; Entomology; Geological and Atmospheric Sciences; Horticulture; Mathematics; Natural Resource Ecology and Management; Plant Pathology; and Statistics cooperate to offer courses and research opportunities leading to the M.S. and Ph.D. degrees with a major in ecology and evolutionary biology.

Applicants should have completed an undergraduate or master of science or arts degree in one of the biological, physical, or Mathematical sciences. Applicants also should have taken undergraduate courses in both basic ecology and evolution.

The EEB major is designed for students interested in the study of mechanisms controlling the composition, structure, and functional processes of ecological systems and the mechanisms that regulate the pattern and rate of evolutionary change within and among species.

Cooperating departments offer courses and research opportunities in population, community, and ecosystems ecology; landscape ecology, modeling, and spatial dynamics; systematics, biodiversity, and biogeography; physiological and behavioral ecology; conservation and restoration ecology; agroecology; natural resources ecology and management; evolutionary ecology; population, quantitative and evolutionary genetics; and environmental Statistics, stochastic modeling, and quantitative ecology and evolution. In addition, interdisciplinary courses in ecology and evolution are offered, including a special topics course, a seminar, and an extended field trip.

Students majoring in EEB may prepare themselves for careers focused on basic or applied ecology and evolutionary biology in a variety of settings, including academia, government, industry, and private organizations. Graduates have a broad understanding of ecology and evolutionary biology, experience designing and conducting research, writing grant proposals, and communicating effectively with scientific colleagues at meetings and through publications. All graduates become aware of Societal and ethical issues that surround the discipline.

Information on application procedures, research interests of the faculty, and specific requirements of the major may be obtained from the EEB web site www.grad-college.iastate.edu/EEB/, or by contacting eeboffice@iastate.edu.

Courses for graduate students

EEB 511. Conceptual Foundations in Ecology and Evolutionary Biology. (3-2) Cr. 4. F. *Prereq: Graduate classification.* Introduction to key figures and ideas that have shaped the development of ecology and evolutionary biology. Covers major developments in ecology and evolutionary biology at five levels of biological organization: Genome, Organism, Population, Community, and Ecosystem. Impacts of these developments on current approaches to investigation and argument formulation. Effects of technological advances on the direction of scientific investigations. Introduction to analytical skills important for critical thinking in ecology and evolutionary biology and the impact of accepted lines of scientific reasoning on the objectives and conduct of research, such as explanation and prediction, design of studies as experimentation, and structured or unstructured observation.

EEB 585. Extended Field Trip. (0-6) Cr. 2. Repeatable. S. *Prereq: Graduate classification.* Annual field trip to a region of North America to study the major terrestrial and aquatic ecosystem types of the region. Report required.

EEB 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification and permission of instructor. For students* wishing to conduct in-depth study of a particular topic in ecology and evolutionary biology.

EEB 698. Seminar. (1-0) Cr. 1. Repeatable. F.S. Reports and discussion of recent research and literature.

EEB 699. Research. Cr. arr. Repeatable. F.S.SS. Thesis and dissertation research.

Courses Offered by the Organization for Tropical Studies

ISU graduate students can take courses through the widely recognized Organization for Tropical Studies (OTS) at field sites in Central and South America. Students register for OTS courses and upon successful completion, receive credit from University of Costa Rica which transfers as either OTS 510 or OTS 515. For further information about OTS courses, see www.ots.duke.edu.

For information regarding OTS course offerings, please contact the EEB Program Office at eeboffice@iastate.edu.

OTS 510. Tropical Biology: An Ecological Approach. Cr. 8. This course is designed for students in the early stages of graduate study in biology or a related field, with the goal of training graduate students in research methods by providing intensive field experience in diverse tropical ecosystems.

OTS 515. Topics in Tropical Biology. Cr. 1-8. This course is designated for students enrolled in graduate course offerings through OTS (excluding OTS 510). Examples of graduate courses offered by OTS include Tropical Plant Systematics, Tropical Ecology and Conservation, Molecular Methods in Tropical Ecology, and Tropical Agroecology.

Ecology, Evolution, and Organismal Biology

www.eeob.iastate.edu

Jonathan Wendel, Chair of Department

Distinguished Professors (Emeritus): Tiffany, Ulmer

University Professor: Horner

Professors: Ackerman, L. Clark, W. Clark, Courtney, Danielson, Debinski, Downing, Janzen, Nason, Van der valk, Vleck, Wendel

Professors (Emeritus): Brown, Buttrey, D. Farrar, Jeska, Lersten, Mutchmor, Redmond

Professor (Collaborator): Otis

Associate Professors: Adams, Colbert, Crumpton, Jurik, Moloney, Raich, Wallace, Wilsey

Associate Professors (Emeritus): E. Farrar, Shaw

Associate Professors (Collaborators): Newton, Rosburg

Assistant Professors: Bronikowski, Harpole, Hofmockel, Kelly, Lavrov, Serb, Valenzuela-Castro

Assistant Professors (Adjunct): Bowen, B. Pleasants, J. Pleasants, Roe

Assistant Professors (Collaborators): Koford, Pierce

Lecturers: Folinsbee, Spalding

Undergraduate Study

Within the Biological Sciences, studies of ecology, evolution, and organismal biology are essential in understanding the complex relationships of life on Planet Earth. Ecology focuses on the interactions among organisms as well as the interactions between organisms and their physical environments. Evolutionary theory addresses the origins and interrelationships of species. Organismal biology studies both the diversity of biological organisms and the structure and function of individual organisms.

The EEOB Department offers several undergraduate majors with other departments. Students interested in the areas of ecology, evolution, and organismal biology should major in Biology, Environmental Science, or Genetics. The Biology Major is administered and offered jointly by the EEOB and GDCB departments. The faculty of EEOB, together with those in GDCB and BBMB, administer and offer the Genetics Major. Faculty in EEOB, in cooperation with faculty from other departments on campus, administer and offer the Environmental Science Major. Each of these majors is available through the College of Liberal Arts and Sciences or through the College of Agriculture and Life Sciences. Faculty in the EEOB Department also teach undergraduate courses at Iowa Lakeside Laboratory (see the I*owa Lakeside Laboratory* listing).

The Biology Major, the Environmental Science Major, and the Genetics Major prepare students for a wide range of careers in biological sciences. Some of these careers include conservation of natural resources and biodiversity, human and veterinary medicine, and life science education. These majors are also excellent preparation for graduate study in systematics, ecology, biological diversity, physiology, and related fields. Faculty members in EEOB contribute to the undergraduate courses listed below. The titles and descriptions of these courses are in the Biology section of the catalog.

Biol 101, 110, 111, 155, 173, 204, 211, 211=-L, 212, 212L, 255, 255L, 256, 256L, 258, 265, 307, 312, 313, 313L, 315, 335, 336, 351, 352, 353, 354, 355, 356, 364, 365, 366, 371, 381, 382, 393, 394, 434, 439, 454, 455, 456, 457, 458, 459, 462, 465, 471, 472, 474, 476, 483, 486, 486L, 487, 488, 489, 490, 491, 494, 495, and 498.

Graduate Study

The department offers graduate work leading to both Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees. EEOB graduate students major in one of several interdepartmental majors including Bioinformatics and Computational Biology, Ecology and Evolutionary Biology, Environmental Science, Genetics, Interdisciplinary Graduate Studies, Neuroscience, and Toxicology. The EEOB faculty members are active in the interdepartmental graduate majors and teach a wide range of graduate courses. Faculty research programs cover a wide range of specializations including physiology and physiological ecology; Microbiology; animal behavior; evolutionary genetics of plants and animals; modeling of evolutionary and ecological processes; plant and animal systematics; neurobiology; developmental biology; aquatic and wetland ecology; functional, population, community, landscape, and ecosystem ecology; and conservation biology. For further information on faculty research interests check the EEOB web site (www.eeob.iastate.edu). Some EEOB faculty teach graduate courses at Iowa Lakeside Laboratory. Field Station courses are also available through the Gulf Coast Marine Laboratory and the Organization for Tropical Studies (see the *Biology* listing).

Prospective graduate students need a sound background in the physical and biological sciences, as well as in mathematics and English. Interested students should check the Graduate Program link from the EEOB web site for specific admission procedures and updates. The department and majors require submission of Graduate Record Examination (GRE) aptitude test scores. Subject area GRE scores are recommended. International students whose native language is other than English must also submit TOEFL or IELTS scores with their application.

Students who are enrolled in the interdepartmental graduate majors with EEOB affiliation are required to participate in departmental seminars, to participate in research activities, and to show adequate progress and professional development while pursuing their degree. For both the M.S. and Ph.D. degrees, it is expected that research conducted by the student will culminate in the writing and presentation of a thesis or dissertation. Requirements and guidelines for study are provided by the Graduate College, the EEOB faculty, and the individual student's major professor and Program of Study Committee. General information about graduate study requirements can be found at the web site for the Graduate College and requirements for the interdepartmental majors can be found by following the links from the EEOB web site above. Although not a formal requirement, the EEOB faculty recommends that students pursuing the Ph.D. include teaching experience in their graduate training.

Courses primarily for graduate students, open to qualified undergraduate students

EEOB 501l. Freshwater Algae. (Cross-listed with Ia LL). Cr. 4. SS. Structure and taxonomy of freshwater algae based on field collected material; emphasis on genus-level identifications, habitats visited include lakes, fens, streams, and rivers; algal ecology.

EEOB 507. Advanced Animal Behavior. (3-0) Cr. 3. S. *Prereq: Graduate standing, Biol 354, or permission of instructor.* Analysis of current research in animal behavior. Topics covered may include behavioral ecology, mechanisms of behavior, evolution of behavior, applications of animal behavior to conservation biology, and applications of animal behavior to wild animals in captivity.

EEOB 514. Evolutionary Ecology. (3-0) Cr. 3. F. *Prereq: 589, Biol 315; graduate standing.* Evolution of ecological adaptations at the individual, population, community and landscape levels. Emphasis is on evolutionary mechanisms and adaptive strategies; units and mechanisms of evolution, life history strategies, species interactions and organization of communities, behavior, and patterns of distribution, speciation and macroevolution.

EEOB 531. Conservation Biology. (Cross-listed with A Ecl). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Biol 312; Biol 313 or graduate standing.* Examination of conservation issues from a population and a community perspective. Population-level analysis will focus on the role of genetics, demography, and environment in determining population viability. Community perspectives will focus on topics such as habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology.

EEOB 531l. Conservation Biology. (Cross-listed with Ia LL, A Ecl). Cr. 4. Alt. SS., offered 2010. *Prereq: Ia LL 312l.* Population-and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

EEOB 534. General and Comparative Endocrinology. (3-3) Cr. arr. S. *Prereq: Biol 314.* Dual-listed with Biol 434. Graduate study in conjunction with Biol 434. Chemical integration of vertebrate organisms. The structure, development, and evolution of the endocrine glands and the function and structure of their hormones. Laboratory techniques for studying hormonal phenomena.

EEOB 535. Restoration Ecology. (Cross-listed with EnSci, NREM). (2-3) Cr. 3. F. *Prereq: Biol 366 or 474 or graduate standing.* Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies.

EEOB 535l. Restoration Ecology. (Cross-listed with Ia LL, A Ecl, EnSci). Cr. 4. Alt. SS., offered 2010. *Prereq: A course in ecology.* Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

EEOB 537. Plant Stress Biology. (Cross-listed with Hort, Agron). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 330A or equivalent and BBMB 404-405.* Physiology and molecular biology of plant responses to environmental stress. Emphasis on the role of hormones and hormone interactions in governing stress responses. Lectures are prepared from journal papers that elucidate key mechanisms controlling responses to drought, flooding, salt, nutrient deficiencies, freezing, pathogens and herbivores. Plants studied include genetic model systems and crops of Horticultural and Agronomic value.

EEOB 539. Environmental Physiology. (3-3) Cr. arr. Alt. S., offered 2010. *Prereq: Biol 335 or A Ecl 311, physics recommended.* Dual-listed with Biol 439. Graduate study in conjunction with Biol 439. Physiological adaptations to the environment with emphasis on vertebrates.

EEOB 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BBMB, BCB, B M S, FS HN, Hort, NutrS, VDPAM, NREM, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

EEOB 552. Pteridology. (1-3) Cr. 2. *Prereq: 10 credits in biological sciences.* Morphology, taxonomy, and ecology of the lower vascular plants, with emphasis on ferns.

EEOB 553. Agrostology. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: Biol 366.* Structure, identification, classification, phylogeny, and economic aspects of grasses and related families.

EEOB 555. Bryophyte and Lichen Biodiversity. (Dual-listed with Biol 455.) Cr. 3. Prereq: Biol 212, Biol 212L. Introduction to the biology and ecology of mosses, liverworts, and lichens. Emphasis on identification and diversity of local representatives of these three groups of organisms. Required field trips and service-learning. Nonmajor graduate credit.

EEOB 557. Herpetology. (Cross-listed with A Ecl). (2-3) Cr. 3. F. *Prereq: A Ecl 365, Biol 351.* Dual-listed with Biol 457. Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodilians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

EEOB 558. Ornithology. (Cross-listed with A Ecl). (2-3) Cr. 3. S. *Prereq: A Ecl 365 or Biol 351.* Dual-listed with Biol 458. Biology, ecology, evolution, and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation. Laboratory exercises complement lecture topics, emphasize identification and distribution of Midwest birds, and include field trips.

EEOB 559. Mammalogy. (Cross-listed with A Ecl). (2-3) Cr. 3. S. *Prereq: Biol 351 or A Ecl 365.* Dual-listed with Biol 459. Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. Laboratory focus on identification, distribution, habits, and habitats of mammals.

EEOB 560. Resource Ecology. (2-3) Cr. 3. Alt. S., offered 2010. *Prereq: Biol 212, 212L, 312; Stat 101 or 104 or graduate standing.* Ecological and economical management of sustainable biological resources. Unifying current management concepts and models in wildlife, fisheries, water quality, forestry, recreation, and agriculture. Research problems.

EEOB 561. Plant Diversity and Evolution. (2-6) Cr. 4. *Prereq: 10 credits in biological sciences.* Current concepts of plant phylogeny from the origin of land plants through the origin of angiosperms, with emphasis on morphology, reproduction and evolutionary trends in bryophytes, pteridophytes, and gymnosperms.

EEOB 562. Evolutionary Genetics. (3-0) Cr. 3. Alt. S., offered 2011.*Prereq: Permission of instructor.* Seminar/discussion course covering the genetic basis of evolutionary processes in multicellular organisms.

EEOB 563. Molecular Phylogenetics. (2-3) Cr. 3. F. *Prereq: Biol 313 and 315.* An overview of the theory underlying phylogenetic analysis and the application of phylogenetic methods to molecular datasets. The course emphasizes a hands-on approach to molecular phylogenetics and combines lecture presentations with computer exercises and discussion of original scientific literature.

EEOB 564. Wetland Ecology. (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: 15 credits in biological sciences.* Ecology, classification, creation and restoration, and management of wetlands. Emphasis on North American temperate wetlands.

EEOB 564l. Wetland Ecology. (Cross-listed with Ia LL, EnSci). Cr. 4. SS. *Prereq: Ia LL 312l.* Ecology, classification, creation, restoration, and management of wetlands. Field studies will examine the composition, structure and functions of local natural wetlands and restored prairie pothole wetlands. Individual or group projects.

EEOB 565. Morphometric Analysis. (3-2) Cr. 4. Alt. S., offered 2010. *Prereq: Stat 401.* Dual-listed with Biol 465. A comprehensive overview of the theory and methods for the analysis of biological shape with emphasis on data acquisition, standardization, statistical analysis, and visualization of results. Methods for both landmark and outline data will be discussed.

EEOB 566. Molecular Evolution. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Permission of instructor.* Seminar/discussion course covering the fundamentals of molecular evolution. Emphasis is placed on original scientific literature and current topics, including rates and patterns of genetic divergence; nucleotide and allelic diversity; molecular clocks; gene duplications; genome structure; organellar genomes; polyploidy; transposable elements; and modes and mechanisms of gene and genome evolution.

EEOB 567. Empirical Population Genetics. (3-0) Cr. 3. F. *Prereq: Permission of instructor.* An overview of fundamental population genetic theory and the ecological and evolutionary factors underlying the distribution of genetic variation within and among natural populations. Emphasis on the analysis of inbreeding, breeding systems, parentage, relatedness, spatial autocorrelation, effective population size, hierarchial population models, and phylogeography.

EEOB 568. Advanced Systematics. (Cross-listed with Ent). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Permission of instructor.* Principles and practice of systematic biology; taxonomy, nomenclature and classification of plants and animals; sources and interpretation of systematic data; speciation; fundamentals of phylogenetic systematics.

EEOB 569. Biogeography. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 315 or equivalent; permission of instructor.* Principles underlying the geographic distribution of organisms throughout the world; biological influences of geological history and tectonic movements; role of climate, migration, dispersal, habitat, and phylogeny on past and present organismal distribution patterns; biogeographic methods.

EEOB 570. Landscape Ecology. (Cross-listed with A Ecl). (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: Permission of instructor; EEOB 588; a course in calculus.* The study of ecological and evolutionary processes within a spatial context with emphasis on behavior, population, and community dynamics.

EEOB 573. Techniques for Biology Teaching. (Cross-listed with Ia LL, A Ecl). Cr. arr. Repeatable. SS. The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.
A. Animal Biology (Same as A Ecl 573A)
B. Plant Biology
C. Fungi and Lichens
D. Aquatic Ecology
E. Prairie Ecology
F. Wetland Ecology
G. Limnology (Same as A Ecl 573G)
H. Animal Behavior (Same as A Ecl 573H)
I. Insect Ecology
J. Biology of Invertebrates
K. Non-invasive Use of Living Organisms
W. Project WET (Same as A Ecl 573W)

EEOB 575. Field Mycology. (2-6) Cr. 4. Repeatable. SS. *Prereq: 5 credits in biology.* Collection and identification of fungi and relation of their occurrence to environmental factors. Field trips.

EEOB 575l. Field Mycology. (Cross-listed with Ia LL). Cr. 4. Alt. SS., offered 2010. Identification and classification of the common fungi; techniques for identification, preservation, and culture practiced with members of the various fungi groups.

EEOB 576. Functional Ecology. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312.* Dual-listed with Biol 476. The nature of adaptations to physical and biotic environments. Biophysical, biomechanical, and physiological bases of the structure, form, growth, distribution, and abundance of organisms.

EEOB 580l. Ecology and Systematics of Diatoms. (Cross-listed with Ia LL). Cr. 4. SS. Field and laboratory study of freshwater diatoms; techniques in collection, preparation, and identification of diatom samples; study of environmental factors affecting growth, distribution, taxonomic characters; project design and execution including construction of reference and voucher collections and data organization and analysis.

EEOB 581. Environmental Systems I: Introduction to Environmental Systems. (Cross-listed with EnSci). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including biology and chemistry.* Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

EEOB 584. Ecosystem Ecology. (Cross-listed with EnSci). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Combined 12 credits in biology and chemistry.* Introduction to the study of ecosystems and the factors that influence their properties and dynamics. Conceptual foundations for ecosystem studies. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems.

EEOB 585. Advanced Community Ecology. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: Biol 312.* Factors controlling species diversity, species abundance,

and the structure and function of communities in space and time. Relationships between species diversity and ecosystem process rates and community stability.

EEOB 586. Aquatic Ecology. (Cross-listed with EnSci). (3-0) Cr. 3. F. *Prereq: EnSci 301 or 312 or 381 or 402.* (Dual-listed with Biol 486.) Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine and wetland ecology.

EEOB 586L. Aquatic Ecology Laboratory. (Cross-listed with EnSci). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in 586.* (Dual-listed with Biol 486L.) Field trips and laboratory exercises to accompany 586. Hands-on experience with aquatic research and monitoring techniques and concepts.

EEOB 587. Microbial Ecology. (Cross-listed with EnSci, Micro). (3-0) Cr. 3. *Prereq: 6 credits in biology* and six credits in chemistry. Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

EEOB 589. Population Ecology. (Cross-listed with A Ecl). (2-2) Cr. 3. F. *Prereq: Biol 312, Stat 101 or 104, a course in calculus, or graduate standing.* (Dual-listed with Biol 489.) Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

EEOB 590. Special Topics. Cr. arr. Repeatable. *Prereq: 10 credits in biology, permission of instructor.*
A. Current Topics in Ecology
B. Current Topics in Evolutionary Biology
C. Current Topics in Organismal Biology
I. Iowa Lakeside Laboratory (Cross-listed with Ia LL 590I, A Ecl 590I, Anthr 590I.)

EEOB 596. Ecology and Society. (Cross-listed with Phil). (3-0) Cr. 3. *Prereq: Graduate classification in biological or environmental sciences/studies with at least one course in ecology.* Analysis of conceptual and methodological debates in ecology. Historical development of competing research traditions and Philosophies. Topics include i) methodological issues in ecological science, ii) conceptual issues in theoretical ecology, iii) conceptual issues in applied ecology, iv) relation of ecology to environmental and social issues.

EEOB 599. Creative Component. Cr. arr. Research toward nonthesis master's degree.

Courses for graduate students

EEOB 611. Analysis of Populations. (Cross-listed with A Ecl). (2-2) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 312; Stat 401; a course in calculus.* Quantitative techniques for analyzing vertebrate population data to estimate parameters such as density and survival. Emphasis on Statistical inference and computing.

EEOB 641. General Mycology. (2-6) Cr. 4. F. *Prereq: Pl P 407.* First semester of a full-year course. Taxonomy, morphology, ecology, and phylogeny of slime molds and fungi (ooymcetes, chytridiomycetes, zygomycetes, ascomycetes, basidiomycetes, and fungi imperfecti).

EEOB 642. General Mycology. (2-6) Cr. 4. S. *Prereq: 641.* Continuation of 641. Taxonomy, morphology, ecology, and phylogeny of slime molds and fungi (oomycetes, chytridiomycetes, zygomycetes, ascomycetes, basidiomycetes, and fungi imperfecti).

EEOB 679. Light Microscopy. (Cross-listed with GDCB, Micro). (2-9) Cr. 5. Alt. F., offered 2010. *Prereq: Permission of instructor.* Current theories encompassing light optics and their applications for specimen preservation, paraffin and resin sectioning, general staining, histochemistry, cytophotometry, immunocytochemistry, autoradiography, image digitization, processing and presentation, and digital macro- and micrography. Limit of 10 students.

EEOB 680. Scanning Electron Microscopy. (Cross-listed with GDCB, Micro). (2-9) Cr. 5. Alt. F., offered 2009. *Prereq: Permission of instructor.* Current theories encompassing scanning electron optics and their applications for high and low vacuum microscopy, specimen chemical and cryopreservation methods, x-ray microanalysis, backscattered and topographic imaging, image digitization, processing and presentation. Limit of 10 students.

EEOB 681. Transmission Electron Microscopy. (Cross-listed with GDCB, Micro). (2-9) Cr. 5. Alt. S., offered 2011. *Prereq: GDCB 679 and permission of instructor.* Current theories encompassing electron optics and their applications for chemical and physical specimen preservation, ultramicrotomy, general staining and cytochemistry, immunocytochemistry, autoradiography, negative staining and shadowing, x-ray microanalysis, image digitization, processing and presentation.

EEOB 698. Seminar. Cr. 1. Repeatable. Meetings of graduate students and faculty to discuss recent literature and problems under investigation.

EEOB 699. Research. Cr. arr. Repeatable. Research for thesis or dissertation. Satisfactory-fail only.
I. Iowa Lakeside Laboratory. (Cross-listed with Ia LL 699I)

Economics

www.econ.iastate.edu

J. Arne Hallam, Chair of Department

Distinguished Professor: W. Huffman

Distinguished Professors (Emeritus): Baumel, Fuller, Harl, Johnson, Ladd, Luckett

University Professors: Lapan, Orazem

University Professor (Emeritus): Wisner

Professors: Babcock, Beghin, Choi, Deiter, Duffy, Edelman, Edwards, Garasky, Ginder, Hallam, Hayes, D. Hennessy, Herriges, Hoffman, Jensen, Jolly, Kliebenstein, Kling, Lawrence, Lence, MacDonald, Miranowski, Moschini, Otto, Schroeter, Tesfatsion, Wang

Professors (Emeritus): J. Adams, R. Adams, Faden, Falk, Fletcher, Hayenga, Julius, Kolmer, Mattila, Meyer, Meyers, Paulsen, Prescott, Starleaf, Stephenson, Stone, Vandewetering

Associate Professors: Bhattacharya, Bunzel, Frankel, Gallagher, Kreider, Quirmbach, Rosenblat, Singh, Weninger, Zheng

Associate Professor (Emeritus): Doak

Assistant Professors: Hart, Oviedo, Zhylyevskyy

Assistant Professors (Adjunct): H. Hennessy, S. Huffman

Senior Lecturers: Alexander, Luvaga

Lecturers: McCullough, Rajan, Roy, Wohlgemuth

Undergraduate Study

The department offers work for the degrees of bachelor of science with a major in agricultural business, bachelor of science with a major in business economics, and bachelor of science with a major in economics. For further discussion of programs in agricultural business, see the statement below under College of Agriculture. For programs in business economics, see the statement below under College of Business. For programs in economics, see the statement below under College of Liberal Arts and Sciences. Visit our web site at www.econ.iastate.edu.

Graduates of the Department of Economics have unique skills that distinguish them from other graduates. They have the ability to think and reason clearly, and can address complex issues using tools and decision making models of economics, mathematics, statistics, as well as concepts from the biological, physical, and social sciences. Graduates develop human relations skills that are essential in the work place and the community. They are able to communicate economic and business concepts to other professionals, collective organizations, governments, and the general public using a variety of means. Graduates understand the interaction of technology, human activity, and the environment. They are able to apply concepts associated with making "optimal" choices among economic alternatives. Graduates are prepared for graduate work in law, economics, and business, as well as the world of work, having learned tools of critical analysis and skills essential to getting and keeping meaningful employment.

College of Agriculture

For the undergraduate curriculum in agricultural business, see *College of Agriculture, Curricula.*

The agricultural business curriculum prepares students for advanced studies and for careers in agricultural finance, management in agricultural supply and marketing industries, commodity merchandising and research, business research and management, farm and ranch operations, commercial farm management and appraisal, agricultural sales and marketing, agricultural reporting and public relations, agricultural extension, international activities, and government service. A major in agricultural business with a minor in economics is not permitted; however, a double major in agricultural business and economics is permitted. A minor in agricultural business will be offered pending administrative approval.

College of Business

For the undergraduate curriculum in business economics, see *College of Business, Curricula.*

The major in business economics provides a high-quality education with a balanced emphasis in both business and economics. Graduates from the business economics major possess a unique mix of analytical and applied business skills well-suited for employment in upper level management and public service positions. Graduates also have solid preparation for graduate studies in law, economics, and in Master of Business Administration (MBA) programs. A double major in business economics and agricultural business is not permitted; a double major in business economics and economics is not permitted, either. A major in business economics with a minor in economics is not permitted.

College of Liberal Arts and Sciences

Candidates for the bachelor of science degree with a major in economics must fulfill requirements established by the College of Liberal Arts and Sciences. (For details of undergraduate curricula in liberal arts and sciences, see *College of Liberal Arts and Sciences, Curriculum.*) The economics curriculum prepares students for advanced studies, professional degrees such as law and business administration, and for careers in finance, business and economic research, management, insurance, brokerage, real estate, labor relations, international development, and government service.

Students majoring in economics are required to take either Math 165 and 166 or Math 165 and Econ 207 or Math 160 and Econ 207 within the mathematical and natural sciences group. Students who plan to take postgraduate work in economics should take Math 165 and 166 for the above sequence. Additional requirements are Stat 226 and 326. Twenty-eight credits in economics are required for the bachelor of science degree. Students must complete the following courses in economics: Econ 101, 102, 301, 302, 371, three Econ courses numbered 400-489, plus one additional Econ course selected from an approved departmental list. Economics majors must maintain a C average in 101, 102, 301, and 302, with no grade lower than a C-.

Optimal progress for an economics major would be to complete the principles sequence, Econ 101 and 102, in the freshman year. Math 165, 166, or Math 165, Econ 207, or Math 160, Econ 207 should also be completed in the freshman year, followed by the intermediate theory sequence, Econ 301 and 302, in the sophomore year. Stat 226 and 326 are recommended in the sophomore year.

A minor in economics is offered. Courses to be included in the minimum of 15 hours are Econ 101, 102, and 301.

Communication Proficiency Requirement: The major in economics requires a grade of C or better in each of the following English courses: 150, 250 (or 250H), and 314.

The department participates in the interdepartmental programs in international studies and women's studies.

Learner Outcome Goals

In general, our goal is that all Department of Economics graduates at Iowa State are able to use economic reasoning to think critically; to make decisions and to communicate effectively; to be ethical; to respect the environment, and to be multi-culturally and internationally aware.

Specifically, with respect to:

1. Critical Thinking, all graduates of the Department of Economics are able to:
   a) distinguish factual statements from opinions or value judgements
   b) use scientific methods to analyze and interpret data
   c) distinguish causal relationships from correlations
   d) determine the accuracy of statements
   e) understand the usefulness of abstractions and models
   f) distinguish simplifying and critical assumptions from unnecessary details
   g) objectively critique competing viewpoints to make reasoned judgements
2. Economic Reasoning:
   a) distinguish positive (what is) and normative (what should be) economics
   b) determine the opportunity cost of alternatives
   c) apply the concepts of comparative advantage, specialization, and exchange to analyze resource allocation issues
   d) identify the conditions under which markets allocate resources efficiently or markets fail
   e) apply marginal economic analysis to solve problems
   f) conduct comparative static analyses
   g) pose and test hypotheses
3. Decision Making/Problem Solving:
   a) work effectively alone and in teams to solve problems
   b) use scientific methods to identify optimal choices among economic alternatives
   c) identify decision-makers, objectives, choice variables, incentives, and constraints
   d) identify and apply the solution technique best suited for the specific problem
   e) understand how conclusions depend on assumptions
4. Communications:
   a) communicate economic and business concepts to professionals, organizations, governments, and the general public
   b) obtain information by accessing electronic or traditional media, listening, or by observation
   c) use computer and statistical methods to organize and analyze data
   d) write clearly and effectively
   e) speak clearly and persuasively
   f) prepare and present visual information effectively
5. Ethics:
   a) develop ethical perspectives and sense of moral responsibility and values
   b) discuss contemporary ethical and moral issues in professional and private life
   c) critically evaluate their own arguments and those of others
6. Environment Awareness:
   a) understand the physical and biological properties of the environment and ecological systems
   b) understand how economic activity, such as business or agriculture, impacts the environment
7. International/Multi-Cultural Awareness:
   a) understand cultural diversity within our own nation
   b) understand cultural diversity around the world
   c) know the different economic or agricultural systems in other countries
   d) have human relation skills essential in the work place and the community

Graduate Study

The department offers work toward the degrees master of science and doctor of philosophy with majors in economics and agricultural economics. The department also offers minors to students with majors in other departments.

Students do not need to have an undergraduate major in economics or agricultural economics in order to qualify for graduate work in the department. However, students must have completed undergraduate coursework in macroeconomics, microeconomics, statistics, calculus, and matrix algebra. Some background in Math courses emphasizing logic and proofs is preferred, particularly for the Ph.D.

Candidates for the degree master of science (thesis option) are required to complete satisfactorily 30 credits of acceptable graduate work, including preparation of a thesis.

Candidates for the degree master of science (non-thesis option) may fulfill requirements by satisfactorily completing 32 credits of coursework, including preparation of a creative component.

Programs of study for the doctorate are organized by each student in consultation with the major professor and the individual's committee. Students may select fields of concentration from the following: agricultural economics, financial economics, industrial organization, international economics, human resources, macroeconomics, and environmental and resource economics.

Each student must complete advanced courses in microeconomic and macroeconomic theory, quantitative methods and econometrics, and two fields from the list above. Students must demonstrate competence in theory by passing qualifying examinations. Students must also participate in workshops.

With the cooperation of the College of Law at Drake University, a joint degree consisting of doctor of jurisprudence and master of science in agricultural economics or economics may be pursued concurrently. Other cooperative programs of study may be arranged with the University of Iowa College of Law or other recognized institutions.

The department cooperates in the interdepartmental graduate majors in transportation and sustainable agriculture, and the interdepartmental minor in gerontology.

Courses primarily for undergraduate students

Econ 101. Principles of Microeconomics. (3-0) Cr. arr. F.S.SS. Resource allocation, opportunity cost, comparative and absolute advantage. Supply and demand. Marginal analysis. Theories of production and consumption, pricing, and the market system. Perfect and imperfect competition and strategic behavior. Factor markets. Present discounted value. Recitation section required for 4 credits.

Econ 101H. Principles of Microeconomics. (3-0) Cr. 3. F. Resource allocation, opportunity cost, comparative and absolute advantage. Supply and demand. Marginal analysis. Theories of production and consumption, pricing, and the market system. Perfect and imperfect competition and strategic behavior. Factor markets. Present discounted value. Open only to honors students.

Econ 101L. Laboratory in Principles of Microeconomics. (0-2) Cr. 1. F. *Prereq: Concurrent enrollment in the appropriate section of 101.* Discussion of material typically covered in Econ 101. Application of economic principles to real world problems. Economic principles and basic business management concepts applied to decision-making in agribusiness operations.

Econ 102. Principles of Macroeconomics. (3-0) Cr. 3. F.S.SS. *Prereq: 101 recommended.* Measurement of macro variables and general macro identities. Classical models of full employment. Production and growth. Savings and investment. Employment and unemployment. Money, inflation, and price levels. Operation of the U.S. banking system. Fiscal and monetary policy. Elements of international finance.

Econ 102H. Principles of Macroeconomics. (3-0) Cr. 3. S. *Prereq: 101.* Measurement of macro variables and general macro identities. Classical models of full employment. Production and growth. Savings and investment. Employment and unemployment. Money, inflation, and price levels. Operation of the U.S. banking system. Fiscal and monetary policy. Elements of international finance. Open only to honors students.

Econ 110. Orientation in Agricultural Business. (1-0) Cr. 0.5. F. Orientation course for freshman and new transfer students in agricultural business. Satisfactory-fail only.

Econ 207. Applied Economic Optimization. (2-2) Cr. 3. S. *Prereq: Math 151, 160, 165 or equivalent.* Application of linear algebra, calculus and unconstrained and constrained optimization techniques to economic problems. Learning outcomes include the ability to (i) identify the objective, decision variables and constraints in economic decision problems, (ii) represent elements of an economic problem in simple mathematical models, (iii) identify and apply mathematical tools that can be used to solve the problems, (iv) identify the strengths and limitations of the solution method, and (v) interpret the economic meaning and implications of the solution.

Econ 230. Farm Business Management. (2-2) Cr. 3. F.S. *Prereq: 101; Acct 284.* Business and economic principles applied to decision making and problem solving in the management of a farm business. Cash flow, partial, enterprise, and whole farm budgeting. Information systems for farm accounting, analysis, and control. Obtaining and managing land, capital, and labor resources. Alternatives for farm business organization and risk management.

Econ 235. Introduction to Agricultural Markets. (3-0) Cr. 3. F.S. *Prereq: 101.* Basic concepts and economics principles related to markets for agricultural inputs and products. Overview of current marketing problems faced by farms and agribusinesses, farm and retail price behavior, structure of markets, food marketing channels, food quality and food safety, and the role of agriculture in the general economy. The implications of consumer preferences at the farm level. Introduction to hedging, futures, and other risk management tools.

Econ 292. Career Seminar. (1-0) Cr. 1. F. *Prereq: Classification in economics or agricultural business.* Career opportunities in the various industries and

government institutions. Required training and skills needed to perform successfully in different types of careers. Factors important in finding and obtaining employment either before or after graduation including personal resumes, interviewing, and letter writing.

Econ 297. Internship. Cr. 2. Repeatable. F. *Prereq: Permission of instructor and classification in agricultural business or economics.* Students complete a research report, based on their internship or approved work experience, that examines chosen topics in management, marketing or finance. No more than 4 credits of Econ 297 may be applied toward graduation. Satisfactory-fail only.

Econ 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Econ 301. Intermediate Microeconomics. (3-0) Cr. arr. F.S.SS. *Prereq: 101; Math 160 or 165.* Theory of consumer and business behavior; optimal consumption choices and demand; theory of firm behavior; costs, production, and supply; competitive and imperfectly competitive markets; theory of demand for and supply of factors of production; general equilibrium analysis. Recitation required for 4 credits. Nonmajor graduate credit.

Econ 302. Intermediate Macroeconomics. (3-0) Cr. 3. F.S. *Prereq: 101, 102; Math 160 or 165.* Theory of income, employment, interest rates, and the price level; fiscal and monetary policy; budget and trade deficits; money and capital inflows, interest rates, and inflation. Nonmajor graduate credit.

Econ 308. Agent-Based Computational Economics. (3-0) Cr. 3. *Prereq: 101.* Computational study of economies as evolving systems of autonomous interacting agents. Key ideas from game theory and complex adaptive systems theory for modeling the adaptation, learning, and co-evolution of economic agents in decentralized market economies. Evolution of behavioral norms and interaction networks. Building agent-based computational laboratories for the experimental study of market protocols and agent learning processes. Illustrative economic applications (e.g., financial markets, labor markets, agricultural markets, electricity markets, auction markets, automated internet markets, collective usage of common-pool resources). Nonmajor graduate credit.

Econ 312. History of Economic Thought. (3-0) Cr. 3. S. *Prereq: 101.* The logic and explanatory value of received economic doctrines since the middle of the eighteenth century. The reflection of past economic doctrines in contemporary theory and policy. Discussion of major works by Smith, Ricardo, Mill, Marx, Marshall, Walras, Wicksell, and Keynes.

Econ 320. Labor Economics. (3-0) Cr. 3. F. *Prereq: 101.* Survey of contemporary labor market problems and public policy toward labor. Economic analysis of topics such as labor supply and demand, work incentives and compensation, transfer programs, education and training, mobility, minimum wages, unions, working conditions, benefits, discrimination, unemployment, wage differentials across regions, and labor markets in other countries. Nonmajor graduate credit.

Econ 321. Economics of Discrimination. (Cross-listed with W S). (3-0) Cr. 3. F. *Prereq: 101.* Economic theories of discrimination. Analysis of the economic problems of women and minorities in such areas as earnings, occupations, and unemployment. Public policy concerning discrimination. Poverty measurement and antipoverty programs in the U.S. Nonmajor graduate credit.

Econ 325. Biorenewable Systems. (Cross-listed with A E, An S, TSM, Agron, BusAd). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing. Counts as a general elective course for majors in agricultural business, economics, and business economics.

Econ 332. Cooperatives. (3-0) Cr. 3. S. *Prereq: 101.* Survey of cooperative activities with emphasis on agricultural cooperatives, types of cooperatives, methods of organization and operation, principles, legal and tax aspects, cooperative finance, economic possibilities, and limitations of cooperation. Students will learn how to work together in teams to solve problems while role playing directors of cooperative boards. Nonmajor graduate credit.

Econ 333. Advanced Farm Business Management. (3-2) Cr. 3-4. F. *Prereq: 230.* Effective use of strategic planning, decision methods, and computer assistance for solving farm problems. Applications of economic and management theory to analyze farm business decisions using efficiency measures to assess current resource use and direct the farm business analysis, planning, and tax process. Computers as aids in the decision process. Three credits available only to students enrolled in AgPAQ. Laboratory required for 4 credits. Nonmajor graduate credit.

Econ 334. Entrepreneurship in Agriculture. (3-0) Cr. 3. *Prereq: 101.* Introduction to the process of entrepreneurship within the agricultural and food sectors. Emphasis on opportunity recognition and assessment, resource acquisition and feasibility analysis for both private and social enterprises. Students will develop a comprehensive feasibility study for a new business or non-profit organization.

Econ 336. Agricultural Selling. (3-0) Cr. 3. F. *Prereq: 101.* Principles of selling with application to agricultural and food related businesses. Attitudes, value systems, and behavioral patterns that relate to agricultural sales. Electronic marketing, selling strategies, preparing for sales calls, making sales presentations, handling objections, and closing sales. Analysis of the buying or purchasing process. Evaluation of agri-selling as a possible career choice.

Econ 338. Topics in Agricultural Marketing. Cr. arr. *Prereq: 101, 235 recommended for topics B and C.* A given topic can be taken only once. A hands-on application of economic concepts and principles to agricultural commodity markets, marketing methods, risk management, and related agribusiness decisions.
A. Dairy marketing. 2 cr.
B. Livestock marketing. 1 cr.
C. Grain marketing. 1 cr.

Econ 344. Public Finance. (3-0) Cr. 3. S. *Prereq: 101.* The economic role of governments in market economies. Public goods, externalities, income distribution, and income maintenance programs. The effect of taxes on economic behavior, descriptions of the structure of the principal U.S. taxes, and current reform proposals. Nonmajor graduate credit.

Econ 353. Money, Banking, and Financial Institutions. (3-0) Cr. 3. F.S.SS. *Prereq: 101, 102.* Theoretical and applied analysis of money, banking, and financial markets; interest rates and portfolio choice; the banking industry in transition; the money supply process; the Federal Reserve System and the conduct of monetary policy; macro implications of monetary policy; international finance.

Econ 355. International Trade and Finance. (3-0) Cr. 3. F.S. *Prereq: 101, 102.* Explanations of causes of international trade and the impact of trade on welfare and employment patterns. Analysis of government policies towards trade, such as tariffs, quotas, and free trade areas. Theory of balance of payments and exchange rate determination, and the role of government policies. Examination of alternative international monetary arrangements. Nonmajor graduate credit.

Econ 362. Applied Ethics in Agriculture. (Cross-listed with Soc). (3-0) Cr. 3. F. *Prereq: Econ 101 or Soc 130 or Soc 134, junior or senior status in the College of Agriculture and Life Sciences.* Identify major ethical issues and dilemmas in the conduct of agricultural and agribusiness management and decision making. Discuss and debate proper ethical behavior in these issues and situations and the relationship between business and personal ethical behavior.

Econ 370. Comparative Capitalism and Economic Transitions. (3-0) Cr. 3. F. *Prereq: 101, 102.* Theories of capitalism and the economics of transition from a planned to a market economy; the role and the creation of economic institutions supporting different economic systems. An examination of recent experiences of Eastern European countries, the former Soviet Union, China, the European Union, and the United States.

Econ 371. Introductory Econometrics. (4-0) Cr. 4. F.S. *Prereq: 301, 302 or 353, Stat 326.* Introduction to the models and methods used to estimate relationships and test hypotheses pertaining to economic variables. Simple and multiple regression analysis; stochastic regressors; heteroskedasticity; autocorrelation; measurement error; simultaneous equations. Nonmajor graduate credit.

Econ 376. Rural, Urban and Regional Economics. (Cross-listed with C R P). (3-0) Cr. 3. F.S. *Prereq: 101.* Firm location with respect to regional resources, transport, scale economies, externalities, and policies. Measures of local comparative advantage and specialization. Spatial markets. Population location considering jobs, wages, commuting, and local amenities. Business, residential, and farm land use and value. Migration. Other topics may include market failure, regulation, the product cycle, theories of rural and urban development, developmental policy, firm recruiting, local public goods and public finance, schools, poverty, segregation, and crime. Nonmajor graduate credit.

Econ 378. Economics of Aging. (Cross-listed with HD FS, Geron). (3-0) Cr. 3. S. *Prereq: 3 credits in principles of economics and 3 credits in human development and family studies.* Economic status of the aging, retirement planning and the retirement decision, role of Social Security, public transfer programs for the elderly, intrafamily transfers to/from the elderly, private pensions, financing medical care and housing for the elderly, prospects and issues for the future.

Econ 380. Environmental and Resource Economics. (Cross-listed with Env S). (3-0) Cr. 3. F. *Prereq: 101.* Natural resource availability, use, conservation, and government policy, including energy issues. Environmental quality and pollution control policies.

Econ 385. Economic Development. (3-0) Cr. 3. S. *Prereq: 101, 102.* Current problems of developing countries, theories of economic development, agriculture, and economic development, measurement and prediction of economic performance of developing countries, alternative policies and reforms required for satisfying basic needs of Third World countries, interrelationships between industrialized countries and the developing countries, including foreign aid. Nonmajor graduate credit.

Econ 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Econ 401. Topics in Microeconomics. (3-0) Cr. 3. *Prereq: 301, Stat 226.* Advanced treatment of selected topics from one or more of the following areas: household production models, factor markets, game theory and imperfect competition, general equilibrium, intertemporal choice, asset markets, income distribution, externalities and public goods, etc. Nonmajor graduate credit.

Econ 402. Topics in Macroeconomics. (3-0) Cr. 3. *Prereq: 301, 302, Stat 226.* Advanced treatment of selected topics from one or more of the following areas: business cycle theory, growth theory, fiscal and monetary policy, coordination issues, open economy macroeconomics, and financial economics. Nonmajor graduate credit.

Econ 415. Firms, Markets and Industry Structure. (2-2) Cr. 3. F.S. *Prereq: 301.* The theory of the firm; determinants of firm boundaries; firm behavior; perfectly competitive markets; welfare and market efficiency;

monopoly and monopsony; price discrimination; oligopoly and oligopsony; strategic market behavior. Nonmajor graduate credit.

Econ 416. Industrial Organization. (3-0) Cr. 3. F. *Prereq: 301, 415.* Game theoretic approaches to competition and strategizing; spatial competition; research and development; entry deterrence; the economics of regulation. Nonmajor graduate credit.

Econ 431. Managerial Economics. (3-0) Cr. 3. S. *Prereq: 301.* Theory of the firm; organizational incentives and efficiency; moral hazard; role of information and decision making under uncertainty; ownership and control; business investment. Nonmajor graduate credit.

Econ 437. Commodity Marketing and Risk Management. (3-0) Cr. 3. S. *Prereq: 235, 301, Stat 326.* The purpose and performance of commodity markets. How commodity marketing institutions function. Merchandising arrangements. Distinguishing features of agricultural commodities. Hedging, arbitrage, and speculation in commodity spot, forward, futures, and options markets. Valuation theory. Nonmajor graduate credit.

Econ 455. International Trade. (3-0) Cr. 3. S. *Prereq: 301.* Rigorous treatment of theories of international trade and international factor movements. Examination of the impact of trade and labor migration on domestic and world welfare and on the distribution of income. Theoretical analysis of government policies towards trade and factor movements, including quotas, tariffs, free trade areas and immigration restrictions. Discussion of contemporary issues and controversies concerning globalization, including multinational firms and labor migration. Nonmajor graduate credit.

Econ 457. International Finance. (3-0) Cr. 3. F. *Prereq: 302.* National income accounting and balance of payments; foreign exchange rates and exchange rate markets; money, interest rates, and exchange rate determination; prices, exchange rates, and output in the short run; international monetary arrangements; fixed versus flexible exchange rates; optimal currency areas; international capital flows; currency and financial crises in emerging markets. Nonmajor graduate credit.

Econ 458. Economic Systems for Electric Power Planning. (Cross-listed with E E). (3-0) Cr. 3. *Prereq: E E 303 or Econ 301.* Evolution of electric power industry. Power system operation and planning and related information systems. Linear and integer optimization methods. Short-term electricity markets and locational marginal prices. Risk management and financial derivatives. Basics of public good economics. Cost recovery models including tax treatment for transmission investments. Nonmajor graduate credit.

Econ 460. Agricultural, Food, and Trade Policy. (Dual-listed with 560). (3-0) Cr. 3. S. *Prereq: 301 or 501.* Description and analysis of economic problems of U.S. agriculture. Explanation and economic analysis of government policies and programs to develop agriculture, conserve agricultural resources, address consumer food concerns, stabilize farm prices, and raise farm incomes. The influence of macropolicy, world economy, and international trade on U.S. agriculture. Nonmajor graduate credit.

Econ 466. Agricultural Finance. (3-0) Cr. 3. S. *Prereq: 301, Stat 226, Fin 301 and Econ 353 (recommended).* Financial analysis of agricultural businesses; liquidity, capital structure, and growth and risk of agricultural firms; capital budgeting methods; analysis of land investments, leasing, and costs of credit; financial intermediation and major financial institutions for agriculture; borrower-lender relationships, and asset-liability management techniques by financial intermediaries; public policies affecting agricultural credit markets. Nonmajor graduate credit.

Econ 480. Intermediate Environmental and Resource Economics. (Dual-listed with 580). (3-0) Cr. 3. *Prereq: 301.* Theories of natural resource utilization and allocation. Externalities, public goods, and environmental quality. Planning natural resource use and environmental quality. Methodologies for analyzing natural resource and environmental problems. Nonmajor graduate credit.

Econ 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or senior classification, 14 credits in economics.* No more than 9 credits of Econ 490 may be used toward graduation. Satisfactory-fail only.
E. Entrepreneurship
H. Honors

Econ 492. Graduating Senior Survey. (1-0) Cr. R. F.S. *Prereq: Graduating senior.* Final preparations for graduation. The final stages of job searching, interviewing, letter writing, and resume preparation. Outcomes assessment information from graduating seniors including opinion surveys, instructor/advisor/course evaluations, exit interviews, student accomplishment surveys, job placement surveys, and comprehensive skills examinations. Departmental recognition of graduating seniors. Life as an alumnus - expectations and obligations. Convocation and commencement information. Satisfactory-fail only.

Econ 496. Economics Travel Course. Cr. arr. Repeatable. *Prereq: Sophomore status; permission of instructor.* Tour and study of international agricultural and/or nonagricultural economies, markets, and institutions. Locations and duration of tours will vary. Limited enrollment.

Econ 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

Econ 500. Quantitative Methods in Economic Analysis I. (4-0) Cr. 4. F. *Prereq: 301, 1 year of calculus, Stat 401, and permission of Director of Graduate Education.* Economic applications of selected mathematical and statistical concepts: linear models and matrix algebra; differential calculus and optimization; integral calculus and economic dynamics; probability distributions, estimation, and hypothesis testing in the analysis of economic data.

Econ 501. Microeconomics. (4-0) Cr. 4. F. *Prereq: 301, credit or enrollment in 500 or equivalent background in calculus and statistics.* The theory of the consumer, theory of the firm, perfect and imperfect competition, welfare economics, and selected topics in general equilibrium and uncertainty. This is a Master's level course.

Econ 502. Macroeconomics. (4-0) Cr. 4. F. *Prereq: 302, credit or enrollment in 500 or equivalent background in calculus and statistics.* Models of aggregate supply and demand, theories of consumption and investment, money supply and demand, inflation, rational expectations, stabilization policy, financial markets, and international finance. This is a Master's level course.

Econ 509. Applied Numerical Methods in Economics. (2-2) Cr. 3. *Prereq: 500, 501; or 600, 601.* Use of numerical techniques to solve economic problems. Numerical differentiation and integration numeric solutions of systems of equations, static and dynamic optimization problems including unconstrained optimization, maximum likelihood methods, general nonlinear programming methods, dynamic programming and optimal control, numerical methods for solving functional equations.

Econ 520. Labor Supply and Human Capital formation. (3-0) Cr. 3. *Prereq: 501 or 601.* Labor supply decisions and empirical analysis for agricultural operators and other self-employed and wage-earning households; multiple job holding; resource allocation in productive households; human capital formation by households, firms, and public institutions, which includes schooling, on-the-job training, migration, health, research, raising of children, and implications for household income and welfare; applications to problems in rural areas of developing and developed countries.

Econ 521. Labor Markets. (3-0) Cr. 3. *Prereq: 501 or 601.* Analysis of labor demand and market determination of wages and employment; analysis of distortions in labor markets due to non-competitive forces, legislation, and discrimination; wage inequality, compensation and work incentives; compensating differentials; microeconomic analysis of unemployment and job search.

Econ 530. Advanced Farm Management. (2-0) Cr. 2. *Prereq: 6 credits in Economics.* Offered off campus as demand warrants. Risk management principles applied to agriculture. Sources of risk and uncertainty. Attitudes toward risk. Techniques for analyzing and controlling production, marketing, financial, legal and human risk. Designed for master of agriculture program only.

Econ 532. Business Economics. (3-0) Cr. 3. *Prereq: 101 and enrollment in MBA or BAS program; not for economics majors.* Applications of microeconomic theory and decision analysis. Demand analysis, production and cost analysis, forecasting, pricing, market structures and strategy, capital investment analysis, decision-making under uncertainty, government and business.

Econ 533. Economic and Business Decision Tools. (Cross-listed with BusAd). (3-0) Cr. 3. *Prereq: Econ 501 or 532.* Team taught by faculty in the Department of Economics and the College of Business, this course focuses on applied economic and business tools for decision making. The topics include: Monte Carlo analysis with applications to option pricing and insurance mechanism design, portfolio analysis using existing standard spreadsheet software and add-ons, dynamic programming tools for inventory management and sequential decisions, discrete choice modeling and statistical bootstrapping, and financial performance evaluation using commercially available software.

Econ 535. Applied Agricultural Marketing. (2-0) Cr. 2. *Prereq: 6 credits in economics.* Off campus. Offered as demand warrants. Market structure and performance in the food and agricultural sector. Vertical coordination systems and pricing systems in agriculture. Market information and price forecasting. Alternative marketing methods and strategies for major Iowa agricultural commodities including the use of futures and options markets. Designed for master of agriculture program only.

Econ 537. Commodity Markets: Analysis and Strategy. (3-0) Cr. 3. *Prereq: 501 or 532 or 601, Econ 571 or Stat 326.* Analysis of exchange-traded and over-the-counter commodity markets, their functions and performance. Evaluation of hedging, speculation, and arbitrage strategies. Valuation of derivatives and comparison with derivatives on financial assets. Efficiency and the role of information in commodity markets. Market regulation.

Econ 545. Public Economics. (3-0) Cr. 3. *Prereq: 501 or 601.* Optimal taxation; excess burden; partial and general equilibrium analysis of tax incidence; social insurance; effects of taxation on labor supply and savings; economics of the health sector.

Econ 553. Applied Research in Monetary and Macroeconomics. (3-0) Cr. 3. *Prereq: 502, 571.* Application of economic theory to the analysis of contemporary issues in macroeconomics, monetary economics, and financial economics. This is a Master's level course.

Econ 555. Issues in International Economics. (3-0) Cr. 3. *Prereq: 501, 502.* Theories of international trade and finance. Emphasis on current policy issues in international economics. This is a Master's level course.

Econ 560. Agricultural, Food, and Trade Policy. (Dual-listed with 460). (3-0) Cr. 3. S. *Prereq: 301 or 501.* Description and analysis of economic problems of U.S. agriculture. Explanation and economic analysis of government policies and programs to develop agriculture, conserve agricultural resources, address consumer food concerns, stabilize farm prices, and raise farm incomes. The influence of macroeconomic policy, world economy, and international trade on U.S. agriculture.

Econ 563. Issues in Government Policy Affecting Agriculture. (2-0) Cr. 2. *Prereq: 101.* Off campus. Offered as demand warrants. Government policy and the policy-making process as it affects food, agriculture, and trade. Description and analysis of government policies and programs designed to address production agriculture problems and consumer food concerns. Evaluation of the interaction of agriculture and world trade as affected by U.S. and foreign government policies. Designed for master of agriculture program only.

Econ 571. Intermediate Econometrics. (3-0) Cr. 3. S. *Prereq: 500.* Single and multiple equation regression models; dummy explanatory variables; serial correlation; heteroskedasticity; distributed lags; qualitative dependent variables; simultaneity. Use of econometric models for tests of economic theories and forecasting.

Econ 576. Spatial Economics. (3-0) Cr. 3. *Prereq: 501.* Analysis of location choice by firms, employees, and households emphasizing the role of spatial variations in agglomeration economies, economies of scale, distance, transport, endowments, amenities, and local government. Models of land use, urban form, spatial competition, central place theory, and migration. Techniques of discrete choice analysis, statistical analysis of categorical data, urban system modeling, and interregional computable general equilibrium.

Econ 580. Intermediate Environmental and Resource Economics. (Dual-listed with 480). (3-0) Cr. 3. *Prereq: 301.* Theories of natural resource utilization and allocation. Externalities, public goods, and environmental quality. Planning natural resource use and environmental quality. Methodologies for analyzing natural resource and environmental problems.

Econ 581. Advanced Environmental Economics. (3-0) Cr. 3. *Prereq: 501 or 601.* Interrelationships of natural resource use and the environment. Applied welfare and benefit-cost analyses. Externalities and pollution abatement. Nonmarket valuation of resources. Property rights. Legal and social constraints. Policy approaches.

Econ 590. Special Topics. Cr. arr. Repeatable. Satisfactory-fail only.

Econ 599. Creative Component. Cr. arr. Satisfactory-fail only.

Courses for graduate students

Econ 600. Quantitative Methods in Economic Analysis II. (4-1) Cr. 4. F. *Prereq: 500 and linear algebra.* Unconstrained and equality- and inequality-constrained optimization; the Kuhn-Tucker formulation; abstract spaces; dynamic programming; dynamical systems.

Econ 601. Microeconomic Analysis I. (4-1) Cr. 4. F. *Prereq: 301, previous or concurrent enrollment in 600 and permission of Director of Graduate Education.* Economic theory and methodology; theory of consumer behavior, theory of the competitive firm, supply and factor demand; duality relations in consumer and producer theory, welfare change measures; partial equilibrium analysis, perfect competition, monopoly; choice under uncertainty, the expected utility model, risk aversion; insurance, portfolio and production decisions under risk.

Econ 602. Macroeconomic Analysis. (4-1) Cr. 4. S. *Prereq: 301, 302, previous or concurrent enrollment in 600 and permission of Director of Graduate Education.* Neoclassical aggregate growth models; the overlapping generations model; endogenous growth models; equilibrium business cycle theories; equilibrium job search and matching; models of money; fiscal and monetary policy; income and wealth distribution.

Econ 603. Microeconomic Analysis II. (4-1) Cr. 4. S. *Prereq: 601, 602 and permission of Director of Graduate Education.* General equilibrium analysis, efficiency, and welfare; market failures, externalities, and the theory of the second best; introduction to game theory; adverse selection, signaling, screening and moral hazard.

Econ 604. Advanced Macroeconomic Analysis. (4-1) Cr. 4. F. *Prereq: 601, 602 and permission of Director of Graduate Education.* Topics will be selected from: new Keynesian approaches to business cycle theory; endogenously generated business cycles; models of credit and financial intermediation; mechanism design and time inconsistency issues; political economy models; heterogeneous-agent models with strategic interaction; path dependence, network effects, and lock-in; economies as evolving self-organizing systems.

Econ 605. Advanced Topics in Microeconomics. (3-0) Cr. 3. *Prereq: 603.* Selected topics in microeconomic theory of current significance to the profession.

Econ 606. Advanced Topics in Macroeconomics. (3-0) Cr. 3. *Prereq: 603, and credit or current enrollment in 604.* Selected topics in macroeconomic theory of current significance to the profession.

Econ 615. Theoretical Industrial Organization. (3-0) Cr. 3. *Prereq: 603.* Theoretical analysis of traditional topics in industrial organization. Review of game theory. Monopoly and oligopoly theory, price discrimination, product differentiation, research and development, diffusion of innovation, network externalities, and asymmetric information.

Econ 616. Empirical Methods in Industrial Organization. (3-0) Cr. 3. *Prereq: 603, 671.* Empirical methods in industrial organization. Measurement of market power. Discrete choice models of product differentiation. Empirical studies of price dynamics, entry, collusion, price discrimination, technology adoption, asymmetric information, and auctions.

Econ 618. Game Theory. (3-0) Cr. 3. *Prereq: 603, or 501 and permission of instructor.* Theoretical analysis and applications of strategic games, extensive form games, and cooperative games. Nash equilibrium, correlated equilibrium, Bayesian games, subgame perfect equilibrium, the core, evolutionary equilibrium, repeated games with finite automata, and common knowledge.

Econ 641. Agricultural Economics I. (3-0) Cr. 3. *Prereq: 603.* Advanced treatment of topics in agricultural economics with emphasis on optimization models. Part 1: Applied duality in production and demand models. Flexible representation of production and demand systems. Production efficiency and nonparametric analysis. Production models with risk. Part 2: The role of contracts in the organization and coordination of agricultural production. Distribution of asset ownership, allocation of risk among parties, and the structure of incentive systems. Rationale for cooperative efforts and information sharing. The role of information, insurance, and credit.

Econ 642. Agricultural Economics II. (3-0) Cr. 3. *Prereq: 603.* Advanced treatment of topics and models in agricultural economics with emphasis on equilibrium analysis. Part 1: Application of price theory to agricultural market analysis. Vertical market relations, product differentiation and quality in agri-food markets. Storage, futures markets and commodity prices. Part 2: Market failures and the scope for government intervention in agriculture. Applied welfare analysis of agricultural and environmental policies. Issues and models in international trade of agricultural products.

Econ 653. Financial Economics. (3-0) Cr. 3. *Prereq: 603, 672. Recommended: 674, Stat 551.* Review of decision-making under uncertainty. Portfolio theory. Theoretical foundations of asset valuation models: capital asset pricing model (CAPM), arbitrage pricing theory (APT), representative agent models, pricing of derivative securities. Complete and incomplete asset markets, credit markets, financial intermediaries, the role of government in the financial sector. Market frictions, crashes, bubbles. Applications of asset valuation models, with emphasis on their testable implications.

Econ 654. Advanced Topics in Financial Economics. (3-0) Cr. 3. Repeatable. *Prereq: 603.* Selected topics in financial economics of current significance to the profession.

Econ 655. International Trade. (3-0) Cr. 3. *Prereq: 603.* Theories of international trade; welfare and distributional aspects of trade and commercial policies. Optimal trade policies in the presence of domestic distortions; strategic trade policy; international trade and economic growth.

Econ 657. International Finance. (3-0) Cr. 3. *Prereq: 602.* The intertemporal approach to current account determination; non-traded goods and the real exchange rate; fiscal policy in the open economy; monetary approach to balance of payments and exchange rate determination; sticky price models of the open economy; exchange-rate based stabilizations; capital inflows; financial and balance of payments crises; international business cycles.

Econ 671. Econometrics I. (4-1) Cr. 4. F. *Prereq: 501 and Stat 447 or 542.* Probability and distribution theory for univariate and multivariate normal random variables, introduction to the theory of estimators for linear models, hypothesis testing and inference, introduction to large sample properties of estimators; derivation of common estimators and their properties for the classical and general multiple regression models, hypothesis testing, forecasting, implications of specification errors - missing data, left-out regressors, measurement error, stochastic regressors.

Econ 672. Econometrics II. (4-1) Cr. 4. S. *Prereq: 671.* Identification, estimation, and evaluation of systems of simultaneous equations; qualitative choice and limited dependent variable models; introduction to time series methods and applications, including alternative variance specifications.

Econ 673. Microeconometrics. (3-0) Cr. 3. *Prereq: 672, 601.* Econometric treatment of models arising in microeconometric applications. Methods are primarily concerned with the analysis of cross-section data. Topics may include: systems of demand equations in panel data settings, random utility models of discrete choices, production possibilities frontier estimation, and discrete/continuous models of participation and consumption.

Econ 674. Macroeconometrics. (3-0) Cr. 3. *Prereq: 672, 602.* Time-series econometric techniques and their application to macroeconomics and financial markets. Techniques may include GARCH and ARCH-M models, unit-root tests, nonlinear adjustment models, structural VARs, and cointegration tests.

Econ 675. Advanced Topics in Econometrics. (3-0) Cr. 3. Repeatable. *Prereq: 672 or Stat 543.* Advanced treatment of issues important in econometrics. Topics chosen from asymptotic theory, nonlinear estimation, Bayesian and robust econometrics, econometric time series, limited dependent variables and censored regression models, nonparametric and semiparametric methods, bootstrapping and Monte Carlo techniques.

Econ 680. Advanced Resource Economics. (3-0) Cr. 3. *Prereq: 603.* Dynamic allocation of scarce, exhaustible, and renewable natural resources, including minerals and energy, soil, water, forests, and fish. Social versus private decisions. Market and nonmarket considerations. Technological change. Regulation. Dynamics and uncertainty.

Econ 690. Advanced Topics. Cr. arr. Repeatable. Satisfactory-fail only.

Econ 691. Third-Year Paper. Cr. 3. Under the direction of the major professor, Ph.D. students write a formal research paper as an introduction to the dissertation research process. Satisfactory-fail only.

Econ 693. Workshops. Cr. arr. Repeatable. *Prereq: 6 graduate credits in chosen field.* Satisfactory-fail only.

Econ 699. Research for Thesis or Dissertation. Cr. arr. Repeatable. Satisfactory-fail only.

Educational Leadership and Policy Studies

(www.elps.hs.iastate.edu/elps/homepage.htm)

Laura Rendon, Chair of Department

Distinguished Professor: Schuh

Distinguished Professor (Emeritus): Warren

University Professors: Ebbers, Licklider, Robinson

University Professors (Emeritus): Manatt

Professors: Evans, Hagedorn, Rendon, Smith

Professors (Emeritus): Blake, Boyles, Bryan, Engel, Hopper, Huba, Jones, Kizer, Lagomarcino, Lawrence, Mccandless, Moore, Pellegreno, Vanast

Professors (Collaborators): Barak, Gardner, Pierce

Associate Professors: Hamrick, Laanan, Mcleod, Porter

Associate Professor (Emeritus): Thielen

Associate Professor (Adjunct): Tesfagiorgis

Assistant Professors: Gildersleeve, Marshall, Osei-Kofi, Patton, Starobin

Assistant Professors (Adjunct): Arthur, Gruenewald, Hill, Jackson, Payne

Senior Clinician: Scharff

Lecturers: Bradley, Cooper, Coppernoll, Drake, Duree, Englin, Forsythe, Gansemer-Topf, Holcomb, Kimpston, Saunders, Shahjahan, Steven

Clinician: Book, Ratigan, Westerman-Beatty

Departmental Mission, Vision and Goals statements

Mission:

The mission of the Department of Educational Leadership and Policy Studies is to advance the quality and effectiveness of educational institutions and individuals engaged in education. The department is guided by the missions of Iowa State University and the College of Human Sciences and embodies the concepts of the land-grant tradition of teaching, research, and service. The department is dedicated to enhancing the intellectual, cultural, social, and ethical potential of students and faculty for the benefit of Iowa, the nation, and the world. Specifically, the Department of Educational Leadership and Policy Studies:

•Provides graduate degree and career preparation programs, coursework, and other learning opportunities for students and practitioners.

•Conducts and disseminates basic and applied research for the advancement of educational theory and practice.

•Provides professional service for institutions, individuals, and organizations at all levels of education.

Vision:

Research All Educational Leadership and Policy Studies faculty create and disseminate knowledge and promote educational inquiry that enhances educational practices at local, state, national, and international levels.

Teaching All Educational Leadership and Policy Studies faculty engage in teaching that is consonant with the principles of adult learning and effective teaching that help students develop critical thinking and professionally relevant skills, and that provides a foundation for the application of knowledge to practice.

Service All Educational Leadership and Policy Studies faculty, using their professional expertise, work with educators, educational institutions, and other constituent groups to solve problems.

Advising All Educational Leadership and Policy Studies faculty foster students' professional and personal growth by guiding and inspiring them to formulate and complete relevant programs of study and to conduct high quality research.

Curricula/Program The Educational Leadership and Policy Studies faculty develop and implement futuristic curricula and programs to ensure that students learn to think critically and perform their professional roles in an exemplary fashion.

General Goals:

The general goals of the department, and hence of each of its program areas and affiliated programs, are to:

•Conduct high quality graduate education programs, both on- and off-campus, for students seeking graduate degrees in a major in education and/or seeking professional licensure as school service personnel.

•Establish appropriate conditions, opportunities, and resources with which both faculty and graduate students may engage in scholarly activities.

•Assist the educational enterprise of Iowa in development by utilizing, when appropriate, the talents and expertise of the faculty and graduate student body in such activities as workshops, conferences, and consultation in small groups, both on- and off-campus.

Graduate Study

Degrees The Department of Educational Leadership and Policy Studies -- ELPS -- offers work for the degrees master of science, master of education, certificate of advanced studies, and doctor of philosophy with a major in education. ELPS also offers minor work to students majoring in other fields of study. At the master's level, students may specialize in educational administration; higher education; and research and evaluation. Interested students should consult the specific program area for master's degree information related to that program.

Students may complete the Ph.D. with a major in education and a specialization in educational leadership with emphasis in either educational administration or higher education. Specific information about the requirements of the Ph.D. degree is available from the departmental office or on the web (www.elps.hs.iastate.edu/elps/elpsdoc.htm).

The following information refers only to the Ph.D. program:

Prerequisites Prerequisite to major graduate work in educational leadership is completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence. In addition it is preferred that students complete a master's degree and 3-5 years of professional experience.

Learning Opportunities Doctoral students in Educational Leadership and Policy Studies will complete seminars, laboratory experiences, field experiences, independent research, and a capstone experience course. In addition to the common experiences noted above, students will each select an intellectual content area that will prepare them to work in the setting of their choice.

Careers Graduates of the doctoral program are prepared to serve as leaders in various educational settings, including school administration, community colleges, public and private colleges and universities, and public and private educational agencies.

Outcomes Graduates of the Ph.D. program, regardless of the emphasis chosen, possess skills and knowledge related to five core domains: leadership, educational research, communication, educational evaluation, and educational foundations. By the time of graduation, students will demonstrate the necessary skills and knowledge to:

- •Work effectively with individuals and groups.
- •Engage in ethical decision-making and management of resources to accomplish goals.
- •Engage in scholarly inquiry.
- •Express ideas clearly, both orally and in writing.
- •Articulate their values, beliefs, and Philosophy of life.
- •Relate sensitively to individuals from diverse backgrounds.
- •Use the principles of program evaluation and assessment intelligently.
- •Have a clear understanding of the foundations of education, grounding their work in theory and Philosophy.
- •Articulate the concepts, theories, and practices related to the educational content area emphasized in their studies.

Other Related Programs Other graduate programs related to education (including Interdisciplinary Graduate Studies) may be more suited to the interests of potential students on the basis of previous education and experiences as well as future plans and needs. Potential students should refer to programs in the Departments of Agricultural Education and Studies, Curriculum and Instruction, Family and Consumer Sciences Education and Studies, Kinesiology, and Interdisciplinary Graduate Studies, or to graduate level course offerings within the other departments, to determine if these offerings may be more closely matched with their career interests.

The following information refers only to the masters level programs:

Prerequisites Prerequisite to major graduate work in educational leadership is completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence.

Educational Administration (EdAdm)

Scott McLeod, Program Coordinator

Degrees and Certificates Several programs are offered: (1) master of science degree, with thesis or creative component, in elementary or secondary school administration; (2) master of education practitioner; (3) advanced study leading to principal's license; (4) certificate of advanced studies providing post-master's training for superintendency licensure; and (5) doctor of philosophy with major in education and specialization in educational leadership. Courses are scheduled with consideration for cohort-collegial teams or groups.

Emphasis The Educational Administration Program places dual emphasis on preparation of professional educational administrators and on the academic/scholarly aspects of educational leadership and management.

Prerequisites Prerequisite to major graduate work in educational leadership is completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence.

Learning Opportunities Students will complete courses, laboratory experiences, field experiences, and independent research so that they can effectively serve in leadership roles.

Careers Graduates of Master's Degree and Certificate of Advanced Study Programs in Educational Administration are prepared for leadership roles in Pre K-12 school districts and education agencies, typically as building-level principals, assistant principals, curriculum directors, and central office administrators. Doctoral graduates are prepared for PreK-12 leadership roles and academic or leadership positions in higher education.

Outcomes Graduates of the Certificate of Advanced Studies Program will possess administrative and leadership skills necessary for the superintendency and central office administration. By the time of graduation, students will demonstrate the necessary skills and knowledge to:

•Serve as visionary leaders, with effective skills in curricular and instructional leadership.
•Work effectively with individuals and groups, both within the district and community, to create and sustain a positive learning culture.
•Engage in ethical decision-making and effective management of human, material, and financial resources to accomplish district goals.
•Express ideas clearly to various publics, both orally and in writing.
•Articulate their values, beliefs, and Philosophies of education.
•Relate sensitively to individuals from diverse backgrounds.
•Access and utilize research information and technology to assist with organizational improvement.
•Translate educational administration concepts and theories into sound management and leadership practices.

Graduates of the Master's Program with a specialization in educational administration and the Principal Licensure Program possess administrative and leadership skills necessary for PreK-12 building-level leadership roles. Upon program completion, each student will possess the knowledge and skills to:

•Work effectively with all members of the school community to create a shared vision of learning, which builds upon the formation of a shared understanding of the purposes of schooling in a pluralistic Society.

•Demonstrate effective skills in collaborative instructional leadership, including an understanding of curriculum standards, principles of effective teaching practices, and effective assessment practices that lead to improved student learning.

•Implement a system of shared governance and empower faculty, staff, students, and families in the school improvement process.
•Create and sustain a safe and caring school culture that values diversity and maintains a commitment to equity in school practices.
•Engage in ethical and moral leadership practices and the effective management of human, material, and financial resources to accomplish school goals.
•Work collaboratively with internal and external stakeholders in responding to school needs and providing community resources to support the learning process.
•Access research and use data to inform teaching and learning practices and support the process of continuous improvement.
•Apply various technologies to support and enhance administrative and instructional purposes.
•Use leadership skills to transform the school into a learning community that promotes change and sustains school improvement initiatives.
•Engage all members of the school community in critical inquiry and reflection, to promote the belief that learning is a lifelong endeavor for every individual.

Graduates of the Ph.D. Program with a specialization in educational administration will possess skills and knowledge related to the six core domains: leadership, educational research, communication, educational evaluation, educational foundations, and educational technology. By the time of graduation, students will demonstrate the necessary skills and knowledge for those outcomes as listed under the ELPS Ph.D. program outcomes.

Courses primarily for graduate students, open to qualified undergraduate students

EdAdm 541. Principles of Educational Leadership. (3-0) Cr. 3. F.S.SS. *Prereq: Teacher licensure and permission of instructor.* Basic principles of educational organizations, including an understanding of organizational behavior and theoretical approaches to administration. Exploration of substantive elements related to school reform, such as leadership, the change process, current issues in education, and developing a shared vision and mission.

EdAdm 551. Supervision for Learning Environments. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Study of effective classroom instructional practices that reflect current principles of learning. Understanding and practice of supervisory techniques that support teachers in improving the teaching and learning process, including skills in observational data collection, data analysis, collaboration, and conferencing skills.

EdAdm 552. Current Issues in Site-Level Leadership. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Essential tasks of building-level leadership and management in contemporary school settings, including: curriculum and organizational structure, theory and practice of scheduling, financial management, roles and responsibilities of governance, communication and public relations skills, home/parental involvement and relationships, project and crisis management, technology integration, school climate and culture, effective student support programs such as counseling and guidance, attendance and discipline.

EdAdm 554. Leading School Reform. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Study of principles of transformational leadership and collaborative decision-making skills. Leadership activities that facilitate the development of a school culture that embraces change and school reforms that result in high quality schools dedicated to improved student achievement.

EdAdm 556. School Systems as Learning Cultures. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Practical and theoretical perspectives on school administrative problems from critical pedagogical studies and research. Exploration of related issues such as cultural literacy, forms of authority and control, and other historical problems of schools in dealing with minorities and culturally different persons.

EdAdm 557. Human Resource Development for Learning. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Leadership theory and practice that focuses on the professional development of school staff to promote improved student learning. Principles of school personnel evaluation; legal issues related to hiring, retention, and dismissal; evaluation models for professional and classified staff; and effective professional development models to support lifelong learning and reflective practice.

EdAdm 558. Diverse Learning Needs. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Learner needs will be examined from major psycho/social perspectives with stress upon developmental phases of normal growth along with common problems encountered in schools. Issues of racism, gender bias, and Socio-economic problems that influence learner responsiveness to school curricula and administrative regulations, routines, and legal requirements.

EdAdm 559. Curriculum Leadership. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Generic administrative approaches to the design and delivery of elementary and secondary school curricula including the study of the organizations for learning; cognition and learning theories; validation; concepts of balance; school goals, student assessments and reporting of progress, alignment, and professional development; development of curriculum guides; mapping; employing national standards and benchmarks.

EdAdm 575. Education Law and Ethics. (3-0) Cr. 3. F.S.SS. *Prereq: 541.* Examination of constitutional, statutory, and judicial provisions as a basis for the legal operation of educational institutions. Rights and ethical responsibilities of school leaders are examined in relation to their roles and responsibilities with boards, other school personnel, and students.

EdAdm 590. Special Topics. Cr. arr. Repeatable. *Prereq: 9 credits in education.*

EdAdm 591. Supervised Field Experience. Cr. arr. Repeatable. *Prereq: 541 and admission to program and instructor's approval.* Supervised on-the-job field experience in special areas.
A. Elementary Principal
B. Secondary Principal

EdAdm 593. Workshops. Cr. arr. *Prereq: 9 credits in education.*

EdAdm 599. Creative Component Development. Cr. arr. *Prereq: 9 credits in educational administration.*

x*Courses for graduate students*

EdAdm 601. Planning Systems, Operations and School Environments. (3-0) Cr. 3. F.SS. *Prereq: 541.* Planning and management theories, assumptions, strategies, and tactics within belief systems; development of vision and mission positions; strategic goals; objectives and operational tactics to attain them, with emphasis on facility renovation and school construction projects.

EdAdm 602. Human Resource Development and Negotiations. (3-0) Cr. 3. S.SS. *Prereq: 541.* Development and practice of collective negotiations within human resource development concepts and strategies, with emphasis on creating and implementing "win-win" approaches that enhance system productivity and performance. Specific contract language and concepts which enhance system effectiveness will be highlighted.

EdAdm 603. Personnel Evaluation and System Assessment Practices. (3-0) Cr. 3. *Prereq: 541.* Theory, strategies, and systems for supervising programs and personnel in school districts and independent schools. Focuses on the principal, cabinet level administrator, e.g., director, headmaster, or assistant superintendent for instruction.

EdAdm 604. Theories of Leadership. (3-0) Cr. 3. F.SS. *Prereq: 541.* Specific leadership theories and models will be studied with an emphasis on: organization building and constructivist strategies for teachers; developing and assessing internal and external support groups for schools; and organizational capacity building.

EdAdm 605. Current Practices of the Superintendency. (3-0) Cr. 3. S.SS. *Prereq: 541.* The historical development of the American Superintendency in public education, problems and pitfalls, and politics and tensions separating executive actions from board policy formulation; executive challenges among contemporary educational problems of resource acquisition and allocation; collaborative relationships; union/system issues; system changes and capacity building models.

EdAdm 606. The Administration of Technology Systems. (3-0) Cr. 3. F.SS. *Prereq: 541.* The design, acquisition and operations of technology in educational administration; accounting; personnel record keeping and health system interfaces; compensation practices, staff development, and instruction record keeping, maintenance and groups.

EdAdm 607. Advanced Education Law. (3-0) Cr. 3. S.SS. *Prereq: 575.* Emerging issues of school case law and litigation as it pertains to school/student safety; student/teacher relationships; administrative authority/oversight; taxation and abatement; home schooling issues; censorship of books and curricula; student clubs and religious practices.

EdAdm 608. Administrative Problems. (3-0) Cr. 3. F.SS. *Prereq: 541.* A case study approach to the resolution of problems in educational administration. Emphasis on decision-making, conflict resolution, and communication using actual situations.

EdAdm 609. Instructional Management. (3-0) Cr. 3. F.SS. *Prereq: 541.* Theories and practices of instructional management including curriculum audits, classroom observations, and analytical models assessing teacher interactions with students. Strategies of improving assessment of teacher interactions with students. Strategies of improving pupil resiliency and achievement will be highlighted. Mapping of curriculum configurations in classrooms will be applied to the use of national/international standards.

EdAdm 611. Superintendent/Board Relations. (3-0) Cr. 3. F.SS. *Prereq: 541.* An historical analysis of the development of governance systems in American public education, and contemporary issues and problems confronting effective school district governance.

EdAdm 612. School Finance and Business Management. (3-0) Cr. 3. S.SS. *Prereq: 541.* Contemporary business and risk management practices, including: financial management and banking; investment of funds; cash flow projections; accounting practices, and school budget development concepts and usage. The functions and duties of school business personnel will be related to specific business and fiduciary tasks.

EdAdm 615. Seminar. Cr. arr. Repeatable. In-depth study of administrative topics of contemporary interest and importance.
A. Client Focus
B. Research
C. Quality Improvement
D. Special Services
E. Assessment
F. Leadership

EdAdm 690. Advanced Special Topics. Cr. arr. Repeatable. *Prereq: 9 credits in educational administration.*

EdAdm 691. Internship. (Cr. 1-3. Repeatable, maximum of 3 credits. *Prereq: 541, admission to program, and instructor's approval.* Supervised on-the-job field experience in special areas.

EdAdm 699. Dissertation Research. Cr. arr. Repeatable. *Prereq: 9 credits in education.*

Educational Leadership and Policy Studies (EL PS)

Courses for graduate students

EL PS 615. Thematic Seminars. Cr. 1. F.S.SS. *Prereq: Admission to educational leadership doctoral program.*
A. Communication and Team Building
B. Governance, Politics and Policies
C. Law, Equity, Equality
D. Ethics, Justice, and Caring
E. Problem Solving and Planning
F. Critical and Creative Thinking

EL PS 616. Capstone Experience. Cr. 3. F.S. *Prereq: 4 credits of 615.* This experience is designed to explore a topic addressed in one of the thematic seminars. The product of the capstone experience is a written paper of sufficient quality to be submitted to a scholarly journal for review.

Higher Education (Hg Ed)

Frankie Laanan, Program Coordinators

Degrees Higher Education offers work for the master of science degree with thesis and master of education degree (non-thesis) and a specialization in higher education, as well as postgraduate professional development. A community college leadership certificate program and a community college teaching and learning certificate program are also offered.

The Master's Program in Higher Education

Emphasis The Higher Education program provides graduate instruction and leadership development in community college education, student affairs practice, institutional research, post-secondary curriculum, and higher education administration.

Prerequisites Prerequisite to major graduate work in educational leadership is completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence.

Learning Opportunities Master's students in Higher Education will complete courses, practical experiences, and independent research or a culminating experience that will enable them to serve as leaders in various educational settings.

Careers Master's students in Higher Education are prepared for entry level positions in student affairs administration, general institutional administration, teaching positions in community colleges, and support positions in post-secondary settings.

Outcomes Graduates of the Master's Program in Higher Education with a specialization in student affairs will demonstrate leadership in student affairs settings. By the time of graduation, students will possess the necessary skills and knowledge to:

- Demonstrate effective oral communication.
- Effectively communicate in writing.
- Work effectively with a diverse student population.
- Employ interventions designed to facilitate the development and learning of college students.
- Create, design, and implement programs and interventions.
- Effectively advise students individually and in groups.
- Organize and administrate student services in post-secondary settings.
- Conduct basic assessment, evaluation, and research.

Graduates of the Master's Program in Higher Education with a specialization in community college teaching and learning will possess teaching and learning leadership skills. By the time of graduation students will possess the necessary skills and knowledge to:

- Facilitate college student learning.
- Employ pedagogical techniques.
- Demonstrate a clear understanding of the foundations of education, grounding their work in theory and Philosophy.
- Use technology effectively in learning and organizational processes.
- Articulate the concepts, theories and practices related to the content of higher education as emphasized in their course work.
- Develop curriculum.
- Assess student learning.
- Understand the Philosophy, organization, functions, and current issues of community colleges.

Graduates of the Master's Program in Higher Education with a specialization in community college administration will demonstrate leadership in community college settings. By the time of graduation, students will possess the necessary skills and knowledge to:

- Create positive environments for community college students.
- Perform administrative functions in community college settings.
- Assist community college students with the academic and personal issues they face.
- Develop effective teaching and learning strategies.
- Work effectively with diverse student populations.
- Shape community college curricula.

The Ph.D. Program in Higher Education

Emphasis The Ph.D. in education with a specialization in educational leadership includes an emphasis on higher education. This program is designed to prepare leaders for post-secondary settings and is concerned with advanced study and independent research on various topics related to post-secondary settings. See departmental overview of the Ph.D. degree in educational leadership.

Prerequisites Prerequisite to doctoral work in educational leadership is completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence. In addition, students are expected to have completed a master's degree and 3-5 years of professional work experience in higher education.

Learning Opportunities Doctoral students will complete courses, laboratory experiences, field experiences, independent research, a capstone experience, and a dissertation so that they can Serve as leaders in various post-secondary educational settings such as colleges and universities, private and state educational agencies, and other organizations concerned with post-secondary education.

Careers Typical careers available to graduates include leadership positions in post-secondary institutions, agencies, and other organizations concerned with post-secondary education. Special experiences are available to those who are interested in a career as a faculty member in post-secondary settings.

Outcomes Graduates of the doctoral program with an emphasis in higher education will possess knowledge and skills related to five core domains: leadership, educational research, communication, educational evaluation, and educational foundations. By the time of graduation, students will demonstrate the necessary skills and knowledge for these outcomes as listed under ELPS Ph.D. program outcomes.

Courses open to community college faculty members only

Hg Ed 420. Introduction to Vocational Technical Teaching at Community Colleges. (3-0) Cr. 3. F. Examines the competencies for successful teaching in vocational technical programs; a focus on lesson planning, motivating students, teaching methods, time management, and evaluation.

Hg Ed 421. Vocational Technical Teaching Methods at Community Colleges. (3-0) Cr. 3. S. *Prereq: 420.* Develops competencies necessary to identify, develop, implement, and evaluate collaborative learning, learning to learn, and other classroom and lab/clinic teaching techniques.

Hg Ed 422. Vocational Technical Curriculum at Community Colleges. (Dual-listed with 522). (3-0) Cr. 3. F. *Prereq: 421.* With a focus on alignment and

accountability develops competencies necessary to identify, develop, implement, and evaluate outcome-based vocational technical courses and programs in community colleges.

Hg Ed 423. Vocational Technical Assessment at Community Colleges. (Dual-listed with 523). (3-0) Cr. 3. S. *Prereq: 422.* With a focus on classroom assessment develops competencies necessary to identify, develop, empower, and evaluate teaching and learning success.

Courses primarily for graduate students, open to qualified undergraduate students

Hg Ed 504. Higher Education in the United States. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Historical development of higher education; diversity, functions, and Philosophies of colleges and universities; federal and state roles; review of general, liberal, technical, graduate, and professional education.

Hg Ed 522. Vocational Technical Curriculum at Community Colleges. (Dual-listed with 422). (3-0) Cr. 3. F. *Prereq: Hg Ed 550.* With a focus on alignment and accountability develops competencies necessary to identify, develop, implement, and evaluate outcome-based vocational technical courses and programs in community colleges.

Hg Ed 523. Vocational Technical Assessment at Community College. (Dual-listed with 423). (3-0) Cr. 3. S. *Prereq: 522.* With a focus on classroom assessment develops competencies necessary to identify, develop, empower, and evaluate teaching and learning success.

Hg Ed 540. Foundations of Leadership: Learning, Ethics, Self and Interaction. (2-0) Cr. 2. F. *Prereq: permission of instructor.* Serving as an introduction to developing practicing leaders, this course will create the foundation upon which enduring understanding of leadership will be built. Specifically explored will be learning as the foundation of human enterprise, everyday leadership, determination of common good, roots of individual's actions, sensitivity to others, merits of divergent ideas, questioning the Status quo, ethics as personal responsibility and choosing to grow.

Hg Ed 541. Learning, Leadership, Ethics and Community. (2-0) Cr. 2. S. *Prereq: permission of instructor.* Serving as the second semester in a program to develop practicing leaders, this course will build upon the foundation started first semester to help students embrace the enduring understandings of leadership. Specifically explored will be team learning and the effect on individuals, skills required for a team to move forward, importance of decisions based on the good of the community, reflection as a means of enhancing learning, and interconnectedness of the individual, the community, and the world.

Hg Ed 542. Learning, Leadership, Ethics, and Teams; Knowing, Doing and Being. (2-0) Cr. 2. F. *Prereq: permission of instructor.* The overall purpose of this course is to expand the foundation started in Foundations of Leadership: Learning, Ethics, Self and Interactions and Learning, Leadership, Ethics and Community for developing practicing leadership. The focus will shift from a naive understanding of the concepts of self within a team and community to a more sophisticated understanding of knowing, being and doing leadership.

Hg Ed 543. Learning, Leadership, Ethics and Teams in Action. (2-0) Cr. 2. S. *Prereq: permission of instructor.* The purpose of this last (in a series of four) course is to allow students to put their knowledge, skills, and abilities related to leadership, learning, Ethics and Teams into practice. In addition to planning and implementing a major service learning project, the focus will be on the next wave of the study of leadership - connecting leadership to the research about the brain and human learning.

Hg Ed 544. Foundations of Leadership & Learning. (3-0) Cr. 3. F. *Prereq: graduate student classification.* First of two-course series to help leaders develop the knowledge and skills to engage the collective capacity of a group to think, learn, and achieve important purpose. The foundation for developing deep understanding about leadership, learning, and the relationships therein. Focus on application of recent knowledge about human learning in the professional practice of leadership. Relationship leadership model and relationship to other leadership models, theories, and concepts; current theories of human learning (including expert/novice and transfer of learning), and interrelationships with leadership practice; critical understanding of self; facilitating learning for others; metacognition as a habit of mind; fundamentals of group interaction theories; social interdependence, communication, trusting, trustworthy goals, decision-making, cohesion, controversy, team development; power, resources, and development of community.

Hg Ed 545. Connecting Leadership & Learning in Practice. (3-0) Cr. 3. F. *Prereq: Graduate student classification and completion of Hg Ed 544.* Second of a two-course series designed to help leaders develop the knowledge and skills to best engage the collective capacity of a group to think, learn and achieve important purpose. Builds on foundation course to support students in creating applications of the relationships between leadership and learning. Focus on developing the habits of mind and habits of practice to best use knowledge about human learning in the professional practice of leadership. Applications of relational leadership model; applications of group interaction theories; development and implementation of action plans to achieve measurable goals; application of current theories of human learning as they relate to leadership; exploration of the fundamentals of emotional intelligence and the impacts on leadership; developing critical habits of mind to practice leadership focused on learning.

Hg Ed 550. Teaching, Learning and Leadership. (3-0) Cr. 3. F. *Prereq: Teacher licensure.* Current issues and practices in community college teaching and learning, and the roles and responsibilities of teachers as leaders.

Hg Ed 561. College Teaching. (3-0) Cr. 3. *Prereq: 6 graduate credits.* Educational theories, methods and strategies for the improvement of college instruction. Assist potential college instructors in developing knowledge of protocol, assessment, and the scholarship and art of teaching. Emphasis on the unique challenge of college teaching in a changing student population environment.

Hg Ed 562. Curriculum Development in Colleges. (3-0) Cr. 3. *Prereq: Graduate classification.* Modes of curriculum design, development, and change in colleges. Development of curricular leadership and evaluation strategies.

Hg Ed 568. Global Education Policy Analysis. (3-0) Cr. 3. *Prereq: 504.* Assessment of global education policy issues in education. Analysis of policies, implementation strategies, and policy outcomes.

Hg Ed 570. Current Topics in Student Affairs. Cr. arr. *Prereq: Graduate classification.* Current issues and new directions in student affairs practice. Topics developed to the specific needs of student affairs professionals. Primarily for off-campus.
D. Residential Life
G. Student Affairs Institute
H. Student Diversity

Hg Ed 574. Student Affairs Practice in Higher Education. (3-0) Cr. 3. F. *Prereq: Graduate classification, admission to Higher Education Program.* An introduction to the field of student affairs practice with a consideration of student activities, counseling services, financial aid, admissions, student conduct, academic advising, and residential programs; includes community college programs.

Hg Ed 575. Organization and Administration of Student Affairs. (3-0) Cr. 3. S. *Prereq: Admission to Higher Education Program, 574.* Organization structures, role and function of student affairs staff; policies and decision-making for student affairs practice.

Hg Ed 576. Student Development in Higher Education. (3-0) Cr. 3. F. *Prereq: Admission to Higher Education Program.* Theories of student development and their applications in student affairs programs, services, and activities are reviewed. Emphasis is placed on psychosocial, cognitive developmental, and learning theories.

Hg Ed 577. Campus Environments and Cultures. (3-0) Cr. 3. F. *Prereq: Admission to Higher Education Program.* Study of the impact of the college environment on students and use of environmental theory to create positive learning situations for students.

Hg Ed 578. Students in American Higher Education. (3-0) Cr. 3. F. *Prereq: Admission to Higher Education Program.* The relationship between college students and characteristics from 1950 to the present. Traditional assumptions about the impact of higher education on students will be reviewed and challenged. Campus issues and concerns relative to commuters and residential life. Participants will analyze institutional responses to students through college missions, organizational development, structure, core curriculum and retention.

Hg Ed 579. Counseling and Group Dynamics in Post-secondary Settings. (3-0) Cr. 3. F. *Prereq: 574, 576.* Development of effective, basic counseling skills. Understanding of group dynamics. Ability to work effectively in groups.

Hg Ed 580. Current Topics in Community Colleges. (1-3) Cr. arr. *Prereq: Graduate classification.* Current issues and new directions in community college education. Topics developed to the specific needs of colleges for off-campus.
A. Student Needs
B. General and Liberal Education
C. Counseling and Advising
D. Adult and Continuing Education
E. Development and Remedial Education
F. Student Services
G. Faculty and Staff Evaluation
H. Organization and Administration
I. Learning and Teaching
J. Human Relations

Hg Ed 582. The Comprehensive Community College. (3-0) Cr. 3. *Prereq: Graduate classification.* The community college as a unique social and educational institution: its history, philosophy, functions, programs, faculty and student characteristics, organization and finance, trends, and issues. Reviews current research and exemplary community college practices internationally, nationally, and in Iowa.

Hg Ed 590. Special Topics. Cr. arr. *Prereq: 9 credits in education.* Independent study on specific topics arranged with an instructor.
A. Student Services
B. Community Colleges
C. Current Issues
D. International Higher Education
E. Federal and State Affairs
F. Law in Higher Education
G. Institutional Research

Hg Ed 591. Supervised Field Experience. Cr. arr. Repeatable. *Prereq: 9 credits graduate work.* Supervised on-the-job field experience.

Hg Ed 593. Workshops. Cr. arr. Repeatable. *Prereq: 15 credits in education.*

Hg Ed 598. Capstone Seminar. (3-0) Cr. 3. S. *Prereq: Completion of 30 credits in EL PS.* This course is designed to integrate the learning experiences of students completing the Master's Degree Program in higher education. Such issues as ethics, continuing professional development, career planning and leadership will be explored.

Hg Ed 599. Creative Component. Cr. arr. *Prereq: 9 credits in education.*

Courses for graduate students

Hg Ed 615. Seminars in Higher Education. Cr. arr.
A. Student Services
B. Community Colleges
C. Current Issues
D. International Higher Education
E. Federal and State Affairs
F. Law in Higher Education
G. Institutional Research
H. Research Designs in Higher Education

Hg Ed 664. College Organization and Administration. (3-0) Cr. 3. F. *Prereq: 504.* Administrative organization and behavior: communications, leadership, finance, strategic planning, and institutional governance.

Hg Ed 665. Financing Higher Education. (3-0) Cr. 3. S. *Prereq: 504.* Lectures, discussions, and individual investigation relating to financial administration in colleges and universities. Budgeting, auxiliary enterprises, administration of financial planning, fund raising, examination of theories on expenditures. Designed for persons aspiring to serve as college administrators.

Hg Ed 666. Academic Issues and Cultures. (3-0) Cr. 3. S. *Prereq: 504.* Examination of institutional culture and issues in higher education focusing on the roles and responsibilities of faculty and academic administrators.

Hg Ed 676. Student Development Theory II. (3-0) Cr. 3. S. *Prereq: 576.* Life span approaches to student development, social identity development, and spiritual development with emphasis on application of these theories in student affairs practice.

Hg Ed 690. Advanced Special Topics. Cr. arr. Repeatable. *Prereq: 9 credits in education.*

Hg Ed 699. Research. Cr. arr. Repeatable. *Prereq: 9 credits in education.*

Organizational Learning and Human Resource Development (OLHRD)

Courses primarily for graduate students, open to qualified undergraduate students

OLHRD 541. Adult Learning. (3-0) Cr. 3. Examines how adults acquire and use knowledge, skills, and attitudes within organizational settings; individual differences in learning as well as the principles and elements of the learning organization.

OLHRD 544. Performance Improvement and Change Through Learning Interventions. (3-0) Cr. 3. *Prereq: OLHRD 541, 542.* Examines the characteristics and elements of the performance improvement and change process, with special attention to the roles and responsibilities of employees, managers, and organizations when improving individual and organizational learning.

OLHRD 545. Learning Acquisition, Transfer, and Evaluation. (3-0) Cr. 3. *Prereq: OLHRD 541, 542, 544.* Critical examination of learning acquisition, transfer, and evaluation barriers, partnerships, strategies, and activities; and the roles and responsibilities of human resource development professionals, managers, employees, and organizations in the application and evaluation of learning on the job.

Research and Evaluation (ResEv)

John Schuh and Linda Serra Hagedorn, Program Co-Coordinators

Degree Research and Evaluation offers work for the Master of Science degree with thesis with a specialization in research and evaluation.

Emphasis Research and Evaluation students receive a broad foundation in the areas of quantitative and qualitative research methodology, data analysis, assessment, and evaluation. Students select one area for in-depth study.

Prerequisites Prerequisites to major graduate work in educational leadership are completion of an undergraduate degree with coursework appropriate to the planned specialization, and evidence that the student ranks above average in scholastic achievement and promise of professional competence.

Learning Opportunities Students in Research and Evaluation will complete courses, laboratory experiences, field experiences, independent research and a thesis.

Careers Graduates are prepared for professional roles in institutional research, assessment of student learning, and program evaluation in post-secondary settings, school districts, and not-for-profit organizations.

Outcomes Graduates of the master's program with a specialization in research and evaluation will be prepared for leadership roles for careers in assessment and evaluation. By the time of graduation, students will demonstrate the necessary skills and knowledge to:

- Articulate current issues and principles in research, program evaluation, and assessment.
- Implement various conceptual approaches to research, program evaluation, and assessment.
- Effectively use the principles and skills of research data analysis.
- Interpret data and prepare accurate and useful reports.

Courses primarily for graduate students, open to qualified undergraduate students

ResEv 550. Introduction to Educational Research. (3-0) Cr. 3. F.S.SS. Understanding the nature of quantitative and qualitative research; reviewing the literature; developing research problems and questions; research designs; data collection and analysis issues; evaluating research studies.

ResEv 552. Basic Educational Statistics. (3-0) Cr. 3. F. Statistical concepts and procedures for analyzing educational data; descriptive Statistics, correlation, t tests, and chi square with computer applications.

ResEv 553. Intermediate Educational Statistics. (3-0) Cr. 3. *Prereq: 552 or equivalent.* A continuation of Statistical concepts and procedures for analyzing educational data; inferential techniques including simple and multiple regression, multiple ANOVA, etc., with educational computer applications.

ResEv 554. Intermediate Research Methods. (3-0) Cr. 3. SS. *Prereq: 580, 553.* Intermediate quantitative and qualitative research methodology in preparation for carrying out thesis and dissertation research; problem formulation; design; data collection and analysis; interpreting and summarizing research findings.

ResEv 560. Assessing Student Learning. (3-0) Cr. 3. *Prereq: 550 or basic Statistical skills.* The purpose and techniques of formal and informal classroom assessment; rubrics, performance assessment, portfolios, paper and pencil tests, communicating assessment findings; emphasis on both theory and practical applications.**ResEv 570. Surveys in Educational Research.** (3-0) Cr. 3. S. *Prereq: ResEv 552 or equivalent.* Examination of survey design and administration in educational research. Designing surveys; developing, evaluating, and asking survey questions; survey sampling; measuring survey reliability and validity; administering mail and web surveys; decreasing survey nonresponse; conducting post-collection survey data processing; conducting survey research with integrity.

ResEv 580. Qualitative Research Methodology. (3-0) Cr. 3. *Prereq: 550.* Qualitative research procedures in education, particularly historical, philosophical, biographical, ethnographic, and case study; use of sources, principles of qualitative research, methods of data collection and analysis, field techniques, and writing of research results.

ResEv 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate standing.* Guided reading and in research and evaluation study on special topic.

ResEv 593. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate standing.* Intensive, concentrated exposure to a special educational research or evaluation problem.

ResEv 597. Program Assessment and Evaluation. (3-0) Cr. 3. S. *Prereq: ResEv 550.* Evaluation models and professional standards. Techniques of evaluating educational programs. Emphasis on both theory and practical applications.

Courses for graduate students

ResEv 615. Current Topics in Research and Evaluation. Cr. arr. Repeatable.

ResEv 680. Critical Issues in Interpretive Methodology. (3-0) Cr. 3. S. *Prereq: 580.* An intensive reading and discussion course focusing on contemporary methodological theory for interpretive inquiry; examines how interpretive field work is conducted, how narrative and ethnographic data are theorized and analyzed, and how interpretive texts are written.

ResEv 690. Advanced Special Topics. Cr. arr. Repeatable. *Prereq: Graduate standing.* Guided reading and/or study on special topics of an advanced nature.

ResEv 699. Research. Cr. arr. Repeatable. F.S.SS.

Electrical Engineering

ecpe.ece.iastate.edu

(Administered by the Department of Electrical and Computer Engineering)

Arun Somani, Chair of Department

Distinguished Professors: Somani, Soukoulis

Distinguished Professors (Emeritus): Brown, Fouad, Lord, Nilsson, Pohm

University Professor: Jacobson

University Professor (Emeritus): Jones

Professors: Ajjarapu, Aluru, J. Bowler, Dalal, Geiger, Kamal, Kothari, Kumar, Kushner, Liu, Luecke, Mccalley, Oliver, Rover, Shinar, Weber

Professors (Emeritus): Anderson, Basart, Brearley, Brockman, Comstock, Fanslow, Hale, Horton, Hsieh, Kopplin, Melsa, Potter, Read, Sheble, Smay, Stewart, Swift, Townsend, Venkata

Professor (Adjunct): Shinar

Professor (Emeritus Adjunct): Hillesland

Professors (Collaborators): Jiles, Lee

Associate Professors: N. Bowler, Chang, Chen, Chu, Davidson, Davis, Dickerson, Dogandzic, Elia, Govindarasu, Guan, S. Kim, Song, Tirthapura, Tuttle, Tyagi, Z. Wang

Associate Professors (Emeritus): Bond, Carlson, Coady, Mericle, Pavlat, Scott, Stephenson

Associate Professors (Adjunct): Biswas, Sosonkina

Associate Professors (Collaborators): Ashlock, Salapaka

Assistant Professors: Aliprantis, Bigelow, Chaudhary, Chung, Daniels, Dong, Fayed, Hornbuckle, Jones, J. Kim, Ma, Neihart, Nguyen, Pandey, Qiao, Ramamoorthy, Stoytchev, Vaidya, Vaswani, L. Wang, Ying, Zambreno, Zhang

Assistant Professors (Adjunct): Amin, Bode

Assistant Professors (Collaborators): Balasubramaniam

Senior Lecturer: Mina, Wiersema

Undergraduate Study

For the undergraduate curriculum in electrical engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission of ABET.

The Department of Electrical and Computer Engineering at Iowa State University provides undergraduate students with the opportunity to learn electrical and computer engineering fundamentals, to study applications of the most recent

advances in state-of-the-art technologies, and to prepare for the practice of electrical engineering. The student-faculty interaction necessary to realize this opportunity occurs within an environment that is motivated by the principle that excellence in undergraduate education is enhanced by an integrated commitment to successful, long-term research and outreach programs.

The electrical engineering curriculum offers a number of emphasis areas at the undergraduate level, including control systems, electromagnetics, microelectronics, VLSI, power systems, and communications and signal processing. Students are required to choose at least one course sequence which focuses on one of these areas; therefore graduates have substantial depth in specific areas to complement the breadth obtained in the required curriculum. Students may also take elective courses in computer networking, security, computer architecture, digital systems, and software.

The objective of the electrical engineering program at ISU is that its graduates should demonstrate expertise, engagement, learning, leadership, and teamwork within five years after graduation.

Expertise: Graduates should establish peer-recognized expertise together with the ability to articulate that expertise and use it for problem solving in at least one of the following domains of communications and signal processing, controls, electromagnetics, power and energy, electronic devices, semiconductor materials, and analog and digital circuits.

Engagement: Graduates should be engaged in the engineering profession, locally and globally, contributing through the ethical, competent, and creative practice of electrical engineering in industry, academia, or the public sector, or graduates may use the program as a foundation for interdisciplinary careers in business, law, medicine, or public service.

Learning: Graduates should demonstrate sustained learning through graduate work or professional improvement opportunities and through self study, and they should demonstrate the ability to adapt in a constantly changing field.

Leadership: Graduates should exhibit leadership and initiative to advance professional and organizational goals, facilitate the achievements of others, and obtain results.

Teamwork: Graduates should demonstrate effective teaming and commitment to working with others of diverse cultural and interdisciplinary backgrounds by applying engineering abilities, communication skills, and knowledge of contemporary and global issues.

As a complement to the instructional activity, the ECPE Department provides opportunities for each student to have experience with broadening activities. Through the cooperative education and internship program, students have the opportunity to gain practical industry experience. See College of Engineering, Cooperative Programs.

Students have the opportunity to participate in advanced research activities; and through international exchange programs, students learn about engineering practices in other parts of the world. Well-qualified juniors and seniors in electrical engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both the bachelor of science and master of science degrees or the bachelor of science and master of science degrees. See Graduate Study for more information.

Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses.

Courses for students who are not in the electrical engineering program: 442, 448. Credit in these courses may not be counted toward a degree in either electrical engineering or computer engineering.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with major in electrical engineering and minor work to students with other majors. Minor work for electrical engineering majors is usually selected from a wide range of courses outside electrical engineering.

The degree master of science with thesis is recommended for students who intend to continue toward the doctor of philosophy degree or to undertake a career in research and development. The nonthesis master of science degree requires a creative component.

The normal prerequisite to major graduate work in electrical engineering is the completion of undergraduate work substantially equivalent to that required of electrical engineering students at this university. Because of the diversification in the electrical engineering graduate program, however, it is possible for a student to qualify for graduate study in certain areas of electrical engineering even though the student's undergraduate or prior graduate training has been in a discipline other than electrical engineering. Supporting work, if required, will depend on the student's background and area of research interest. Prospective students from a discipline other than electrical engineering are required to submit, with the application for admission, a statement of the proposed area of graduate study.

The department requires submission of GRE General test scores by applicants. All students whose first language is not English and who have no U.S. degree must submit TOEFL examination scores. Students pursuing the doctor of philosophy must complete the department qualifying process.

The Department of Electrical and Computer Engineering is a participating department in the interdepartmental graduate minor in complex adaptive systems. Students interested in this program should see the Complex Adaptive Systems section of the catalog for requirements.

The Department of Electrical and Computer Engineering is a participating department in the interdepartmental master of science and doctor of philosophy degree programs in bioinformatics and computational biology. Students interested in these programs may earn their degrees while working under an adviser in electrical and computer engineering.

The Department of Electrical and Computer Engineering is also a participating department in the interdepartmental master of science in information assurance program. Students interested in studying information assurance topics may earn a degree in computer engineering or in information assurance. *(See catalog section on Information Assurance.)*

The Department of Electrical and Computer Engineering offers a graduate certificate in electric power systems engineering. Completion of the certificate requires at least twelve credits selected from 553, 554, 555, 556, and 653. E E 653 is a repeatable course and may be used more than once to satisfy the certificate requirement.

Well qualified juniors or seniors in electrical engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both the bachelor of science and master of science degrees or the bachelor of science and master of business administration degrees. Under concurrent enrollment, students are eligible for assistantships and simultaneously take undergraduate and graduate courses. Details are available in the Student Services Office and on the department's web site.

Courses primarily for undergraduate students

E E 166. Professional Programs Orientation. (Cross-listed with Cpr E). Cr. R. F.S. (1-0) Overview of the nature and scope of electrical engineering and computer engineering professions. Overview of portfolios. Departmental rules, advising center operations, degree requirements, program of study planning, career options, and student organizations.

E E 185. Introduction to Electrical Engineering and Problem-Solving I. (2-2) Cr. 3. F.S. *Prereq: Credit or enrollment in Math 142.* Project based examples from electrical engineering. Systematic thinking process for engineering problem solving. Group problem solving. Mathematical, conceptual and computer based projects. Solving engineering problems and presenting solutions through technical reports and oral presentations. Solutions of engineering problems using computation tools and basic programming in C.

E E 186. Introduction to Electrical Engineering and Problem Solving II. (0-2) Cr. 1. S. *Prereq: 185.* Project based and hands on continuation of 185. Group skills needed to work effectively in teams. Individual interactive skills for small and large groups. Learning to use tools and methods for solving electrical engineering problems.

E E 201. Electric Circuits. (3-2) Cr. 4. F.S. *Prereq: Credit or registration in Math 267 and Phys 222.* Emphasis on Mathematical tools. Circuit elements (resistors, inductors, capacitors) and analysis methods including power and energy relationships. Network theorems. DC, sinusoidal steady-state, and transient analysis. AC power. Frequency response. Two port models. Diodes, PSPICE. Laboratory instrumentation and experimentation. Credit for only E E 201 or 442 may be used towards graduation.

E E 224. Signals and Systems I. (3-3) Cr. 4. F.S. *Prereq: 201, Math 267, Phys 222.* Mathematical preliminaries. Introduction to signals and systems. Signal manipulations. System properties. LTI systems, impulse response and convolution. Fourier Series representation and properties. Continuous and discrete-time Fourier Transforms and properties. Sampling and reconstruction. Modulation and demodulation. Applications and demonstrations using Matlab.

E E 230. Electronic Circuits and Systems. (3-3) Cr. 4. F.S. *Prereq: 201, Math 267, Phys 222.* Frequency domain characterization of electronic circuits and systems, transfer functions, sinusoidal steady state response. Time domain models of linear and nonlinear electronic circuits, linearization, small signal analysis. Stability and feedback circuits. Operational amplifiers, device models, linear and nonlinear applications, transfer function realizations. A/D and D/A converters, sources of distortions, converter linearity and spectral characterization, applications. Design and laboratory instrumentation and measurements.

E E 294. Program Discovery. (Cross-listed with Cpr E). Cr. R. *Prereq: 166 or Cpr E 166.* The roles of professionals in computer and electrical engineering. Relationship of coursework to industry and academic careers. Issues relevant to today's world. Satisfactory-fail only.

E E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

E E 303. Energy Systems and Power Electronics. (3-0) Cr. 3. F.S. *Prereq: Math 267, Phys 222. Credit or registration in 224 and 230.* Structure of competitive electric energy systems. System operation and economic optimization. Mutual inductance, transformers. Synchronous generators. Balanced three-phase circuit analysis and power calculations. Network calculations and associated numerical algorithms. Two-port circuits. Voltage regulation. Resonance and power factor correction. DC and induction motors. Power electronic circuit applications to power supplies and motor drives. Electronic loads and power quality. Nonmajor graduate credit.

E E 311. Electromagnetic Fields and Waves. (4-0) Cr. 4. F.S. *Prereq: 201, Math 265, Phys 222, credit or registration in Math 267.* Fundamentals and applications of electric and magnetic fields and materials. Electrostatics and magentostatics, potentials, capacitance and inductance, energy, force, torque. Uniform plane electromagnetic waves, Poynting vector. Transmission lines: transient and sinusoidal steady-state conditions, reflection coefficient. Nonmajor graduate credit.

E E 314. Electromagnetics for non Electrical Engineers. (3-0) Cr. 3. *Prereq: Physics 222, 112, or equivalent.* Conceptual study of electomagnetism and its application in engineering and related fields. Em fundamentals, Em spectrum, radiation, radiating systems, wireless, Moderns concepts of physics, transmission lines, high speed effects, waveguides, GPS and other related phenomena will be discussed and explained with the application in mind. Nonmajor graduate credit.

E E 322. Probabilistic Methods for Electrical Engineers. (Cross-listed with Stat). (3-0) Cr. 3. F.S. *Prereq: E E 224.* Introduction to probability with applications to electrical engineers. Sets and events, probability space, conditional probability, total probability and Bayes' rule. Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, moments, moment generating function, multiple random variables, functions of random variables. Elements of Statistics, hypothesis testing, confidence intervals, least squares. Introduction to random processes.

E E 324. Signals and Systems II. (3-3) Cr. 4. F.S. *Prereq: 224.* Laplace and z-Transforms, properties and inverses. Applications to LTI systems and analog/digital filters. Feedback systems and stability. State-space representation and analysis. Nonmajor graduate credit.

E E 330. Integrated Electronics. (Cross-listed with Cpr E). (3-3) Cr. 4. *Prereq: 201, credit or enrollment in 230, Cpr E 281.* Semiconductor technology for integrated circuits. Modeling of integrated devices including diodes, BJTs, and MOSFETs. Physical layout. Circuit simulation. Digital building blocks and digital circuit synthesis. Analysis and design of analog building blocks. Laboratory exercises and design projects with CAD tools and standard cells. Credit for only one of E E 330 or 331 may be counted toward graduation. Nonmajor graduate credit.

E E 331. Electronics II. (3-3) Cr. 4. *Prereq: 230, Cpr E 288, E E 224 recommended.* I-V characteristics of diodes, BJTs, and MOSFETs. Diode and transistor circuits. Small-signal analysis and biasing techniques for amplifier circuits. CMOS digital circuit building blocks. Noise and distortion in electronic systems. Various types of sensors and their use in electronic systems. Active filters. Power Amplifiers. DC motor control circuits. Interfacing electronic circuits with programmable microcontrollers. Laboratory exercises and design projects, including a board-level system layout. Credit for only one of E E 330 or 331 may be counted toward graduation.

E E 332. Semiconductor Materials and Devices. (Cross-listed with Mat E). (3-0) Cr. 3. S. *Prereq: Phys 222 and, only for Mat E majors, Mat E 334.* Introduction to semiconductor material and device physics. Quantum mechanics and band theory of semiconductors. Charge carrier distributions, generation/recombination, transport properties. Physical and electrical properties and fabrication of semiconductor devices such as MOSFETs, bipolar transistors, laser diodes and LED's. Nonmajor graduate credit.

E E 351. Introduction to Energy Systems: An Engineering Perspective. (Cross-listed with E St). (3-0) Cr. 3. Dalal. Energy-scientific, engineering and economic foundations. Energy utilization-global and national. Sectoral analysis of energy consumption. Relationship of energy consumption and production to economic growth and environment. Technology for energy production. Economic evaluation of energy utilization and production. Scientific basis for global warming. Environmental impact of energy production and utilization. Renewable energy.

E E 388. Sustainable Engineering and International Development. (Cross-listed with A E, C E, M E, Mat E). (2-2) Cr. 3. F. *Prereq: Junior classification in engineering.* Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as nongovernment organizations (NGOs). Course readings, final project/design report.

E E 394. Program Exploration. (Cross-listed with Cpr E). Cr. R. *Prereq: 294 or Cpr E 294.* Exploration of academic and career fields for electrical and computer engineers. Examination of professionalism in the context of engineering and technology with competencies based skills. Introduction to professional portfolio development and construction. Satisfactory-fail only.

E E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period. Students must register for this course before commencing work.

E E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* One semester maximum per academic year professional work period. Students must register for this course before commencing work.

E E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

E E 408. Interdisciplinary Problem Solving. (Cross-listed with I E, TSM). (3-0) Cr. 3. F.S. *Prereq: Junior or senior classification.* Use of the Theory of Constraints as a way of approaching problem solving, win-win negotiation, project planning and effective delegation in the context of engineering/business systems. Team projects aimed at improving design outcomes. Nonmajor graduate credit.

E E 409. Interdisciplinary Systems Effectiveness. (Cross-listed with I E, TSM). (3-0) Cr. 3. F.SS. *Prereq: Junior or senior classification.* Focus on functions that determine the effectiveness of an entire organization. Generic Theory of Constraints solutions to production, distribution, and project management are compared to traditional solutions. Strategy for improvements discovered using simulations. Nonmajor graduate credit.

E E 414. Microwave Engineering. (Dual-listed with 514). (3-3) Cr. 4. F. *Prereq: 230, 311.* Principles, analyses, and instrumentation used in the microwave portion of the electromagnetic spectrum. Wave theory in relation to circuit parameters. S parameters, couplers, discontinuities, and microwave device equivalent circuits. RF amplifier design, microwave sources, optimum noise figure and maximum power designs. Microwave filters and oscillators. Nonmajor graduate credit.

E E 417. Electromagnetic Radiation, Antennas, and Propagation. (Dual-listed with 517). (3-3) Cr. 4. S. *Prereq: 311.* Fundamental antenna concepts. Radiation from wire-and aperture-type sources. Radio transmission formulas. Wave and antenna polarization. Antenna arrays. Modern antenna topics. Practical antenna design. Antenna noise. Radiowave propagation in the presence of the earth and its atmosphere. Antenna measurements and computer aided analysis. Nonmajor graduate credit.

E E 418. High Speed System Engineering Measurement and Testing. (Cross-listed with Cpr E). (3-2) Cr. 4. F. *Prereq: 230 and 311.* Measurement of high speed systems and mixed signal systems. Measurement accuracy and error. Network analysis and spectrum analysis used in high speed measurement and testing. Test specification process and parametric measurement. Sampling and digital signal processing concepts. Design for testability. Testing equipment. Applications. Nonmajor graduate credit.

E E 421. Communication Systems I. (3-0) Cr. 3. F. *Prereq: 224, credit or registration in 322.* Frequency domain analysis, spectral filtering, bandwidth. Linear modulation systems. Angle modulation systems. Phase locked loop, super-heterodyne receiver. Sampling and pulse code modulation. Digital data transmission, line coding, pulse shaping, multiplexing. Nonmajor graduate credit.

E E 422. Communication Systems II. (3-0) Cr. 3. *Prereq: 421 and enrollment in 423.* Introduction to probability and random processes; Performance of analog systems with noise; Performance of digital communication with noise; optimum receivers, transmission impairments, and error rates; Introduction to information theory and coding: source coding, channel coding, channel capacity. Nonmajor graduate credit.

E E 423. Communication Systems Laboratory. (0-3) Cr. 1. *Prereq: 421, enrollment in 422.* Construction and evaluation of modulators, demodulators, modems, and other components for analog and digital communications. Design and evaluate wireless communication systems and their key components. Noise measurement. Design and construction of a communication system. Nonmajor graduate credit.

E E 424. Introduction to Digital Signal Processing. (3-3) Cr. 4. *Prereq: 324.* Sampling and reconstruction. Concepts and mathematical tools in discrete-time signal processing with examples from digital signal processing and communications. Discrete-time correlation and matched-filter receivers. Discrete Fourier transform (DFT). Fast Fourier algorithms. Z transforms. Design of finite impulse response (FIR) and infinite impulse response (IIR) filters. Realizations of discrete-time systems and quantization effects. Multi-rate signal processing. Laboratory experiments illustrating DSP implementations and applications. Nonmajor graduate credit.

E E 432. Microelectronics Fabrication Techniques. (Dual-listed with 532). (Cross-listed with Mat E). (2-4) Cr. 4. *Prereq: Phys 222, Math 267. E E 332 or Mat E 334 recommended.* Techniques used in modern integrated circuit fabrication, including diffusion, oxidation, ion implantation, lithography, evaporation, sputtering, chemical-vapor deposition, and etching. Process integration. Process evaluation and final device testing. Extensive laboratory exercises utilizing fabrication methods to build electronic devices. Use of computer simulation tools for predicting processing outcomes. Recent advances in processing CMOS ICs and micro-electro-mechanical systems (MEMS). Nonmajor graduate credit.

E E 435. Analog VLSI Circuit Design. (Cross-listed with Cpr E). (3-3) Cr. 4. S. *Prereq: 324, 330, 332, and either E E 322 or Stat 330.* Basic analog integrated circuit and system design including design space exploration, performance enhancement strategies,

operational amplifiers, references, integrated filters, and data converters. Nonmajor graduate credit.

E E 438. Optoelectronic Devices and Applications. (Dual-listed with 538). (3-0) Cr. 3. *Prereq: 311, 332.* Transmission and reflection of electromagnetic plane waves. Propagation in dielectric and fiber optic waveguides. LED and laser operating principles and applications. Photodetectors and solar cells. Optical modulation and switching. Nonmajor graduate credit.

E E 439. Nanoelectronics. (3-0) Cr. 3. S. *Prereq: E E 332/Mat E 332 or Mat E 331.* Concepts of quantum mechanics relevant to nanoelectronic devices, including quantization, tunneling, and transport; overview of some of the leading technologies for nanoelectronics, including carbon nanotubes, quantum dots, and molecular transistors; fabrication methods for building nanoelectronic devices. Nonmajor graduate credit.

E E 442. Introduction to Circuits and Instruments. (3-2) Cr. 2. F.S. *Prereq: Phys 222, Math 267.* Half-semester course. Basic circuit analysis using network theorems with time domain and Laplace transform techniques for resistive, resistive-inductive, resistive-capacitive, and resistive- inductive-capacitive circuits. Transient circuit behavior. Basic operational amplifiers and applications. Familiarization with common E E instrumentation and demonstration of basic principles. Credit for only 201 or 442 may be counted toward graduation; credit for 442 will not count toward graduation for E E or Cpr E majors. Nonmajor graduate credit.

E E 448. Introduction to AC Circuits and Motors. (3-2) Cr. 2. F.S. *Prereq: 303 or 441 or 442.* Half-semester course. Magnetic circuits. Power transformers. AC steady state and three-phase circuit analysis. Basic principles of operation and control of induction and single-phase motors. Nonmajor graduate credit.

E E 452. Electrical Machines and Power Electronic Drives. (2-3) Cr. 3. S. *Prereq: 303; 330 or 332; credit or registration in E E 324.* Basic concepts of electromagnetic energy conversion. DC motors and three-phase induction motors. Basic introduction to power electronics. Adjustable speed drives used for control of DC, induction, and AC motors. Experiments with converter topologies, DC motors, AC motors and adjustable speed drives. Nonmajor graduate credit.

E E 455. Introduction to Energy Distribution Systems. (3-0) Cr. 3. F. *Prereq: 303, credit or registration in 324.* Overhead and underground distribution system descriptions and characteristics, load descriptions and characteristics, overhead line and underground cable models, distribution transformers, power flow and fault analysis, overcurrent protection, power factor correction, system planning and automation, and economics in a deregulated environment. Nonmajor graduate credit.

E E 456. Power System Analysis I. (3-0) Cr. 3. F. *Prereq: 303, credit or registration in 324.* Power transmission lines and transformers, synchronous machine modeling, network analysis, power system representation, load flow. Nonmajor graduate credit.

E E 457. Power System Analysis II. (3-0) Cr. 3. S. *Prereq: 303, credit or registration in 324.* Power system protection, symmetrical components, faults, stability. Power system operations including the new utility environment. Nonmajor graduate credit.

E E 458. Economic Systems for Electric Power Planning. (Cross-listed with Econ). (3-0) Cr. 3. *Prereq: 303 or Econ 301.* Evolution of electric power industry. Power system operation and planning and related information systems. Linear and integer optimization methods. Short-term electricity markets and locational marginal prices. Risk management and financial derivatives. Basics of public good economics. Cost recovery models including tax treatment for transmission investments. Nonmajor graduate credit.

E E 463. Design of Electrical Systems. (1-10) Cr. 5. SS. *Prereq: 322 and completion of 24 credits in the E E core professional program, Engl 314.* Distance-education students only. Team project design experience. Emphasis on defining, planning, and implementing to achieve project objectives to meet a client's need with due consideration to professional and technical considerations of engineering design and implementation. Oral and written presentations of project achievements.

E E 465. Digital VLSI Design. (Cross-listed with Cpr E). (3-3) Cr. 4. S. *Prereq: E E 330.* Digital design of integrated circuits employing very large scale integration (VLSI) methodologies. Technology considerations in design. High level hardware design languages, CMOS logic design styles, area-energy-delay design space characterization, datapath blocks: arithmetic and memory, architectures and systems on a chip (Soc) considerations. VLSI chip hardware design project. Nonmajor graduate credit.

E E 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Aer E, Cpr E, Engr, I E, M E, Mat E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing, and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

E E 475. Automatic Control Systems. (3-0) Cr. 3. F. *Prereq: 324.* Stability and performance analysis of automatic control systems. The state space, root locus, and frequency response methods for control systems design. PID control and lead-lag compensation. Computer tools for control system analysis and design. Nonmajor graduate credit.

E E 476. Control System Simulation. (2-3) Cr. 3. S. *Prereq: 475.* Computer aided techniques for feedback control system design, simulation, and implementation. Nonmajor graduate credit.

E E 488. Eddy Current Nondestructive Evaluation. (Dual-listed with 588). (Cross-listed with Mat E). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Math 265 and (Mat E 216 or 272 or E E 311 or Phys 364).* Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

E E 490. Independent Study. Cr. arr. *Prereq: Senior classification in electrical engineering.* Investigation of an approved topic commensurate with the student's prerequisites.
H. Honors

E E 491. Senior Design Project I and Professionalism. (Cross-listed with Cpr E). (2-3) Cr. 3. F.S. *Prereq: 322 or Cpr E 308, completion of 24 credits in the E E core professional program or 29 credits in the Cpr E core professional program, Engl 314.* Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; design review presentation. First of two-semester team-oriented, project design and implementation experience.

E E 492. Senior Design Project II. (Cross-listed with Cpr E). (1-3) Cr. 2. F.S. *Prereq: 491 or Cpr E 491.* Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in E E 491 or Cpr E 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements; project poster.

E E 494. Portfolio Assessment. (Cross-listed with Cpr E). Cr. R. *Prereq: Credit or enrollment in 491.* Portfolio update and evaluation. Portfolios as a tool to enhance career opportunities.

E E 496. Modern Optics. (Cross-listed with Phys). (3-0) Cr. 3. *Prereq: Credit or enrollment in Phys 322 and 365.* Review of wave and electromagnetic theory; topics selected from: reflection/refraction, interference, geometrical optics, Fourier analysis, dispersion, coherence, Fraunhofer and Fresnel diffraction, holography, quantum optics, nonlinear optics. Nonmajor graduate credit.

E E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education programs. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduate students

E E 501. Analog and Mixed-Signal VLSI Circuit Design Techniques. (Cross-listed with Cpr E). (3-3) Cr. 4. F. *Prereq: 435.* Design techniques for analog and mixed-signal VLSI circuits. Amplifiers; operational amplifiers, transconductance amplifiers, finite gain amplifiers and current amplifiers. Linear building blocks; differential amplifiers, current mirrors, references, cascading and buffering. Performance characterization of linear integrated circuits; offset, noise, sensitivity and stability. Layout considerations, simulation, yield and modeling for high-performance linear integrated circuits.

E E 505. CMOS and BiCMOS Data Conversion Circuits. (Cross-listed with Cpr E). (3-3) Cr. 4. Alt. S., offered 2010. *Prereq: 501.* Theory, design and applications of data conversion circuits (A/D and D/A converters) including: architectures, characterization, quantization effects, conversion algorithms, spectral performance, element matching, design for yield, and practical comparators, implementation issues.

E E 507. VLSI Communication Circuits. (Cross-listed with Cpr E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 330 or 501.* Phase-locked loops, frequency synthesizers, clock and data recovery circuits, theory and implementation of adaptive filters, low-noise amplifiers, mixers, power amplifiers, transmitter and receiver architectures.

E E 508. Filter Design and Applications. (3-3) Cr. 4. *Prereq: 501.* Filter design concepts. Approximation and synthesis. Transformations. Continuous-time and discrete time filters. Discrete, active and integrated synthesis techniques.

E E 510. Topics in Electromagnetics. Cr. arr. Repeatable.

E E 511. Modern Optical Communications. (3-0) Cr. 3. S. *Prereq: 311.* Propagation in optical media. Optical fibers. Optical sources and detectors. Fiber optic communications systems. DWDM considerations.

E E 512. Advanced Electromagnetic Field Theory I. (3-0) Cr. 3. F. *Prereq: 413.* Review of Static electric and magnetic fields. Maxwell's equations. Circuit concepts and impedance elements. Propagation and reflection of plane waves in isotropic media. Guided electromagnetic wave. Characteristics of common waveguides and transmission lines. Propagation in anisotropic media. Special theorems and concepts. Radiation and scattering.

E E 513. Advanced Electromagnetic Field Theory II. (3-0) Cr. 3. S. *Prereq: 512.* Green's functions, perturbational and variational techniques. Analysis of microstrip lines and interconnects. Spectral domain approach, waves in layered media. Integral equations. Inverse scattering. Electromagnetic applications.

E E 514. Microwave Engineering. (Dual-listed with 414). (3-3) Cr. 4. F. *Prereq: 230, 311.* Principles, analyses, and instrumentation used in the microwave portion of the electromagnetic spectrum. Wave theory in relation to circuit parameters. S parameters, couplers, discontinuities, and microwave device equivalent circuits. RF amplifier design, microwave sources, optimum noise figure and maximum power designs. Microwave filters and oscillators.

E E 516. Computational Methods in Electromagnetics. (3-0) Cr. 3. S. *Prereq: 311.* Maxwell's equations. Analytical methods. Differential equation based methods. Finite Difference and Finite Difference Time Domain Methods, Boundary Conditions. Finite Element Method, Applications to the Analysis of Practical Devices. Integral Equation Based Methods. Electric and Magnetic Field Integral Equations. Fast Solution Methods.

E E 517. Electromagnetic Radiation, Antennas, and Propagation. (Dual-listed with 417). (3-3) Cr. 4. S. *Prereq: 311.* Fundamental antenna concepts. Radiation from wire-and aperture-type sources. Radio transmission formulas. Wave and antenna polarization. Antenna arrays. Modern antenna topics. Practical antenna design. Antenna noise. Radiowave propagation in the presence of the earth and its atmosphere. Antenna measurements and computer-aided analysis.

E E 518. Microwave Remote Sensing. (Cross-listed with Agron, Mteor). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 265 or equivalent or permission of instructor.* Microwave remote sensing of Earth's surface and atmosphere. Overview of relevant electromagnetic theory and antenna theory. Planck emission and the radiative transfer equation. The electrical properties of natural materials at microwave frequencies. Specific examples include remote sensing of atmospheric temperature and water vapor, precipitation, and soil and vegetation water content.

E E 520. Selected Topics in Communications and Signal Processing. (3-0) Cr. 3. Repeatable. Space-time processing. Multiuser communications, Wireless Communications, statistical signal processing. Pattern recognition. Coding theory. Multirate communications and signal processing. Signal processing and communications applications.

E E 521. Advanced Communications. (3-0) Cr. 3. F. *Prereq: 422, Coreq: 523.* Digital communication systems overview. Characterization of communication channels. Digital modulation and demodulation design and performance analysis. Channel capacity and error-control coding concepts. Waveform design for band-limited channels. Equalization. Wireless fading channels and performance.

E E 523. Random Processes for Communications and Signal Processing. (3-0) Cr. 3. *Prereq: 322, Math 317.* Axioms of probability; Repeated trials; Functions of a random variable and multiple random variables: covariance matrix, conditional distribution, joint distribution, moments, and joint moment generating function; Mean Square estimation; stochastic convergence; Some important stochastic processes: Random walk, Poisson, Wiener, and shot noise; Markov chaines; Power spectral analysis; Selected applications.

E E 524. Digital Signal Processing. (3-0) Cr. 3. F. *Prereq: 322, 424, Math 317.* Review: sampling and reconstruction of signals; discrete-time signals, systems, and transforms. Multi-rate digital signal processing and introduction to filter banks. Optimal linear filtering and prediction. Introductions to adaptive filtering and spectral estimation. Applications.

E E 527. Detection and Estimation Theory. (3-0) Cr. 3. S. *Prereq: 422.* Statistical estimation theory and performance measures: maximum likelihood estimation, Cramer-Rao bound, Bayesian estimation, optimal demodulation, signal design. Introduction to graphical models. Hidden Markov models and Kalman filter. Classical Statistical decision theory, decision criteria, binary and composite hypothesis tests. Error probability and Chernoff bound. Applications.

E E 528. Digital Image Processing. (3-0) Cr. 3. S. *Prereq: 322, 424.* Review of sampling, linear algebra and probability. Classical image processing topics such as image sampling and quantization, image transforms (2D Fourier, KLT, DCT, etc), image enhancement, restoration and filtering. Image analysis topics including edge detection, segmentation, registration and tracking (uses least squares estimation, EM, Kalman filter). Medical image reconstruction from tomographic projections (Radon transform, Fourier slice theorem and reconstruction algorithms using them) and Magnetic Resonance Imaging (MRI). Basic introduction to image and video compression methods.

E E 530. Selected Topics in Electronics, Microelectronics and Photonics. (3-0) Cr. 3. Repeatable. *Prereq: 332.*

E E 532. Microelectronics Fabrication Techniques. (Dual-listed with 432). (2-4) Cr. 4. *Prereq: Phys 222, Math 267. E E 332 or Mat E 331 recommended.* Techniques used in modern integrated circuit fabrication, including diffusion, oxidation, ion implantation, lithography, evaporation, sputtering, chemical-vapor deposition, and etching. Process integration. Process evaluation and final device testing. Extensive laboratory exercises utilizing fabrication methods to build electronic devices. Use of computer simulation tools for predicting processing outcomes. Recent advances in processing CMOS ICs and micro-electro-mechanical systems (MEMS).

E E 535. Physics of Semiconductors. (Cross-listed with Phys). (3-3) Cr. 4. *Prereq: 311 and 332.* Basic elements of quantum theory, Fermi Statistics, motion of electrons in periodic structures, crystal structure, energy bands, equilibrium carrier concentration and doping, excess carriers and recombination, carrier transport at low and high fields, phonons, optical properties, amorphous semiconductors, heterostructures, and surface effects. Laboratory experiments on optical properties, carrier lifetimes, mobility, defect density, doping density.

E E 536. Physics of Semiconductor Devices. (Cross-listed with Phys). (3-0) Cr. 3. *Prereq: 535.* P-n junctions, band-bending theory, tunneling phenomena, Schottky barriers, heterojunctions, bipolar transistors, field-effect transistors, negative-resistance devices and optoelectronic devices.

E E 538. Optoelectronic Devices and Applications. (Dual-listed with 438). (3-0) Cr. 3. *Prereq: 311 or 332.* Transmission and reflection of electromagnetic plane waves. Propagation in dielectric and fiber optic waveguides. Led and laser operating principles and applications. Photodetectors and solar cells. Optical modulation and switching.

E E 545. Artificial Neural Networks. (3-0) Cr. 3. F. *Prereq: 324.* Introduction to the fundamentals of artificial neural networks (ANNs). Theory and practical implementation of networks. ANNs for pattern recognition, function approximation, prediction. Activation functions, neural net architectures, supervised and unsupervised learning. Various neural network methods and architectures.

E E 547. Pattern Recognition. (3-0) Cr. 3. F. *Prereq: 324.* Mathematical formulation of pattern recognition problems and decision functions. Statistical approaches: Bayes classifier, probability density function estimation and expectation minimization. Clustering (supervised and unsupervised), learning, and neural network algorithms. Fuzzy recognition systems. Feature selection systems. Classifier comparison. Current applications.

E E 553. Steady State Analysis. (3-0) Cr. 3. F. *Prereq: 456, 457.* Power flow, economic dispatch, unit commitment, electricity markets, automatic generation control, sparse matrix techniques, interconnected operation, voltage control.

E E 554. Power System Dynamics. (3-0) Cr. 3. S. *Prereq: 456, 457, 475.* Dynamic performance of power systems with emphasis on stability. Modeling of system components and control equipment. Analysis of the dynamic behavior of the system in response to small and large disturbances.

E E 555. Advanced Energy Distribution Systems. (3-0) Cr. 3. *Prereq: 455.* Transient models of distribution components, automated system planning and distribution automation, surge protection, reliability, power quality, power electronics and intelligent systems applications.

E E 556. Power Electronic Systems. (3-0) Cr. 3. *Prereq: 452.* Converter topologies, AC/DC, DC/DC, DC/AC, AC/AC. Converter applications to do motor drives, power supplies, AC motor drives, power system utility applications (var compensators) and power quality.

E E 565. Systems Engineering and Analysis. (Cross-listed with Aer E, I E). (3-0) Cr. 3. *Prereq: Coursework in basic Statistics.* Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated systems. Life-cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test, evaluation and systems engineering planning and organization. Not available for degrees in industrial engineering.

E E 566. Avionics Systems Engineering. (Cross-listed with Aer E). (3-0) Cr. 3. S. *Prereq: E E 565.* Avionics functions. Applications of systems engineering principles to avionics. Top down design of avionics systems. Automated design tools.

E E 570. Systems Engineering Analysis and Design. (3-0) Cr. 3. *Prereq: 475, 577.* Selected topics in abstract algebra, linear algebra, real analysis, functional analysis, and optimization methods in electrical engineering.

E E 573. Random Signal Analysis and Kalman Filtering. (Cross-listed with Aer E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 370 or 411 or Math 341 or 395.* Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

E E 574. Optimal Control. (Cross-listed with Aer E, Math, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* The optimal control problem. Variational approach. Pontryagin's principle, Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

E E 575. Introduction to Robust Control. (Cross-listed with Math, Aer E, M E). (3-0) Cr. 3. *Prereq: E E 577.* Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H2, Hoo, and l1 control problems. Tools for robustness analysis and synthesis.

E E 576. Digital Feedback Control Systems. (Cross-listed with Aer E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 475 or Aer E 432 or M E 411 or 414 or Math 415; and Math 267.* Sampled data, discrete data, and the z-transform. Design of digital control systems using transform methods: root locus, frequency response and direct design methods. Design using State-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

E E 577. Linear Systems. (Cross-listed with Aer E, Math, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 414 or Math 415; and Math 307.* State variable and input-output descriptions of linear continuous-time and discrete-time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by State feedback. Design of feedback systems. Stability of linear dynamical systems.

E E 578. Nonlinear Systems. (Cross-listed with Aer E, Math, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* Classification of nonlinear control systems. Existence and uniqueness of solutions. Approximate analysis methods. Periodic orbits. Concept of stability and Lyapunov stability theory. Absolute stability of feedback systems. Input-output stability. Passivity.

E E 588. Eddy Current Nondestructive Evaluation. (Dual-listed with 488). (Cross-listed with M S E). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Math 265 and Mat E 216 or 272 or E E311 or Phys 364).* Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

E E 590. Special Topics. Cr. arr. Repeatable. Formulation and solution of theoretical or practical problems in electrical engineering.
A. Electromagnetic Theory
B. Control Systems
C. Communication Systems
E. Computer Engineering
F. Electric Power
G. Electrical Materials
H. Electronic Devices and Circuits
I. Signal Processing

E E 591. Seminar in Electronics, Microelectronics, and Photonics. Cr. arr. Repeatable.

E E 592. Seminar in Electromagnetics, Microwave, and Nondestructive Evaluation. Cr. 1. Repeatable. *Prereq: Graduate student Status.* Satisfactory-fail only.

E E 594. Seminar in Electric Power. Cr. arr. Repeatable.

E E 596. Seminar in Control Systems. Cr. arr. Repeatable.

E E 597. Seminar in Communications and Signal Processing. Cr. 1. Repeatable. Satisfactory-fail only.

E E 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

E E 621. Coding Theory. (3-0) Cr. 3. *Prereq: 521.* Fundamentals of error-control coding techniques: coding gain, linear block codes. Galois fields. Cyclic codes: BCH, Reed-Solomon. Convolutional codes and the Viterbi algorithm. Trellis-coded modulation. Iterative decoding. Recent developments in coding theory.

E E 622. Information Theory. (3-0) Cr. 3. *Prereq: 521, 523. Information* system overview. Entropy and mutual information. Data Compression and source encoding. Discrete memoryless channel capacity. Noisy channel coding theorem. Rate distortion theory. Waveform channels. Advanced topics in information theory.

E E 653. Advanced Topics in Electric Power System Engineering. (3-0) Cr. 3. *Prereq: Permission of instructor.* Advanced topics of current interest in electric power system engineering.

E E 674. Advanced Topics in Systems Engineering. (3-0) Cr. 3. *Prereq: Permission of instructor.* Advanced topics of current interest in the areas of control theory, stochastic processes, digital signal processing, and image processing.

E E 697. Engineering Internship. (Cross-listed with Cpr E). Cr. R. Repeatable. *Prereq: Permission of department chair and Engineering Career Services, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

E E 699. Research. Cr. arr. Repeatable.

Engineering

Most of the courses with the designator of Engr are broad-based engineering courses applicable to all engineering disciplines. Several of these courses are part of the basic program which is required for engineering students. All courses are administered by the college and with the exception of Engr 160 and Engr 170 are coordinated through Engineering Student Services in Engineering Academic and Student Affairs. Course-related questions should be directed to the department or unit with responsibility for that course. The following is a list of those responsibilities:

Engr 160 Materials Science and Engineering

Engr 170 Agricultural and Biosystems Engineering

Courses primarily for undergraduate students

Engr 101. Engineering Orientation. Cr. R. F.S. Introduction to the College of Engineering and the engineering profession. Information concerning university and college policies, procedures, and resources. Undeclared sections: Considerations in choosing an engineering curriculum. Opportunities to interact with departments. Declared sections: Introduction to major-specific topics. Satisfactory-fail only.

Engr 104. LEAD Program Orientation. (1-0) Cr. 1. F. Orientation for LEAD Living/Learning Community participants. Applications of problem solving, engineering design, teamwork, study, and time management techniques and skills. Engineering professional development. Satisfactory-fail only.

Engr 105. LEAD Program Seminar. (1-0) Cr. 1. S. Seminar for LEAD Program participants in the residential learning community. Industrial tours and orientation to engineering profession. Satisfactory-fail only.

Engr 131. Learning Community Seminar. (1-0) Cr. R. F.S. Peer-mentored review of course topics in engineering undeclared learning communities. Available to students interested in engineering if in Liberal Arts and Science Open (option) major. Satisfactory-fail only.

Engr 150. Foundations of Leadership Development and Learning. (1-0) Cr. 1. F.S. *Prereq: ELP students only.* Leadership development with focus on global context and awareness of events shaping the context. Exposure to theory of leadership with examples. Necessary characteristics of a leader, and strategies for leadership skills development. Exposure to non-traditional career paths for engineers. Outline of personalized leadership development. Satisfactory-fail only.

Engr 160. Engineering Problems with Computer Applications Laboratory. (2-2) Cr. 3. F.S.SS. *Prereq: Satisfactory scores on Mathematics placement examinations; credit or enrollment in Math 142, 165.* Solving engineering problems and presenting solutions through technical reports. Significant figures. Use of SI units. Graphing and curve-fitting. Flowcharting. Introduction to mechanics, statistics and engineering economics. Use of spreadsheet programs to solve and present engineering problems. Solution of engineering problems using computer programming languages. (The honors section includes application of programming to mobile robotics).
H. Honors. F.

Engr 170. Engineering Graphics and Introductory Design. (2-2) Cr. 3. F.S. *Prereq: Satisfactory scores on mathematics placement assessments; credit or enrollment in Math 142.* Integration of fundamental graphics, computer modeling, and engineering design. Applications of multiview drawings and dimensioning. Techniques for visualizing, analyzing, and communicating 3-D geometries. Application of the design process including written and oral reports. Freehand and computer methods.

Engr 193. Academic Excellence Workshop. (0-3) Cr. 1. F.S. *Prereq: Engineering classification and concurrent enrollment in appropriate course.* Collaborative learning community workshops for LEAD participants. Satisfactory-fail only.
A. Chemistry 155 (Fall only)
B. Chemistry 165 (Spring only)
C. Chemistry 167
D. Mathematics 165
E. Mathematics 166
F. Physics 221
G. Physics 222
I. Engineering Problems-Computer Applications

Engr 320. International Experience Report. Cr. 3. F.S. *Prereq: Satisfactory completion of international work experience of at least ten weeks or nine credits of approved course work taken abroad. Permission of student's department prior to departure.* Critique of work/study abroad experience as it relates to professional development. Taken the semester after completion of work abroad or study abroad. Written report and presentation. Satisfactory-fail only.

Engr 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of Engineering Student Services advisor and Engineering Career Services.* Summer professional work period.

Engr 397. Professional Internship. Cr. R. F.S.SS. *Prereq: Permission of adviser and engineering college classification officer.* Professional or interdisciplinary work period in engineering or career-related field. Enrollment limited to one summer and/or one semester per academic year. Satisfactory-fail only.

Engr 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Aer E, Cpr E, E E, I E, M E, Mat E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing, and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

Engr 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or senior classification in engineering, college approval.*
E. Entrepreneurship

Engineering Mechanics

(Administered by the Department of Aerospace Engineering)

Thomas Shih, Chair of Department

Distinguished Professors: Soukoulis, R. B. Thompson

Distinguished Professors (Emeritus): D. Thompson, Young

Professors: Chandra, Chimenti, Durbin, Holger, Kelkar, Levitas, Lu, Oliver, Rajagopalan, Rothmayer, Rudolphi, Sarkar, Schmerr, Shih, Takle, Wang, Wie, Zachary

Professors (Emeritus): Akers, Greer, Inger, Iversen, Jenison, McConnell, McDaniel, Munson, Pierson, Rizzo, Rogge, Rohach, Tannehill, Tsai, Weiss, Wilson

Professors (Adjunct): Hsu, Nakagawa

Associate Professors: Bastawros, Bryden, Dayal, Hilliard, Hindman, Mitra, Sherman, Sturges

Associate Professors (Emeritus): Hermann, Seversike, Trulin, Vogel

Associate Professors (Adjunct): Biner, Cox, Roberts

Associate Professor (Collaborator): Flatau

Assistant Professors: Chung, Holland, Hong, Hu, Jacobson

Assistant Professors (Adjunct): Byrd, Gray

Assistant Professor (Collaborator): Chavez

Senior Lecturers: Deam, Haugli, Schaefer

Lecturer: Boylan

Undergraduate Study

The undergraduate courses in mechanics are intermediate between those in physics and mathematics and the professional and design courses of the several engineering curricula. In these courses the student is expected to acquire an understanding of the basic principles and analysis techniques pertaining to the static and dynamic behavior of rigid media, deformable solids, fluids, and gasses. Physical properties of engineering materials are studied in the classroom and are tested in the laboratory. General physical laws are given mathematical expression and are made suitable for use in the solution of specific problems in machine and structural design, and in the flow and measurement of fluids.

Graduate Study

The department offers work for the degrees master of science, master of engineering, and doctor of philosophy with major in engineering mechanics, and minor work to students taking major work in other departments.

The master of science degree requires a thesis and a minimum of 8 research credits. It has strong research emphasis and is recommended for students who anticipate entering a doctoral program later. At least 30 credits of acceptable graduate work are required for the degree.

The master of engineering degree does not require either research credits or a thesis. However, at least two credits of acceptable creative component and at least 26 credits of acceptable graduate coursework are required. A minimum of 30 credits of acceptable graduate work is required for the degree. The program is intended to give students additional instruction at the graduate level to better qualify them for advanced professional engineering work. By careful selection of electives and perhaps additional courses during the senior undergraduate year, students should be able to qualify for the master of engineering degree with an additional year of full-time study after receiving their baccalaureate degree in one of the several engineering curricula.

Credits for creative component will be obtained by registering for E M 599. A written report and an oral presentation will be given to the student's graduate committee.

The normal prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this university. However, because of the diversity of interests in graduate work in engineering mechanics, it is possible for a student to qualify for graduate study even though undergraduate or prior graduate training has been in a discipline other than engineering—e.g., physics or mathematics.

Courses primarily for undergraduate students

E M 274. Statics of Engineering. (3-0) Cr. 3. F.S.SS. *Prereq: Credit or enrollment in Math 166; credit or enrollment in Phys 111 or 221.* Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, second moments of areas, principal second moments of area, radius of gyration, internal forces, shear and bending moment diagrams.
H. Honors. F.S.

E M 324. Mechanics of Materials. (3-0) Cr. 3. F.S.SS. *Prereq: 274.* Plane stress, plane strain, stress-strain relationships, and elements of material behavior. Application of stress and deformation analysis to members subject to centric, torsional, flexural, and combined loadings. Elementary considerations of theories of failure, buckling. Nonmajor graduate credit.

E M 327. Mechanics of Materials Laboratory. (0-2) Cr. 1. F.S.SS. *Prereq: Credit or enrollment in 324.* Experimental determination of mechanical properties of selected engineering materials. Experimental verification of assumptions made in 324. Use of strain measuring devices. Preparation of reports. Students who are not present for the first laboratory meeting of their own sections may qualify for continuation in the course only by attending the first laboratory meeting of some other section of the course. Nonmajor graduate credit.

E M 345. Dynamics. (3-0) Cr. 3. F.S.SS. *Prereq: 274, credit or enrollment in Math 266 or 267.* Particle and rigid body kinematics, Newton's laws of motion, kinetics of plane motion, rigid body problems using work-energy, linear, and angular impulse-momentum principles, vibrations. Nonmajor graduate credit.

E M 350. Introduction to Nondestructive Evaluation Engineering. (3-0) Cr. 3. S. *Prereq: 324, Math 266 or 267, Phys 222.* The Physics of ultrasonic, eddy current, and x-ray testing. Introduction to linear system concepts, wave propagation, electromagnestics and radiation. Models of the generation, scattering and reception of waves in ultrasonics, the electrical impedance changes of eddy current testing, and image formation process for x-rays. Pattern recognition methods for the interpretation of measured responses. Nonmajor graduate credit.

E M 362. Principles of Nondestructive Testing. (Cross-listed with Mat E). (3-0) Cr. 3. S. *Prereq: Phys 112 or 222.* Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection, and other techniques. Physical bases of tests; materials to which applicable; types of defects detectable; calibration standards, and reliability safety precautions. Nonmajor graduate credit.

E M 362L. Nondestructive Testing Laboratory. (Cross-listed with Mat E). (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 362.* Application of nondestructive testing techniques to the detection and sizing of flaws in materials and to the characterization of material's microstructure. Included are experiments in hardness, dye penetrant, magnetic particle, x-ray, ultrasonic and eddy current testing. Field trips to industrial laboratories. Nonmajor graduate credit.

E M 378. Mechanics of Fluids. (2-2) Cr. 3. F.S.SS. *Prereq: 274.* Properties of fluids. Fluid Statics. Kinematics and kinetics of fluid flow. Mass, momentum, and energy conservation laws; dimensional analysis; flow in pipes and channels. Selected laboratory experiments. Nonmajor graduate credit.

E M 417. Experimental Mechanics. (Cross-listed with Aer E). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: 324.* Introduction of different aspects of measuring deformation, strains, and stress for practical engineering problems. Strain gage theory and application. Selected laboratory experiments. Nonmajor graduate credit.

E M 424. Intermediate Mechanics of Materials. (3-0) Cr. 3. F.S. *Prereq: 324.* Analysis of stresses, strains, and deflections. Torsion and bending of unsymmetrical members. Analysis of thick wall pressure vessels and shrink fit problems. Dynamic load effects, fatigue and fracture mechanics introduction. Work-strain energy methods. Nonmajor graduate credit.

E M 425. Introduction to the Finite Element Method. (3-0) Cr. 3. S. *Prereq: 324, Math 266 or 267.* Introduction of finite element analysis through applications to one-dimensional, steady-state problems such as elastic deformation, heat and fluid flow, consolidation, beam bending, and mass transport. Transient heat conduction and wave propagation. Two-dimensional triangular and quadrilateral elements. Plane problems of torsion, thermal and potential flow, stress analysis. Simple computer programs for one- and two-dimensional problems. Nonmajor graduate credit.

E M 450. Engineering Vibrations. (Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: 324, 345.* Elementary vibration analysis, single and multiple degrees of freedom, energy methods, free and forced vibrations, viscous and other forms of damping transform methods and response to periodic and random force inputs, numerical methods of solution, eigenvalues and modal analysis, energy methods, vibration isolation and suppression, string or cable dynamics, beam bending dynamics, application problems in aerospace and mechanical engineering (as relevant). Nonmajor graduate credit.

E M 451. Engineering Acoustics. (Cross-listed with M E). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: Phys 221 and Math 266 or 267.* Sound sources and propagation. Noise standards and effects of noise on people. Principles of noise and vibration control used in architectural and engineering design. Characteristics of basic noise measurement equipment. Experience in use of noise measuring equipment, sound power measurements, techniques for performing noise surveys, evaluation of various noise abatement techniques applied to common noise sources. Selected laboratory experiments. Nonmajor graduate credit.

E M 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
H. Honors

Courses primarily for graduate students, open to qualified undergraduate students

E M 510. Continuum Mechanics. (3-0) Cr. 3. F. *Prereq: Math 385.* Introduction to Cartesian tensors as linear vector transformations. Kinematics of continuous deformations, Lagrangian and Eulerian descriptions of motion. Fundamental equations or balance laws of continuous media, linear and angular momentum balance. Conservation laws of momentum and energy. Introduction to constitutive equations of classical elastic solids and simple fluids. Formulations and solutions of some canonical problems.

E M 514. Advanced Mechanics of Materials. (Cross-listed with Aer E). (3-0) Cr. 3. F. *Prereq: 324.* Theory of stress and strain, stress-strain relationships. Unsymmetrical bending, curved beams, shear center. Torsion of thin-walled noncircular sections. Equilibrium, compatibility equations. Airy stress functions. Membrane stresses in shells, thick-walled cylinders.

E M 516. Mechanics of Deformable Solids. (3-0) Cr. 3. S. *Prereq: E M 510.* Fundamental mechanics of linear elasticity, formulation and solution of simple elastostatic boundary value problems. Kinematics of small deformations, constitutive equations for isotropic and anisotropic media. Field equations for elastic solids, plane strain/plane stress and some classic canonical solutions. Constitutive models of inelastic/plastic solids and selected problems of elastoplasticiy, contact mechanics, fracture mechanics and defects in crystalline solids.

E M 517. Experimental Mechanics. (Cross-listed with Aer E). (3-2) Cr. 4. Alt. S., offered 2010. *Prereq: E M 510 or 514 or 516.* Fundamental concepts for force, displacement, stress, and strain measurements. Strain gages. Full field deformation measurements with laser interferometry and digital image processing. Advanced experimental concepts at the micro and nano scale regimes.

E M 518. Waves in Elastic Solids with Applications to Ultrasonic Nondestructive Evaluation. (3-0) Cr. 3. F. *Prereq: Math 385.* Propagation of bulk waves, surface waves, and guided waves in isotropic and anisotropic elastic media. Transmission and reflection of waves at plane and curved interfaces. Radiation of sources with application to ultrasonic transducer beam modeling. Elastic wave scattering from cracks and inclusions. Reciprocity principles and their use in the development of an ultrasonic measurement model. Characterization and measurement of material attenuation.

E M 525. Finite Element Analysis. (Cross-listed with Aer E). (3-0) Cr. 3. S. *Prereq: 425, Math 385.* Variational and weighted residual approach to finite element equations. Emphasis on two- and three-dimensional problems in solid mechanics. Isoparametric element formulation, higher order elements, numerical integration, imposition of constraints and penalty, convergence, and other more advanced topics. Use

of two- and three-dimensional computer programs. Dynamic and vibrational problems, eigenvalues, and time integration. Introduction to geometric and material nonlinearities.

E M 526. Boundary Element Methods in Engineering. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 514 or 516.* Introductory boundary element methods through plane problems. Singular integrals, Cauchy principal values, integral representations and boundary integrals in one dimension. Direct and indirect formulations. Plane potential and elastostatic problems. Higher order elements, numerical integration. Regularizations. Body forces and infinite regions. Specialized fundamental solutions, half-plane and axisymmetric problems. Diffusion and wave problems. Coupling with finite elements.

E M 543. Introduction to Random Vibrations and Nonlinear Dynamics. (Cross-listed with M E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 444.* Vibrations of continuous systems. Nonlinear vibration phenomena, perturbation expansions; methods of multiple time scales and slowly-varying amplitude and phase. Characteristics of random vibrations; random processes, probability distributions, spectral density and its significance, the normal or Gaussian random process. Transmission of random vibration, response of simple single and two-degree-of-freedom systems to Stationary random excitation. Fatigue failure due to random excitation.

E M 548. Advanced Engineering Dynamics. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 345, Math 266 or 267.* 3-D kinematics and dynamics of particles and rigid bodies. Coordinate systems, calculus of variations. Lagrange's equations with constraints, modified Euler's equations, torque-free motion of rigid bodies in 3-D, moment equations with constraints.

E M 550. Fundamentals of Nondestructive Evaluation. (Cross-listed with M S E). (3-2) Cr. 4. S. *Prereq: 324, Math 385.* Principles of five basic NDE methods and their application in engineering inspections. Materials behavior and simple failure analysis. NDE reliability, and damage-tolerant design. Advanced methods such as acoustic microscopy, laser ultrasonics, thermal waves, computed tomography, and thermoelectrics are analyzed. Laboratory experiments on all basic methods: ultrasonics, eddy currents, x-ray, liquid penetrants, magnetic testing, and visual inspection are performed.

E M 552. Advanced Acoustics. (Cross-listed with M E). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 451.* Theoretical acoustics: wave propagation in fluids; acoustic radiation, diffraction and scattering; and architectural acoustics. Applications of basic acoustic theory in noise control and acoustic radiation. Introduction to selected numerical methods in acoustics.

E M 564. Fracture and Fatigue. (Cross-listed with M S E, M E). (3-0) Cr. 3. F. *Prereq: 324 and either Mat E 216 or 272 or 392. Undergraduates: Permission of instructor.* Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

E M 569. Mechanics of Composite and Combined Materials. (Cross-listed with M S E, Aer E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 324.* Mechanics of fiber-reinforced materials. Micromechanics of lamina. Macromechanical behavior of lamina and laminates. Strength and interlaminar stresses of laminates. Failure criteria. Stress analysis of laminates. Thermal moisture and residual stresses. Joints in composites.

E M 570. Wind Engineering. (Cross-listed with Aer E). (3-0) Cr. 3. F. *Prereq: 378, 345.* Atmospheric circulations, atmospheric boundary layer wind, bluff-body aerodynamics, aeroelastic phenomena, wind-tunnel and full-scale testing, wind-load code and standards, effect of tornado and thunderstorm winds, design applications.

E M 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
F. Introduction to Dislocation and Plasticity
H. Mechanics of Thin Films and Adhesives
I. Mechanics of Cellular and Porous Media
J. Other

E M 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

E M 690. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
N. Advanced Experimental Methods
O. Advanced Wave Propagation
P. Advanced Materials
Q. Advanced Computational Methods
R. Reliability and Failure
S. Other

E M 697. Engineering Internship. Cr. R. Repeatable. *Prereq: Permission of DOGE (Director of Graduate Education), graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

E M 699. Research. Cr. arr. Repeatable.

Engineering Studies

www.eng.iastate.edu/esm/

(Interdepartmental minor)

The College of Engineering offers an undergraduate minor in engineering studies for non-engineering students designed to improve their understanding of engineering. This minor is not intended to train non-engineering students to do the work of practicing, degree-holding engineers. Rather, students who complete the minor in engineering studies will be able to work more effectively in their primary field by better appreciating the nature, capabilities, and limitations of engineering.

The minor in engineering studies is structured so that no student will be excluded due to insufficient preparation in mathematics or the sciences. The required courses in the minor and many of the elective courses are specifically designed to offer a range of prerequisites, so that students from all curricula will find coursework that supports an accessible and intellectually stimulating program of study.

With the exception of E St 260, 265, and 270, courses offered for the minor in engineering studies are also open to students whose major curriculum is in the College of Engineering. However, the minor in engineering studies will be awarded only to students whose degree program is not in engineering.

To receive a minor in engineering studies, students must complete a total of 21 course credits that satisfy the following:

- E St 260, 265, and 270 (3 credits each) are required for all students in the minor in engineering studies.
- Twelve additional credits from an approved list of eligible courses. Some of these approved courses are taught by the College of Engineering; additional courses are taught by other colleges. A minimum of six of those 12 credits must be courses that bear the designation "E St" or are courses offered by engineering departments. Eligible courses will include those 200-level and above courses offered by the departments in the College of Engineering that are expressly designated by that department's curriculum committee for use in the minor in engineering studies.
- A minimum of 6 credits in the minor must be 300-level or above (university requirement)

Courses primarily for undergraduate students

E St 260. Engineering: Getting from Thought to Thing. (2-2) Cr. 3. *Prereq: Students enrolled in minor in Engineering Studies only.* What is engineering, technology and their roles in Society? Investigation of engineering methods through case studies of everyday objects. Explore questions about the impact of technology in Society. Apply engineering methods to design and failure analysis.

E St 265. Survey of the Impacts of Engineering Activity. (3-0) Cr. 3. *Prereq: Students enrolled in minor in Engineering Studies only.* Survey of the economic, environmental, societal, and political benefits and problems resulting from engineering activity. Effects of engineering projects on human health, social structures, and the environment. Examination of improvements in economic opportunities and quality of life resulting from engineering activity. Case studies of the effects of engineering activity.

E St 270. Survey of How Things Work. (2-2) Cr. 3. *Prereq: Students enrolled in minor in Engineering Studies only.* An overview of the similarities and differences of the major engineering disciplines; methods used to manufacture products, build structures, and design systems. Laboratory exercises in measuring properties of basic engineering materials, welding, casting, and machining; case studies in product development; student design exercises.

E St 351. Introduction to Energy Systems: An Engineering Perspective. (Cross-listed with E E). (3-0) Cr. 3. Dalal. Energy-scientific, engineering and economic foundations. Energy utilization-global and national. Sectoral analysis of energy consumption. Relationship of energy consumption and production to economic growth and environment. Technology for energy production. Economic evaluation of energy utilization and production. Scientific basis for global warming. Environmental impact of energy production and utilization. Renewable energy.

E St 490. Independent Study. Cr. arr. F. *Prereq: Permission of instructor.*

English

www.Engl.iastate.edu/

Charles Kostelnick, Chair of Department

Distinguished Professor: Swander

Distinguished Professor (Emeritus): Bowers

University Professors: Mendelson, Nakadate

University Professors (Emeritus): Burnett, Daly

Professors: Carlson, Chapelle, Ewald, Freed, Graham, Herndl, Hickok, Kienzler, Kostelnick, Marquart, Owen, Poague, Price-Herndl, Russell, Tremmel, Z. Zimmerman

Professors (Emeritus): Abraham, Anderson-Hsieh, Bataille, Blyler, David, Dearin, Douglas, Geha, Haggard, Herrnstadt, McCarthy, Nostwich, Potter, Silet, Underhill, Vann, Winsor, Zbaracki

Associate Professors: Blakely, Consigny, Goodwin, Haas, Hagge, Hegelheimer, Honeycutt, Kupfer, Larson, LaWare, Levis, Niday, Payne, Pett, Post, Redmond, Roberts, Schwarte, Slagell, Yager

Associate Professor (Adjunct): Betcher

Associate Professors (Emeritus): Galyon, Gwiasda, Matthies, Ross, Whitaker

Assistant Professors: Pendar, Percy, Sauer, Shenk, Sivils, Wiegand, Wilson, D. Zimmerman

Assistant Professors (Emeritus): Kaufmann, McCully, J. Vallier

Assistant Professor (Adjunct): Vrchota

Instructors (Adjunct): Barratt, Mahoney, Myers, Noland, Schmidt

Senior Lecturers: Aune, Benner, Clarke, Demaray, Dewall, Gilchrist, Levis, Liebich, Lowery, McGough, Messenger, Ringlee, Schabel, Tremmel, Vandervalk

Lecturers: Behrens, Boehm, Brottman, Chamberlin, Collins, Coppoc, Corey, Cross, DeBoest, DiSalvo, Fromm, Greenwald, Hagge, House, Hughes, Judge, Kelley, Langenberg, Malven, Meyer, Nelson, Newgaard, Paulson, Reedy, Regenold, Rozendaal, Satterwhite, Smith, Thune, F. Vallier, Walrod, Weiner

Undergraduate Study

The department offers a wide variety of courses for students seeking a degree in English or Technical Communication, as well as for students wishing to broaden their general education. Offerings include classes in introductory college writing, literature, film, creative writing, rhetoric and professional communication, technical communication, English education, linguistics, and teaching English as a second language/applied linguistics.

The discipline of English helps to develop students' understanding of how language functions in literature, mass media, and both personal and professional writing. Students not pursuing an English or Technical Communication major may select English courses to fill electives, to pursue a minor, or to complement their training in other majors.

Graduates majoring in English will possess a broad-based knowledge and understanding of the discipline. They will also understand their particular disciplinary specialization whether it be literary studies, rhetorical studies, teacher education, creative writing, or teaching English as a second language/applied linguistics. Graduates in Technical Communication will learn how to communicate scientific and technical information through coursework both in English and in scientific and technical fields. Graduates in either major will be able to write well-organized, well-reasoned essays that demonstrate their ability to read and think critically.

Introductory writing courses in the department are designed to improve the skills in communication and reading comprehension necessary for successful university work.

Through the Intensive English and Orientation Program, the department offers special courses in English for both undergraduate and graduate students who are native speakers of other languages. (See catalog entries under *English Courses for Native Speakers of Other Languages and English Requirement for International Students*.)

Careers for English Majors

Students who graduate with a major in English often enter fields that require special communication skills, such as publishing, public service, research, business and technical writing, or human resources. An undergraduate major in English can be a solid basis for the professional study of law, medicine, theology, or business management. Students in English Education can qualify to teach English in middle or high school. (See *Index, Teacher Education*.) English majors may also pursue graduate studies in a number of communication-related fields.

Careers for Technical Communication Majors

Students who graduate with a major in Technical Communication will be prepared for careers in scientific and technical writing and editing. They will typically seek positions in companies or nonprofit organizations; in communication-based units of local, state, and federal government; in the documentation units of software developers or publishers; or in such areas as web design and communication consulting. Technical Communication majors may also pursue graduate study in rhetoric and professional communication or other communication-related fields.

English Major Requirements

English majors choose one of three programs of study: Literary Studies, Rhetorical Studies, or English Education. Students interested in creative writing typically choose Literary Studies as a program of study. English majors are required to have, in addition to ISUComm foundation courses, at least 39 credits in English; those in English Education must have 48 credits in English in addition to required teaching-related courses taken in other departments. English majors transferring from other institutions must take at least 18 of their credits in English while in residence at Iowa State.

To graduate with a major in the English Department, a student must earn at least a C (not a C-) in English 150 and 250 as well as in each of the courses taken to fulfill the program of study. Earning at least a C in ISUComm foundation courses and in one advanced communication course also meets the departmental Communication Proficiency requirement.

Finally, all English majors must take at least one pre-1800 literature course and one pre-1900 literature course.

Distributed Requirements

All English majors, no matter what their program of study, must take nine courses for a total of 27 credits from a list of distributed requirements:

Engl 199: Introduction to the Study of English	R
Engl 497: Capstone Assessment	R
Engl 220: Descriptive English Grammar	3
Engl 225-228:Literature Survey	9
Engl 260: Introduction to Literary Study	3
Engl 310: Rhetorical Analysis	3
Engl 207, 302-309, 313-316 Advanced Comm	3
Engl 340-349, 352, 389: Women's or Multicultural Literature	3
	27

These distributed requirements may not overlap with any advanced study requirements.

Advanced Study Requirements

Each program of study has its own requirements for advanced work:

Literary Studies

Engl 200- or 300-Level—Literary History	3
Engl 300 or above—English Elective	3
Engl 440-460 Literature Seminars	6
	12

Rhetorical Studies

Rhetorical Studies Elective	3
Engl 350 Rhetorical Theories and Issues in Context	3
Engl/Sp Cm 300+Rhetorical Studies Elective	3
Engl 418 Seminar in Argumentation	3
Engl/Sp Cm 400+Rhetorical Studies Elective	3
	12

English Education

Engl 219 Intro to Linguistics	3
Engl 225-228 Literature Surveys, whichever course not taken for Distributed Requirement	3
Engl 353 World Literature: Ancient to Renaissance	3
Engl 354 World Literature: Seventeenth Century to the Present	3
Engl 396 Teaching the Reading of Young Adult Literature	3
Engl 397 Practice & Theory of Teaching Writing in the Secondary Schools	3
Engl 420 History of the English Language	3
Engl 494Prac & Theory of Teaching Literature in the Secondary School	3
	24

There are a number of other course requirements outside of English for English Education majors. These requirements may overlap with General Education requirements for the college:

C I 202 Introduction to Instructional Technology for Grades 7-12	3
C I 204 Social Foundations of American Education	3
C I 280A Pre-Student-Teaching Experience	4
C I 395 Teaching Reading in Middle and Secondary Schools	3
C I 406 Multicultural Gender Fair Education	3
C I 426 Principles of Secondary Education	3
Engl 417E Student Teaching	16
Cl St 353 World Literature	3
Psych 230 Developmental Psychology	3
Psych 333 Educational Psychology	3
Hist or Pol S American History or Government	3
Sp Cm 212 or Thtre 358	3

Technical Communication Major Requirements

Technical Communication majors must take 39 credits within the major as well as 12 credits in a Designated Area of Concentration (DAC) in a technical, scientific, or design field. Majors develop advanced skills in multiple aspects of technical communication and apply their knowledge of technical communication to a specific discipline.

Core Requirements

Engl 310 Rhetorical Analysis	3
Engl 350 Rhetoric Theories and Issues in Context	3
Engl 411 Technology, Rhetoric and Professional Communication	3
Engl 314 Technical Communication	3
Engl 415 Business and Technical Editing	3
Engl 416 Visual Aspects of Business and Technical Communication	3
Engl 477 Seminar in Technical Communication	6

TComm Elective credits, from Engl 309, 313, 332, 418, 477 6

Complementary courses

Engl 220 Descriptive English Grammar	3
200-or 300-level literature course	3
Communication Elective	3
Engl 487 Internship	1-3

Designated Area of Concentration in a Technical, Scientific, or Design Field 12

The DAC is a student-designed grouping of related courses in a technical, scientific, or design field that will meet the student's professional or academic interests. All courses for the 12-credit DAC must be taken outside the English Department and approved by the Technical Communication Program Coordinator. A second major or a minor in areas such as computer science, social science, natural science, entrepreneurial studies, design studies, engineering studies, or another technical, scientific, or design field may substitute for the DAC.

Learning Goals

Graduates of the bachelor's degree programs in the English Department will demonstrate knowledge of the nature, history, current practice and critical issues in their curricular fields. They will employ the terminology, skills, and techniques specific to the field. Specifically, they will demonstrate advanced skills in reading and writing, speaking and argumentation, and research and application of appropriate technology. They will demonstrate the ability to perform professionally as educators, communicators, writers and editors. They will also be able to analyze aspects of culture and society and will become critical thinkers, having an awareness of ethical and humane issues essential to professional careers and to the practice of lifelong learning. (See department's URL for learning goals for specific programs.)

Graduates of advanced degree programs in the department will have, in addition to these

skills, knowledge of theory, methodology, and practice within their disciplines; advanced skills in research, innovation, and creative and critical thinking; and well-developed skills in problem-solving and critical analysis.

Minors and Second Majors
English majors are encouraged to seek a minor or a second major to complement their English studies. To find out the requirements for particular majors or minors, consult the section in this catalog relating to the department offering the major or minor. Students in English Education are particularly encouraged to acquire secondary certification in another teaching area. Consult ISU's certification officer in the College of Education for a list of Iowa Secondary Certification requirements in various subject areas.

Degree Choices
English majors may earn a bachelor of arts or a bachelor of science degree; Technical Communication majors may earn a bachelor of science degree only. For English majors, the B.S. degree requires an extra 12 credits beyond the general education requirements; these credits must be taken in linguistics, natural science, mathematics, social science, or selected courses in exercise and sport science.

English Minor Requirements
The department offers a minor in English, which students may earn by completing at least 18 credits in English courses beyond the 100 level, excluding Engl 250. A student earning an English minor must take 9 of the 18 credits at the 300-level or above and must earn a grade of C (not C-) or higher in each course taken in the minor. No specific courses need be taken; students may design their minor programs around their own interests.

Technical Communication Minor Requirements
The department offers a minor in Technical Communication, which students may earn by completing 18 credits in Technical Communication courses, 6 from Theory and History and 12 additional credits. Half of the 18 credits must be 300-level or above and students must earn a grade of C (not C-) or higher in each course taken in the minor. Although students may design their minor programs around their own interests, they are encouraged to work with a departmental adviser in Technical Communication.

Departmental Awards and Scholarships
Each spring the English Department offers many scholarships and awards for both undergraduate and graduate students. Some undergraduate awards are for returning English and Technical Communication majors only; others are for returning students of any major demonstrating excellence in some aspect of English or Technical Communication. A list of current awards and application forms are available on the English Department website and in 206 Ross Hall early in the Spring Semester. Award winners are announced each year in April.

Other Programs Associated with English
The English Department participates in interdepartmental programs in African American Studies, American Indian Studies, Classical Studies, Latina/o Studies, Linguistics, Speech Communication, Theatre and Women's Studies. (See the *Index for requirements for these interdepartmental programs.*)

Graduate Study

The master of arts degree programs offer various possibilities for the advanced study of writing, language, and literature. Prospective students must first secure admission to the graduate studies program through the English Department. Students can be admitted to the M.A. in English with a specialization in literature which is designed to prepare students for teaching at the secondary, two-year college, or beginning college and university levels; or for further graduate study in language and literature. Students can be admitted to the M.A. in Rhetoric, Composition, and Professional Communication designed to prepare students for technical writing, business communication, editing, and associated professional writing. Students can be admitted to one of the optional specializations for the M.A. in TESL/Applied Linguistics: Computer-Assisted Language Learning (CALL); Language Assessment; English for Specific Purposes (ESP); Literacy; and Literature in ESL. The master of arts degree requires 30 hours of graduate credits, including a thesis or project (3 credits). The M.A. in English (literature specialization) and the M.A. in TESL/Applied Linguistics have language requirements that may be met through a number of options, including previous foreign language study, graduate linguistics courses, or satisfactory performance on a test-out exam. A student whose native language is other than English is considered to have met the language requirement after satisfying the Graduate College English requirement.

The master of fine arts program in Creative Writing and Environment is unique in its effort to cultivate in its students an interdisciplinary approach to research and writing, as well as develop a heightened environmental imagination that finds expression in quality, publishable works of fiction, nonfiction, and poetry. The program is designed to prepare students for careers as writers, teachers at the college and university level, and editors. Prospective students must first secure admission to the graduate studies program through the English Department. The master of fine arts degree requires 54 hours of graduate credit: a core of creative writing courses, a book-length thesis (6 credits), a fieldwork experiential component (3 credits), and 18 credits in disciplines other than English (such as Landscape Architecture, Anthropology, Environmental Science, among many others) relevant to an individual student's research interests and thesis project.

The doctor of philosophy in Applied Linguistics and Technology focuses on English language teaching and assessment with particular emphasis on issues and practices related to technology use in these areas. It prepares students to hold a variety of academic appointments in departments of applied linguistics and English, and professional opportunities in research and development foundations, international publishing enterprises, and government agencies in the U.S. and around the world where English as a second language is taught and used for specific educational, vocational, and professional purposes. Prospective students must first secure admission to the graduate studies program through the English Department. Candidates are required to complete 72 hours of graduate credit and a dissertation, and to pass a portfolio assessment, a preliminary examination consisting of a dissertation proposal and pilot study and a written response to questions about the proposal or pilot study, and an oral defense of the dissertation.

The doctor of philosophy in Rhetoric and Professional Communication focuses on the theory of rhetoric and the practice of written communication in professional communities such as business, industry, and government. The degree qualifies graduates for academic positions in rhetoric and in business and technical communication, as well as for work in the private sector as professional writing specialists, editors, and communications production managers. Prospective students must first secure admission to the graduate studies program through the English Department. Candidates are required to complete 72 hours of graduate credit and a dissertation, and to pass a portfolio assessment, a preliminary examination consisting of a comprehensive examination and a special field examination, and an oral defense of the dissertation.

The department offers graduate students an opportunity to gain professional experience through professional writing internships, selected departmental research activities, the Intensive English and Orientation Program (IEOP), the ISUComm foundation courses program, the advanced communication program, and the interpersonal and rhetorical communication program. Teaching and research assistantships are available for qualified students. Teaching assistants are responsible for teaching with faculty supervision, classes in ISUComm foundation courses, courses in public speaking, courses in English as a second language, and courses in business and technical communication. Research assistants are assigned to individual faculty members engaged in projects in writing, language, or literature. One or more Pearl Hogrefe Fellowships in Creative Writing covering stipend and tuition are awarded each year to outstanding graduate students. Grannis Scholarships are awarded to new students in the Applied Linguistics and Technology doctoral program. Several Freda Huncke Endowment Graduate Teaching Fellowships are available to first-year Rhetoric and Professional Communication doctoral students. Miller Fellowships are also available to highly qualified students.

With prior written approval from the College of Human Sciences, students may take English courses to meet part of the requirements for certification to teach English in two-year and community colleges. Selected courses may also be used to meet requirements for ESL endorsement (K-12) for teachers.

A graduate minor in the English Department at the M.A. level requires 9 credits of English at the 500 or 600 level in the respective major (English, RCPC, TESL/AL). A graduate minor in the English Department at the M.F.A. or Ph.D. level requires 12 credits at the 500 or 600 level in the respective major (CWE, ALT, RPC).

A graduate certificate in Teaching English as a Second Language is a 12 credit program that includes two prerequisites, one core requirement (Engl 518), and three graduate courses chosen from a list of accepted graduate courses.

Courses primarily for undergraduate students

Engl 010. Intensive English and Orientation Program. (21-0) F.S.SS. *Prereq: Recommendation of the English Department.* Full-time study of English for speakers of other languages. Brochure available from the IEOP Office, 102 Landscape Architecture, or at www.ieop.iastate.edu. Satisfactory-fail only.

Engl 099. Strategies for Non-native Speakers of English. F.S. *Prereq: Recommendation of English Department; placement in sections is determined by examination.*
L. Strategies for Listening. Available P/NP to graduate students at their department's option.
R. Strategies for Reading. Available for P/NP to graduate students at their department's option.

Engl 101. English for Native Speakers of Other Languages. (3-0) Cr. 3. F.S. *Prereq: Recommendation of English Department; placement in various sections is determined by examination. (See English Requirement for International Students in Index.).* For undergraduates: Completion of English 101 requirement prepares students for English 150. For graduates: Completion of English 101 satisfies the English requirement of the Graduate College. Engl 101 courses are limited to students who are nonnative speakers of English. Credit from Engl 101 does not count toward graduation.
B. Academic English I. Available P/NP to graduate students at their department's option.
C. Academic English II–Undergraduates.
D. Academic English II–Graduates. Available P/NP to graduate students at their department's option.

Engl 120. Computers and Language. (Cross-listed with Ling). (3-0) Cr. 3. Introduction to the use of linguistic knowledge in computer applications today and the basic computational techniques used in such applications. The development of these techniques throughout the history of computational linguistics. How the study of language has contributed to the advancement of technology and how certain computational problems have influenced the way linguists study language.

Engl 150. Critical Thinking and Communication. (3-0) Cr. 3. F.S.SS. *Prereq: Concurrent enrollment in Lib 160.* Application of critical reading and thinking abilities to topics of civic and cultural importance. Introduction of basic oral, visual, and electronic communication principles to support writing development. Initiation of communication portfolio.

Engl 180. Communication Skills for International Teaching Assistants. Cr. arr. Repeatable. F.S. Placement based upon SPEAK/TEACH test results. Persons whose native language is English cannot take 180 for credit. No more than one section of 180 may be taken per semester; up to two sections total. Credit for Engl 180 does not apply toward graduation. Satisfactory-fail only.
A. Speaking Skills. Cr. 3. Emphasis on pronunciation improvement and greater fluency in spoken English for teaching purposes.
B. Intermediate Spoken English. Cr. 3.
C. Advanced Spoken English. Cr. 3. For students who have completed 180A or 180B but have not reached the passing level on the SPEAK/TEACH test.
D. Presentation Skills. Cr. 3. Developing explanations, leading discussions and handling questions in a teaching environment.
E. Supervised Independent Study. Cr. 1. Seminar with individual observation and consultation.

Engl 199. Introduction to the Study of English. (1-0) Cr. R. F.S. 8 weeks. General introduction to the discipline; discussion of the various fields in English; consideration of career opportunities. Satisfactory-fail only.

Engl 201. Introduction to Literature. (3-0) Cr. 3. F.S. *Prereq: Credit in or exemption from 150.* Study of selected examples of drama, poetry, short fiction, and the novel drawn from both British and American literature. Recommended for nonmajors.

Engl 205. Popular Culture Analysis. (Cross-listed with Sp Cm). (3-0) Cr. 3. F.S. *Prereq: Credit in or exemption from 150.* Analysis of how information and entertainment forms persuade and manipulate audiences. Study of several forms that may include newspapers, speeches, television, film, advertising, fiction, and magazines. Special attention to verbal and visual devices.

Engl 207. Introduction to Creative Writing. (3-0) Cr. 3. F.S. *Prereq: Credit in or exemption from 150.* Course introduces students to the fundamentals of writing fiction, poetry, and creative nonfiction. Extensive readings in all three genres. Students learn creative processes through writing exercises, workshops, and conferences.

Engl 219. Introduction to Linguistics. (Cross-listed with Ling). (3-0) Cr. 3. F.S. *Prereq: Sophomore classification.* Introduction to linguistic concepts and principles of linguistic analysis with English as the primary source of data. Sound and writing systems, sentence structure, vocabulary, and meaning. Issues in the study of usage, regional and social dialects, language acquisition, and language change.

Engl 220. Descriptive English Grammar. (Cross-listed with Ling). (3-0) Cr. 3. F.S. *Prereq: 250.* Overview of grammatical structures and functions. Parts of speech; phrase, clause, and sentence structure; sentence types and sentence analysis; rhetorical grammar and sentence style; terminology. Not a remedial, English composition, or ESL course.

Engl 225. Survey of British Literature to 1800. (3-0) Cr. 3. *Prereq: 250.* Representative works of British literature from the origins to 1800 in historical, cultural, and literary contexts. Will include multiple genres.

Engl 226. Survey of British Literature since 1800. (3-0) Cr. 3. *Prereq: 250.* Representative works from 1800 to the present in historical, cultural, and literary contexts. Will include multiple genres and may include texts that reflect and/or critique the impact and legacy of the British empire on its former colonies, i.e., postcolonial literature.

Engl 227. Survey of American Literature to 1865. (3-0) Cr. 3. *Prereq: 250.* Representative works of American literature from its origins (including indigenous and conquest literatures) through the end of the Civil War in historical, cultural, and literary contexts. Will include multiple genres.

Engl 228. Survey of American Literature since 1865. (3-0) Cr. 3. *Prereq: 250.* Representative works written in the United States since the Civil War in historical, cultural, and literary contexts, with attention to the cultural and ethnic diversity of Americans. Will include multiple genres.

Engl 237. Survey of Film History. (3-0) Cr. 3. F. *Prereq: Credit in or exemption from 150.* A survey of the history of film, both U.S. and international, from the beginnings in the late nineteenth century to the present.

Engl 240. Introduction to American Indian Literature. (Cross-listed with Am In). (3-0) Cr. 3. F. *Prereq: Credit in or exemption from Engl 150.* Appreciation of oral and written forms of American Indian literatures. Tropes and techniques in oral, visual and written texts. Focus on the role of American Indians in interdisciplinary approaches to modern social and environmental issues as expressed in literary works.

Engl 250. Written, Oral, Visual, and Electronic Composition. (3-0) Cr. 3. F.S.SS. *Prereq: 150 or exemption from 150; sophomore classification or exemption from 150; credit for or concurrent enrollment in Lib 160.* Analyzing, composing, and reflecting on written, oral, visual, and electronic (WOVE) discourse within academic, civic, and cultural contexts. Emphasis on supporting a claim and using primary and secondary sources. Continued development of student portfolio.

Engl 250H. Written, Oral, Visual, and Electronic Composition, Honors. (3-0) Cr. 3. F. *Prereq: Exemption from 150 and admission to Freshman Honors Program; credit for or concurrent enrollment in Lib 160.* In-depth analysis, composition, and reflection on written, oral, visual, and electronic (WOVE) discourse within academic, civic, and cultural contexts. Emphasis on argumentation: developing claims, generating reasons, providing evidence. Individual sections organized by special topics. Development of student portfolio.

Engl 260. Introduction to Literary Study. (3-0) Cr. 3. F.S. *Prereq: Credit in or exemption from 150.* Basic principles of literary study. Emphasis on writing of interpretive and critical essays. Particular attention to poetry. Designed for English majors.

Engl 302. Business Communication. (3-0) Cr. 3. F.S.SS. *Prereq: 250, junior classification.* Theory, principles and processes of effective written communication typically encountered in business and the professions. Extensive practice in many areas of workplace communication, including letter, memo, and email correspondence; short proposals and reports; policies and procedures; job packet including letters of application and resumes; website analysis; brochures; and individual and team presentations.
H. Honors.

Engl 303. Free-Lance Writing for Popular Magazines. (3-0) Cr. 3. S. *Prereq: 250, not open to freshmen.* Practical workshop in writing nonfiction articles for popular magazines. Emphasis on writing, market research, preparation of manuscripts, methods of submission. Major goal of the course is production of marketable material.

Engl 304. Creative Writing—Fiction. (Cross-listed with W S). (3-0) Cr. 3. F.S. *Prereq: 250, not open to freshmen.* Progresses from practice in basic techniques of fiction writing to fully developed short stories. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

Engl 305. Creative Writing—Nonfiction. (3-0) Cr. 3. F.S. *Prereq: 250, not open to freshmen.* Workshop in writing imaginative essays, both critical and personal. Analytical reading, development of literary techniques. Individual and small group conferences.

Engl 306. Creative Writing—Poetry. (3-0) Cr. 3. F.S. *Prereq: 250, not open to freshmen.* Progresses from traditional to contemporary forms. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

Engl 309. Report and Proposal Writing. (3-0) Cr. 3. F.S. *Prereq: 250, junior classification.* Introduction to the theory and practice of preparing and analyzing reports and proposals intended for businesses, governmental agencies, and/or private and corporate foundations. Individual assignments and group projects include text documents and oral presentations.

Engl 310. Rhetorical Analysis. (3-0) Cr. 3. F.S. *Prereq: 250.* Fundamental principles of rhetorical criticism. Focus on selected theories for analyzing cultural texts, including essays, speeches, film, technical and scientific documents, and websites. Emphasis on identifying artifacts, formulating research questions, applying methodologies, and understanding and practicing critical analysis through discussion and in writing.

Engl 312. Biological Communication. (3-0) Cr. 3. F.S. *Prereq: Engl 250.* Emphasis on effective writing and communication methods in the biological sciences, presentation of research data, methods of bibliographic citation, ethical communication, use of oral and visual presentation methods for biological information, manuscript and report preparation. For students in the biological and related life sciences.

Engl 313. Writing for the World Wide Web. (3-0) Cr. 3. F.S. *Prereq: 250.* Rhetorical principles of hypertextual writing and publishing. Group and individual projects using XHTML to construct interactive sites for the World Wide Web. Special emphasis on business and technical applications. Nonmajor graduate credit.

Engl 314. Technical Communication. (3-0) Cr. 3. F.S.SS. *Prereq: 250, junior classification.* Theories, principles, and processes of effective written communication of technical information. Attention to major strategies for analyzing and adapting to audiences in various communication situations and composing technical discourse including organizing visual and verbal information. Extensive practice in many areas of technical communication, including instructions and procedures, proposals and reports, website analysis and design, and individual and team presentations.
H. Honors.

Engl 315. Creative Writing—Screenplays. (3-0) Cr. 3. F. *Prereq: 250, not open to freshmen.* Stresses master scene technique of writing fully developed screenplays. Emphasis on movie techniques, writing, workshop criticism, analytical reading and viewing, and individual conferences. Nonmajor graduate credit.

Engl 316. Creative Writing—Playwriting. (Cross-listed with Thtre). (3-0) Cr. 3. S. *Prereq: Engl 250, not open to freshmen.* Progresses from production of scenes to fully developed one-act plays. Emphasis on action, staging, writing, analytical reading, workshop criticism, and individual conferences. Nonmajor graduate credit.

Engl 330. Science Fiction. (3-0) Cr. 3. *Prereq: 250.* Study of science fiction from its origins in nineteenth-century to the present. May include study of specific types of science fiction, such as classic, cyberpunk, feminist, or apocalyptic narratives; and may include consideration of science fiction film and/or theory.

Engl 332. Visual Communication of Quantitative Information. (Cross-listed with Stat). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Stat 101, 104 or 226; Engl 250.* Communicating quantitative information using visual displays; visualizing data; interactive and dynamic data displays; evaluating current examples in the media; color, perception, and representation in graphs; interpreting data displays. Nonmajor graduate credit.

Engl 335. Studies in Film. (3-0) Cr. 3. Repeatable. *Prereq: 250.* Principles of film art and the traditional vocabulary of literature as applied to film. Influence of film on modes of thought and behavior. Nonmajor graduate credit.

Engl 339. Literary Theory and Criticism. (3-0) Cr. 3. F.S. *Prereq: 260 and 3 additional credits in literature.* Study of selected texts of literary criticism, with attention to the purposes and practices of criticism.

Engl 340. Women's Literature. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: 250.* Historical and thematic survey of literature by and about women. May include autobiographies, journals, letters, poetry, fiction, and drama. Nonmajor graduate credit.

Engl 344. U.S. Latino/a Literature. (3-0) Cr. 3. S. *Prereq: 250.* An introduction to the literature of Mexican Americans, Puerto Ricans, Cuban Americans and other Latino/a sub-groups. Special emphasis on themes such as ethnic relations and comparisons with EuroAmerican literary traditions.

Engl 345. Women and Literature: Selected Topics. (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: Engl 250.* Literature by women and/or dealing with the images of women, e.g., study of individual authors or related schools of authors; exploration of specific themes or genres in women's literature; analysis of recurrent images of women in literature. Nonmajor graduate credit.

Engl 346. American Indian Literature. (Cross-listed with Am In). (3-0) Cr. 3. S. *Prereq: 250.* Survey of literature by Native Americans from pre-Columbian tales and songs to contemporary novels and poetry. Nonmajor graduate credit.

Engl 347. African American Literature to 1960. (Cross-listed with Af Am). (3-0) Cr. 3. *Prereq: 250.* Intensive study of African American writing, possibly including slave narratives, Harlem Renaissance works, literature of social protest, and forerunners of contemporary works that reveal key thematic, stylistic, and historical range of the literature. Nonmajor graduate credit.

Engl 348. Contemporary African American Literature. (Cross-listed with Af Am). (3-0) Cr. 3. S. *Prereq: 250.* Intensive reading in literature by African Americans from 1960 to the present. Nonmajor graduate credit.

Engl 349. Topics in Multicultural Literatures of the United States. (3-0) Cr. 3. Repeatable. *Prereq: 250.* Literature by writers from U.S. multicultural groups. May include literature of several groups or focus upon one of the following: Asian Americans, African Americans, Latino/a Americans, American Indians. Nonmajor graduate credit.

Engl 350. Rhetorical Theories and Issues in Context. (Cross-listed with Cl St, Sp Cm). (3-0) Cr. 3. S. *Prereq: 250.* Ideas about the relationship between rhetoric and society in contemporary and historical contexts. An exploration of classical and contemporary rhetorical theories in relation to selected topics that may include politics, gender, race, ethics, education, science, or technology.

Engl 351. Literature and Science. (3-0) Cr. 3. *Prereq: 250.* Study of texts that may include the following topics: the representation of science in literature; the use of literature by science and scientists; reading "scientific" texts as literature; the interactions between literary and scientific ideas. Nonmajor graduate credit.

Engl 352. Gay and Lesbian Literature. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Engl 250.* Literary portrayals of gay and lesbian lives and relationships from many different genres. Attention to changing definitions and representations of sexual orientation and gender identity over time. Nonmajor graduate credit

Engl 353. World Literature: Western Foundations through Renaissance. (Cross-listed with Cl St). (3-0) Cr. 3. F.S. *Prereq: 250.* Representative works from the drama, epics, poetry, and prose of the Ancient World through the late sixteenth century. May include Homer, Aeschylus, Sappho, Catullus, Dante, Marie de France, Boccaccio, Christine de Pizan, Cervantes, and others.

Engl 354. World Literature: Seventeenth Century to the Present. (3-0) Cr. 3. F. *Prereq: 250.* Global literatures in their various cultural and aesthetic contexts. Representative works, oral and written literature, including poetry, fiction, nonfiction, and drama.

Engl 355. Literature and the Environment. (Cross-listed with Env S). (3-0) Cr. 3. *Prereq: 250.* Study of literary texts that address the following topics, among others: the relationship between people and natural/urban environments, ecocriticism, and the importance of place in the literary imagination. Nonmajor graduate credit.

Engl 358. Myth and Fairytale. (3-0) Cr. 3. *Prereq: 250.* Study of traditional fairytales, myths, and legends from diverse cultures. Nonmajor graduate credit.

Engl 359. Literature and the Arts. (3-0) Cr. 3. *Prereq: 250.* Study of texts that may include the following topics: the relationship between literature and other art forms (including painting, sculpture, dance, music, photography, and film); the representation of the arts in literature; the influences of other art forms on literature; the interrelation of art theory and literary theory. Nonmajor graduate credit.

Engl 360. Studies in American Literature to 1800. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in American literature from its beginnings through the colonial period; may reflect themes, genres, or social and cultural contexts.

Engl 362. Studies in 19th Century American Literature. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in American literature of the 19th century; may reflect themes, genres, or social and cultural contexts.

Engl 364. Studies in American Literature: 1900 to the Present. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in American literature since 1900; may reflect themes, genres, or social and cultural contexts.

Engl 370. Shakespeare. (3-0) Cr. 3. F.S. *Prereq: 250.* Reading and analysis of selected plays. Development of Shakespeare's dramatic art in its social and intellectual context.

Engl 373. Studies in British Literature: The Middle Ages. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in medieval literature from its beginnings through the fifteenth century; may reflect themes, genres, or social and cultural contexts.

Engl 374. Studies in British Literature: The Renaissance. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in British literature from 1500 to 1660; may reflect themes, genres, or social and cultural contexts.

Engl 375. Studies in British Literature: The Restoration and 18th Century. (3-0) Cr. 3. S. *Prereq: 250; sophomore classification.* Selected readings in British literature from 1660 to 1800; may reflect themes, genres, or social and cultural contexts.

Engl 376. Studies in British Literature: Romantic and Victorian. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings from British literature from the late eighteenth century to about 1900; may reflect themes, genres, or social and cultural contexts.

Engl 378. Studies in British Literature: 1900 to the Present. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Selected readings in British literature since 1900; may reflect themes, genres, or social and cultural contexts.

Engl 389. Postcolonial Literature. (3-0) Cr. 3. *Prereq: 250; sophomore classification.* Historical, thematic and theoretical study of postcolonial literatures from one or more of the following areas: Africa, South Asia, the Caribbean, and the Middle East. Irish and immigrant British writers may also be included.

Engl 393. The History of Children's Literature. (3-0) Cr. 3. F. *Prereq: 250.* Origin and development of English and American children's literature through the early twentieth century. Special emphasis on nature, structure, and enduring themes of fantasy literature.

Engl 395. Study and Travel. Cr. arr. SS. *Prereq: Permission of instructor.* Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.
A. Literature.
B. Creative Writing.
C. Linguistics.
D. Rhetoric and Professional Communication.
E. Teacher Education.

Engl 396. Teaching the Reading of Young Adult Literature. (3-0) Cr. 3. F.S. *Prereq: 250.* Critical study and evaluation of the genre; examination of modes and themes found in the literature; strategies of effective reading; study of the relationship of the genre to children's literature and adult literature; discussion techniques for teachers and parents. Evaluation of literature for use in school programs. Restricted to students seeking teacher licensure. Nonmajor graduate credit.

Engl 397. Practice and Theory of Teaching Writing in the Secondary Schools. (3-0) Cr. 3. F.S. *Prereq: 219 or 220 (Taken concurrently with C I 280. Cr. 2). Students must begin the application process for admission to the University Teacher Education Program and initiate a State of Iowa Department of Criminal Investigation background check prior to the semester in which they plan to take English 397.* Introduction to teaching secondary language arts. Current theories and practices in the teaching of writing to secondary school students. Theories of rhetoric, approaches to teaching, lesson design and planning. Evaluating writing. Professional portfolio preparation.

Engl 404. Creative Writing Workshop—Fiction. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 304.* Individual projects in short fiction on a workshop and conference basis. Readings in short fiction. Discussion of elements of narrative such as plot, point of view, characterization, theme, setting.

Engl 405. Creative Writing Workshop—Nonfiction. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 305.* Individual projects in memoir, immersion journalism, character studies, and/or the personal essay on a workshop and conference basis. Readings in creative nonfiction.

Engl 406. Creative Writing Workshop—Poetry. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 306.* Individual projects in poetry on a workshop and conference basis. Readings in poetry. Discussion of poetic elements such as image, sound, internal structure, rhythm, tone, figurative language.

Engl 411. Technology, Rhetoric, and Professional Communication. (3-0) Cr. 3. S. *Prereq: 310; 302, 309, 313, or 314; junior classification.* Study of the implication of technologies, especially computer technology, for the writing and reading of business, technical, and academic texts. Focus on selected technology-related topics.

Engl 415. Business and Technical Editing. (3-0) Cr. 3. S. *Prereq: 302, 309, or 314; junior classification.* Editing journal articles, research reports, technical manuals, newsletters, and proposals. Attention to editorial levels and styles, project management, editor-author relationships, and electronic editing. Nonmajor graduate credit.

Engl 416. Visual Aspects of Business and Technical Communication. (3-0) Cr. 3. F. *Prereq: 302, 309, or 314; junior classification.* Rhetoric of visual elements in business and technical communication. Issues in the design of text, charts, graphs, diagrams, schematics, illustrations, and other visual displays.

Engl 417. Student Teaching. (Cross-listed with C I). Cr. arr. F.S. *Prereq: 494, admission to teacher education, approval of coordinator the semester prior to student teaching.* Full-time teaching in secondary English: long term and unit planning, lesson planning, classroom teaching practice in English language arts. E. English and Literature (Same as C I 417E.)

Engl 418. Seminar in Argumentation. (3-0) Cr. 3. S. *Prereq: 310, junior classification.* Advanced seminar in theory and analysis with extensive practice in various modes of argument. Nonmajor graduate credit.

Engl 420. History of the English Language. (Cross-listed with Ling). (3-0) Cr. 3. F.S. *Prereq: 219, 220.* Comparison of English to other languages by family background and by type. Analysis of representative Old, Middle, Early Modern and present-day English texts, including both literary works and non-literary documents. Nonmajor graduate credit.

Engl 422. Women, Men, and the English Language. (Cross-listed with Ling, W S). (3-0) Cr. 3. S. *Prereq: 219.* The ways men and women differ in using language in varied settings and the ways in which language both creates and reflects gender divisions. Nonmajor graduate credit.

Engl 425. Second Language Learning and Teaching. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: 219; junior classification.* The process of second language learning and principles and techniques of teaching second languages. Learning and teaching in specific situations and for particular purposes. Current applications of technology in teaching and assessment. Nonmajor graduate credit.

Engl 437. Grammatical Analysis. (Dual-listed with 537). (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 220; junior classification.* Theories and methods for analysis of English syntax with emphasis on recent syntactic theory.

Engl 440. Seminar in British Literature. (3-0) Cr. 3. Repeatable. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected authors, movements, eras, or genres in British literature. Readings in criticism; required research paper. Nonmajor graduate credit.

Engl 441. Seminar in American Literature. (3-0) Cr. 3. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected authors, movements, eras, or genres in American literature. Readings in criticism; required research paper. Nonmajor graduate credit.

Engl 445. Seminar: Literature Crossing Boundaries. (3-0) Cr. 3. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Intensive study of selected literature that bridges traditional genre, period, national, or disciplinary boundaries. Readings in criticism; required research paper. Nonmajor graduate credit

Engl 450. Seminar in Drama and Film. (3-0) Cr. 3. Repeatable. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected playwrights, screenwriters, film directors, dramatic or cinematic movements, genres, or national traditions. Readings in criticism; required research paper. Nonmajor graduate credit.
A. Drama
B. Film
C. Other

Engl 451. Seminar in Poetry. (3-0) Cr. 3. Repeatable. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected authors, movements, eras, or national literatures. Readings in criticism; required research paper. Nonmajor graduate credit.

Engl 452. Seminar in Prose. (3-0) Cr. 3. Repeatable. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected authors, movements, eras, or national literatures. May include the novel, the short story, the essay, or autobiography. Readings in criticism; required research paper. Nonmajor graduate credit.

Engl 460. Seminar in Gender and Ethnicity. (Cross-listed with W S). (3-0) Cr. 3. Repeatable. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected readings of various authors, movements, eras, or genres. Readings in criticism; required research paper. Nonmajor graduate credit.

Engl 477. Seminar in Technical Communication. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 302, 309, or 314 and 6 additional credits in technical communication.* Intensive study of a selected topic that bridges theory and practice in technical communication. Required project that contributes to the understanding of an emerging issue in the profession. Nonmajor graduate credit.

Engl 487. Internship in Business, Technical, and Professional Communication. Cr. R. F, S. *Prereq: 9 credits in 302, 309, 313, 314, 415 (preferred), 416, or 477, senior classification; and permission of coordinator.* An opportunity to write, edit, and design business and technical documents in a professional setting. Projects include reports, proposals, manuals, brochures, newsletters.

Engl 489. Undergraduate Seminar. (Cross-listed with Ling). (3-0) Cr. 3. Repeatable. F. *Prereq: 9 credits in English beyond 250.* Intensive study of a selected topic in literature, criticism, rhetoric, writing, or language. Cross-listing with linguistics acceptable only when offered as a course in linguistics. Nonmajor graduate credit.

Engl 490. Independent Study. Cr. arr. Repeatable. F.S. *Prereq: 9 credits in English beyond 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee.* Designed to meet the needs of students who wish study in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Engl 490 may be used toward graduation.
A. Literature
B. Linguistics, Semantics (Ling 490B)
C. Rhetoric, Teaching of Composition
D. Criticism and Theory of Literature
E. Reading: Instructional Methods and Research
F. Creative Writing
G. Business/Technical Communication
H. Honors

Engl 494. Practice and Theory of Teaching Literature in the Secondary Schools. (Cross-listed with C I). (3-0) Cr. 3. F.S. *Prereq: Engl 310, 397, 9 other credits in English beyond 250, Psych 333, admission to teacher education program.* Portfolio review. Current theories and practices in the teaching of literature to secondary school students. Integrating literary study and writing. Preparation and selection of materials. Classroom presentation. Unit planning. (Taken concurrently with C I 280, Cr. 2, and Sp Ed 450)

Engl 497. Capstone Assessment. Cr. R. F.S. *Prereq: 199.* Must be taken by all seniors in their last semester of classes.

Courses primarily for graduate students, open to qualified undergraduate students

Open on a priority basis to graduate students admitted to one of the degree programs in English; instructor permission required for other students.

Engl 500. Proseminar: Teaching English Composition. (3-0) Cr. 3. F. Required of all new English teaching assistants. Introduction to the teaching of ISUComm Foundation Courses. Foundational and relevant newer composition theory and pedagogical methods related to ISUComm Foundation Courses objectives and their classroom enactment, including development of assignments and supporting activities, and evaluation of student projects.

Engl 503. Theory and Research in Composition. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits in English.* In-depth consideration of the theory and practice of critical composition pedagogy. Opportunities for actual classroom application.

Engl 504. Teaching Business and Technical Communication. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 302, 309 or 314.* Theory and practice of teaching college courses in business and technical communication. Some consideration of in-service writing courses for business and government. Emphasis on applicable communication and composition theory, curriculum planning, assignment design, and materials development.

Engl 505. Technology in Business, Technical, and Professional Communication. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate classification.* Examination of the role of technology, especially computer technology, in communication practices within academic and workplace settings.

Engl 506. Theory and Research in Professional Communication. (3-0) Cr. 3. S. *Prereq: 6 credits in English.* Introduction to professional communication as a discipline, with emphasis on theories of communication and discourse that inform professional communication research and on trends and developments in that research and the field.

Engl 507. Writing and Analyzing Professional Documents. (3-0) Cr. 3. F. *Prereq: 6 credits in English.* Introduction to the theory and practice of planning, preparing, and presenting information in written, oral, and visual forms prepared for business, science, industry, and government. Guided readings. Team projects. Individual projects.

Engl 508. Advanced Workshop in Academic Writing. (3-0) Cr. 3. Repeatable. Alt. SS., offered 2011. *Prereq: 6 graduate credits.* Hands-on practice in writing academic discourse for publication; rhetorical analyses of student-selected academic journals; discussion of current trends in academic writing; professional perspectives on the referee process and on journal editorial decision making. Focus on the writing of selected short pieces (opinion essays, standard reviews, conference-length papers) and of article-length manuscripts.

Engl 509. Writing Proposals and Grant Applications. (3-0) Cr. 3. F. *Prereq: 6 credits in English composition.* Introduction to the theory and practice of preparing and analyzing proposals and grant applications intended for businesses, governmental agencies, and/or private and corporate foundations. Individual assignments and group projects include text documents and oral presentations.

Engl 510. Introduction to Computers in Applied Linguistics. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Use of applications software for language teaching, linguistic analysis, and statistical analysis. Issues and problems in applied linguistics related to computer methods.

Engl 511. Introduction to Linguistic Analysis. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Principles and methods of linguistic analysis with emphasis on phonology, morphology,

and syntax. Description of linguistic variation and current theoretical approaches to linguistics.

Engl 513. Language Assessment Practicum. (3-0) Cr. 3. F.S.SS. *Prereq: 519.* Advanced practicum in language assessment.

Engl 514. Sociolinguistics. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Theories and methods of examining language in its social setting. Analysis of individual characteristics (e.g., age, gender, ethnicity, social class, region), interactional factors (e.g., situation, topic, purpose) and national policies affecting language use.

Engl 515. Statistical Natural Language Processing. (Cross-listed with Ling, HCI). (3-0) Cr. 3. F. *Prereq: Stat 330 or equivalent, recommended Ling 219 or Ling 511.* Introduction to computational techniques involving human language and speech in applications such as information retrieval and extraction, automatic text categorization, word prediction, intelligent Web searching, spelling and grammar checking, speech recognition and synthesis, statistical machine translation, n-grams, POS-tagging, word-sense disambiguation, on-line lexicons and thesauri, markup languages, corpus analysis, and Python programming language.

Engl 517. Second Language Acquisition. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Theory, methods, and results of second language acquisition research with emphasis on approaches relevant to second language teaching.

Engl 518. Teaching English as a Second Language Methods and Materials. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Introduction to approaches, methods, techniques, materials, curricular design, and assessment for various levels of ESL instruction. Attention to issues related to the teaching of listening, speaking, reading, writing, vocabulary, pronunciation, and culture.

Engl 519. Second Language Assessment. (3-0) Cr. 3. S. *Prereq: 517.* Principles of second language assessment including reliability, validity, authenticity and practicality. Constructing, scoring, interpreting, and evaluating second language tests for a variety of situations.

Engl 520. Computational Analysis of English. (Cross-listed with Ling, HCI). (3-0) Cr. 3. F. *Prereq: Engl 510 or 511.* Concepts and practices for analysis of English by computer with emphasis on the applications of computational analysis to problems in applied linguistics such as corpus analysis and recognition of learner language in computer-assisted learning and language assessment.

Engl 521. Teaching of Literature and the Literature Curriculum. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in literature.* Examination of the roles of the literary work, reader, and teacher in literary study. Responses to literature. Place of literature in language arts. Study and development of curriculum materials for middle school, high school, and college levels of instruction.

Engl 522. Literary Theory and Criticism. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 credits in literature.* Examination of the history, logic, and rhetoric of contemporary literary criticism and analysis.

Engl 523. Introduction to Old English Language and Literature. (3-0) Cr. 3. *Prereq: Course in medieval literature or history or history of the English language recommended.* Introductory study of Old English language and literature in prose and poetry, including extracts from Beowulf. Some attention to Anglo-Saxon culture.

Engl 524. Literacy: Issues and Methods for Non-native Speakers of English. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Theoretical and practical issues and techniques in the teaching of literacy in a variety of contexts, involving children and adults at basic skill levels and teens and adults in academic and vocational programs.

Engl 525. Methods in Teaching Listening and Speaking Skills to Nonnative Speakers of English. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Theoretical and practical issues and techniques in the teaching of second language pronunciation, listening, and speaking skills. Topics will be relevant to those intending to teach in various contexts involving both K-12 and adult learners.

Engl 526. Computer-Assisted Language Learning. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: 511 or equivalent.* Theory, research, and practice in computer use for teaching nonnative speakers of English. Methods for planning and evaluating computer-based learning activities.

Engl 527. Discourse Analysis. (Cross-listed with Ling). (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Methods and theoretical foundations for linguistic approaches to discourse analysis. Applications of discourse analysis to the study of texts in a variety of settings, including academic and research contexts.

Engl 528. English for Specific Purposes. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 511 or an introductory course in linguistics.* Issues and techniques in analyzing, teaching, and assessing English for specific purposes. Topics include theories of specific purpose language use, analysis of learner needs in target language contexts, and syllabus and materials development for teaching and assessment.

Engl 529. Multimedia Content Management. (3-0) Cr. 3. Alt. S. *Prereq: 313, 505, or permission of instructor.* Strategies for developing and delivering multimodal content via digital media. Focus on the principles of database design, interface development, usability testing, and collaborative content management within professional communication settings.

Engl 531. Topics in the Study of Literature. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: 6 credits in literature.* Intensive study of literary genres, periods, movements, or themes; e.g., Literature and Historicism, Narrating the Feminine, Allegory.

Engl 532. American Literature to 1865. (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 6 credits in literature.* Selected texts in American literature from Beginnings to the Civil War. Study may include Native American literature, the literature of European conquest, Colonial and Revolutionary periods, Early Republic, and Jacksonian Era, in critical and cultural contexts.

Engl 533. British Literature to 1830. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: 6 credits in literature.* Selected texts from the Medieval, Renaissance, Restoration, Eighteenth-Century, and/or Romantic periods, in critical and cultural contexts.

Engl 534. American Literature 1865 to the Present. (3-0) Cr. 3. Repeatable. Alt. F., offered 2009. *Prereq: 6 credits in literature.* Selected texts in American literature from the Civil War to the present. Study may include Realism, Naturalism, Modernism, and Postmodernism, with significant attention to race/ethnicity, gender, and identity, and to contemporary critical views. Range of authors and genres.

Engl 535. British Literature 1830 to the Present. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: 6 credits in literature.* Selected texts from the Victorian, Edwardian, Modernist, and/or Contemporary periods, in critical and cultural contexts.

Engl 536. Postcolonial Literatures. (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 6 credits in literature.* Colonial and postcolonial Anglophone literatures from various locations, such as Africa, Asia, the Caribbean, and the British Isles, in critical and cultural contexts.

Engl 537. Grammatical Analysis. (Dual-listed with 437). (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 219, 220, or 511; junior classification.* Theories and methods for analysis of English syntax with emphasis on recent syntactic theory.

Engl 538. Fiction. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: 6 credits in literature.* Selected fiction writers in English; range of authors and genres. Emphasis on both male and female writers; attention to the relationships between fiction and cultural change.

Engl 539. Poetry. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: 6 credits in literature.* Selected poets writing in English, considered in representative groups. Some emphasis on twentieth-century poets and poetics.

Engl 540. Drama. (3-0) Cr. 3. Repeatable. F. *Prereq: 6 credits in literature.* Primary texts in dramatic genres from various literary periods, in critical and cultural contexts. Frequently concentrates on the English Renaissance and the Shakespearean stage.

Engl 541. Autobiography, Biography, Memoir. (3-0) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: 6 credits in literature.* Study of lifewriting, e.g., autobiography, biography, memoir, cross-genre writing, autobiographical criticism. Readings may be arranged by period, nationality, or subgenre (e.g., autobiography of childhood experience, celebrity auto/biography).

Engl 542. Production Processes for Technical Documents. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 302, 309, 313, or 314; junior classification.* Review of the principles of desktop publishing as practiced in the field of technical communication. Focus on theories of print document design and project management, as well as digital prepress techniques needed to produce documents using outside print bureaus. Practice with current desktop publishing software.

Engl 543. Environmental Literature. (3-0) Cr. 3. S. *Prereq: Graduate classification.* An exploration of the major genres that derive from literary encounters with the environment. Readings may come from various cultures and time periods, but about half of the texts will represent canonical American environmental literature from the 19th and 20th centuries.

Engl 544. Multicultural U.S. Literatures. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: 6 credits in literature.* Primary texts by U.S. multicultural writers. Development of U.S. literary traditions, discourses of race and gender, counter-storytelling, myths of origin, phases and movements within the national literary canon. Readings in several genres.

Engl 545. Women's Literature. (Cross-listed with W S). (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 6 credits in literature.* Primary texts by women writers; historical, thematic, formal, or theoretical approaches; secondary readings; e.g., Nineteenth-Century Women Writers; American Women's Personal Narratives; Southern Women Writers of the U.S.

Engl 546. Issues in the Study of Literature. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. *Prereq: 6 credits in literature.* Intensive study of current and emerging topics and problems concerning literature and its relationship to theory and to language study; e.g., Theory of Metaphor; Renegotiating the Canon; Feminist Theory.

Engl 547. The History of Rhetorical Theory I: From Plato to Bacon. (3-0) Cr. 3. F. *Prereq: 6 credits in English.* Rhetorical theory from the classical period of ancient Greece and Rome through the Middle Ages to the early Renaissance; attention to its relation to the nature of knowledge, communication, practice, and pedagogy.

Engl 548. The History of Rhetorical Theory II: From Bacon to the Present. (3-0) Cr. 3. S. *Prereq: 6 credits in English.* Rhetorical theory from the early modern period (Bacon, Descartes, and Locke) to the present; attention to its relation to the nature of knowledge, communication practice, and pedagogy.

Engl 549. Multimedia Design in Professional Communication. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 505.* Rhetorical principles of information-based multimedia design. Practical understanding of computer applications used in multimedia development. Focus on theoretical and practical elements of producing

multimedia training programs in both education and industry. Work with interactive hypertext, digital audio, and non-linear video editing.

Engl 550. Creative Writing: Craft and Professional. (3-0) Cr. 3. F. *Prereq: Admission into MFA Program in Creative Writing and Environment.* A multigenre craft course required of all incoming students in the *MFA Program in Creative Writing and Environment.* Students develop an understanding of craft and environmental writing across genres (poetry, fiction, nonfiction) as well as learn about editing and publication practice through the lens of a working literacy journal, Flyway: A Journal of Writing and Environment. Other course activities include presentations on the production practices of leading literary journals; individual editing projects; pragmatic tips for finding publication outlets for polished creative work; and a field trip to publishing houses.

Engl 551. Advanced Multi-Genre Creative Writing Workshop. (3-0) Cr. 3. *Prereq: Fourth-semester or equivalent standing in the Creative Writing and Environment M.F.A. program.* Students develop book-length manuscripts of fiction, creative nonfiction, or poetry.

Engl 553. Graduate Workshop: Writing The Long Project. (3-0) Cr. 3. Repeatable. *Prereq: 550 and graduate classification. Open to graduate students outside Creative Writing only with permission of instructor.* Individual long creative writing project ideas developed in course. Portions of long creative writing project workshopped, revised, discussed in conferences.

Engl 554. Graduate Fiction Workshop. (3-0) Cr. 3. Repeatable. *Prereq: 550 and graduate classification. Open to graduate students outside Creative Writing only with permission of instructor.* Individual projects in fiction on a workshop and conference basis. Readings in short fiction. Discussion of elements of narrative such as plot, point of view, characterization, theme, setting.

Engl 555. Graduate Nonfiction Workshop. (3-0) Cr. 3. Repeatable. *Prereq: 550 and graduate classification. Open to graduate students outside Creative Writing only with permission of instructor.* Individual projects in memoir, immersion journalism, character studies, and/or the personal essay on a workshop and conference basis. Readings in creative nonfiction.

Engl 556. Graduate Poetry Workshop. (3-0) Cr. 3. Repeatable. *Prereq: 550 and graduate classification. Open to graduate students outside Creative Writing only with permission of instructor.* Individual projects in poetry on a workshop and conference basis. Readings in poetry. Discussion of poetic elements such as image, sound, internal structure, rhythm, tone, figurative language.

Engl 557. Studies in Creative Writing. (3-0) Cr. 3. Repeatable. *Prereq: Graduate classification.* Special topics course on ideas, issues, and techniques in creative writing. Subject matter may include specific genres, aspects of the creative writing process, or themes of particular interest. Significant readings and written work required; previous workshop experience helpful.

Engl 558. Teaching Creative Writing. (3-0) Cr. 3. *Prereq: Graduate classification.* Pedagogical approaches that are effective for grade-school through adult-education creative writing teaching. Writing exercises, workshops, text evaluation, and visits from creative writers.

Engl 559. Creative Writing Teaching Internship. Cr. arr. *Prereq: Permission of participating instructors.* Students assist in an introductory creative writing class. Some supervised teaching but mainly evaluation of submissions and individual conferences. Requirements and grades determined by participating instructors.

Engl 560. Environmental Field Experience. (3-0) Cr. 3. Repeatable. *Prereq: Graduate classification.* Students spend a term on a project that requires fieldwork. Projects might include working for a federal, state or private non-profit environmental organization or farm, or living and working in a specified natural area.

Engl 586. Visual Communication in Professional Writing. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: A course in business or technical communication.* Rhetorical theory and research in graphics, document design, and related principles of visual communication. Methods of designing texts, data displays, illustrations, and other visual elements in business and technical communication.

Engl 587. Internship in Business, Technical, and Professional Communication. (3-0) Cr. arr. Repeatable. F. S. *Prereq: 507 plus 3 additional graduate credits in business and technical writing or composition and rhetoric, permission of instructor. Limited to master's and doctoral degree candidates in the English Department.* An opportunity to write, edit, and design business and technical documents in a professional setting. Projects include reports, proposals, manuals, brochures, newsletters.

Engl 588. Supervised Practicum in Teaching English as a Second Language. (Cross-listed with Ling). (1-5) Cr. 3. F.S.SS. *Prereq: 15 credits toward the TESL/Applied Linguistics master's degree.* Intensive observation of ESL instruction and supervised practice in teaching learners of English in a context appropriate to the practicum student's goals. Seminar discussion of observed practices in relation to language teaching theories and methods.

Engl 589. Supervised Practicum in Literary Editing. (3-0) Cr. 3. S. *Prereq: 552, at least one graduate creative writing workshop, permission of instructor.* Students assume editorial duties for Flyway, a nationally distributed literary journal: overseeing a staff; screening submissions; corresponding with authors; editing and proofing; assisting with layout; communicating with the printer; overseeing a contest; and promoting the magazine.

Engl 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of the Graduate Studies Committee according to guidelines available in the department office.*
A. Literature
B. Teaching English as a Second Language (TESL)/Applied Linguistics. (Cross-listed with Ling 590B)
C. Composition and Rhetoric
E. Rhetoric and Professional Communication
F. Creative Writing
G. Applied Linguistics and Technology

Engl 592. Studies in Rhetoric and Professional Communication. (3-0) Cr. 3. Repeatable. *Prereq: 12 hours in rhetoric, linguistics, or literature, excluding 150/250.* Seminar on selected topics in rhetoric and professional communication or composition.

Engl 595. Graduate Study and Travel. Cr. R. *Prereq: Permission of instructor.* Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.
A. Literature
B. Creative Writing
C. Linguistics
D. Rhetoric and Professional Communication
E. Teacher Education

Engl 599. Creative Component. Cr. 3. F.S.SS. *Prereq: Graduate classification, permission of major professor.*

Courses for graduate students

Engl 601. Research Methods in Rhetoric and Professional Communication. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 graduate credits in English.* Survey of the major qualitative and quantitative methods used in research on communication and language in academic and nonacademic settings.

Engl 602. Research Design in Rhetoric and Professional Communication. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 601.* A workshop for advanced graduate students in rhetoric and professional communication. Focus on qualitative and/or quantitative methods.

Engl 603. Seminar in Advanced Pedagogy in Rhetoric and Composition: Theory and Research. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 503 or 504.* Exploration of relationships between theory and practice in current pedagogy. Intensive examination of contemporary theories of poststructuralism, new media, feminism, postcolonialism, or cultural studies and their impact on current pedagogical practice. Participation in pedagogical research and theory building.

Engl 611. Topics in the History of Rhetorical Theory. (3-0) Cr. 3. Repeatable. Alt. F., offered 2009. *Prereq: 547 or 548.* Rhetorical theory, criticism, and/or practice in relation to a historical period; the historical development of a rhetorical concept.

Engl 621. Topics in Current Rhetorical Theory. (3-0) Cr. 3. Repeatable. S. *Prereq: 503 or 506.* Advanced study of a specialized topic or problem in rhetorical theory, criticism, or practice.

Engl 623. Research Methods in Applied Linguistics. (Cross-listed with Ling). (3-0) Cr. 3. F. *Prereq: 511, 517, 518, 519.* Survey of research traditions in applied linguistics. Focus on theoretical and practical aspects of quantitative and qualitative approaches to applied linguistic study, including experimental and quasi-experimental methods, classroom observation and research, introspective methods, elicitation techniques, case studies, interactional analysis, ethnography, and program evaluation. Computational tools and resources for linguistic research will be highlighted.

Engl 626. Computer-Assisted Language Testing. (3-0) Cr. 3. F. *Prereq: 510, 511, 519.* Principles and practice for the use and study of computers and the Internet in second language assessment.

Engl 630. Seminar in Technology and Applied Linguistics. (Cross-listed with Ling). (3-0) Cr. 3. F.S. *Prereq: Engl 510, 511, 517, 518, others depending on the topic.* Topic changes each semester. Topics include advanced methods in natural language processing, technology and literacy in a global context, feed back in CALL programs, and advances in language assessment.

Engl 688. Practicum in Technology and Applied Linguistics. (Cross-listed with Ling). (1-5) Cr. 3. F.S.SS. *Prereq: Engl 510, 626, or equivalent; 2nd year PhD student.* Focus on integrating theoretical knowledge with practical expertise. Assess client needs; develop, integrate, and evaluate solutions. Practical understanding of computer applications used in multimedia development. Create web-based or CD-ROM-based multimedia materials. Work with advanced authoring applications.

Engl 699. Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification, permission of major professor.* Research.

Entomology

www.ent.iastate.edu

Leslie Lewis, Chair of Department

University Professr (Emeritus): Pedigo

Professors: Bonning, Coats, Courtney, Dewitt, Jurenka, D. Lewis, L. Lewis, Rice, Tollefson, Wintersteen

Professors (Emeritus): Guthrie, Hart, Krafsur, R. Lewis, Mutchmor, Rowley, Showers

Associate Professors: Beetham, Holscher

Assistant Professors: Bartholomay, Gassmann, Oneal

Assistant Professor (Adjunct): Vandyk

Assistant Professors (Collaborators): Hellmich, Sappington, Sumerford

Undergraduate Study

For undergraduate curriculum in Insect Science, see *College of Agriculture, Curricula*.

A degree in Insect Science will provide students with a strong foundation in the biological sciences with an emphasis on insects. This degree prepares students for positions in industry, government, education, and public health. Chemical and seed companies, pest-management or consulting firms, and Horticultural nurseries employ insect scientists. State and federal agencies employ insect science graduates as consultants, extension directors, mosquito abatement agents, and research aides. A significant number of graduates pursue advanced graduate degrees in academia or professional degrees in the medical or veterinary fields.

Graduates understand the evolutionary and ecological relationships of insects with other life forms, and the impact of insects relative to human and animal health, as well as the relationships between insects and humanity's food, fiber, structural, and aesthetic needs and expectations. They are skilled in identifying insects and related groups and understand the biology, ecology, behavior, diversity, and evolutionary relationships of the major groups of insects. Graduates understand the principles and methods available to manage beneficial and pest insect populations. They understand the application of the scientific method in problem solving and the principles of experimental design and analysis. Graduates are able to communicate research and educational materials properly and competently - orally, visually, and in writing - and are able to work effectively with others.

Graduates of the agricultural and Horticultural insect management option are skilled in identifying pests and measuring their impact on plant and animal hosts for the management of these pests. They understand the environmental, legal, and ethical issues involved in insect population management. Graduates of the insect biology option have achieved an understanding of the biochemical and physiological processes governing insect metabolism, growth, and form. They understand the evolutionary and ecological significance of insects. Graduates of this option often enter graduate or professional schools.

The department offers a minor in Insect Science that may be earned by completing Ent 370 and 12 credits in courses selected from an approved list supplied by the department. Entomology administers the Emerging Global Diseases minor (see www.ent.iastate.edu/dept/undergrad/egd). Core courses address the biology of emerging disease agents (e.g., protozoa, fungi, microbes, and viruses), the clinical manifestations and epidemiology of emerging diseases, and the impact of those diseases on human interactions and Socioeconomics. One course must be taken from each of three core areas: (Pathogens and Disease) Micro 310 or Biol/Micro 353; (Sociology and Economics) Soc 411, Soc 345, FS HN 342, or Anthr 439; (Arthropod-borne Diseases) Ent 374 or Ent 574. The remainder of the credits (for a total of 15) may be selected from any of the above-listed courses not selected, and from other appropriate courses as approved by Emerging Global Diseases program advisers.

Graduate Study

The department offers work for the master of science and doctor of philosophy degrees with a major in entomology. Studies at the Ecosystem, Organismal, and Subcellar levels occur in the following areas: aquatic entomology, biological control, chemical ecology, ecology, host plant resistance, insecticide toxicology, medical/veterinary entomology, pathology, pest management, physiology, population genetics, or systematics.

Graduates have a broad understanding of entomology and related disciplines, and an in-depth command of their area of concentration. They are able to communicate effectively with scientific colleagues and the general public in both formal and informal settings. Graduates are able to address complex problems facing entomology or toxicology professionals, taking into account related ethical, social, legal, economic, and environmental issues. They are skilled in research methods, data analyses, and interpretation of results. They also are skilled in working effectively with their colleagues, and writing concise and persuasive grant proposals. They have an understanding of and can critically evaluate current entomological literature.

Prerequisite to the entomology major and to minor graduate work in the department is completion of at least two years of zoological courses, for part of which credit in other closely allied biological sciences may be substituted. Specific course requirements for advanced degrees depend partly upon previous training and experience in the major field of specialization.

Any student receiving the M.S. in entomology shall have at least one course in insect physiology, one course in insect systematics, two courses of Ent 590 (selected from topics A through D, F through I, M and N, inclusive), and at least 1 credit of Ent 600. Any student receiving the Ph.D. in entomology shall have at least one course in insect physiology, one course in insect systematics, four additional courses of Ent 590 (selected from topics A through D and F through I, M through N inclusive), and at least 1 credit of Ent 600. At least one 590 must be taken from each of these subgroups: Population (C, D, N); Organismal (A, B, F, M); and Suborganismal (G, H, I). In addition, Ph.D. students majoring either in Entomology or Toxicology shall have two semesters of teaching experience, taken as Ent 590K both semesters or Ent 590K one semester and Ent 590L the other semester.

A student can receive a Ph.D. minor in Entomology by taking 3 Entomology courses (500 level and above) for a total of 9 credits to be determined by the student's POS committee and approved by the Entomology Director of Graduate Education.

An option for an emphasis in molecular Entomology is available. Any student receiving the M.S. in entomology with an emphasis in molecular entomology is required to take Ent 555, Ent 590G, plus one other course of Ent 590 (selected from topics A through D, F, H, I, M, N), one additional course in molecular entomology, Ent 600 Seminar, BBMB 404, BBMB 542A, and one course from the following: Ent 576, Ent 525, or Ent 568.

Any student receiving the Ph.D. in entomology with an emphasis in molecular entomology is required to take Ent 555, Ent 590G, plus three other courses of Ent 590 (selected from topics A through D, F, H, I, M, N), one additional course in molecular entomology, Ent 600 Seminar, BBMB 542A, plus two other workshops selected from BBMB 542 B through E, an additional course with a molecular component, and one from each of the following two categories: Systematics (Ent 576, Ent 525, Ent 568), Biochemistry (BBMB 404, BBMB 405, BBMB 501).

Entomology participates in the interdepartmental majors in ecology and evolutionary biology; genetics; Microbiology; and molecular, cellular and developmental biology; and in the interdepartmental major and minor in toxicology (see *Index*).

The Federal Corn Insects and Crop Genetics Research Unit and the North Central Plant Introduction Station are available for advanced study in certain phases of entomological research.

More information about the department, such as current research, faculty resumes, physical facilities, and graduate students can be viewed on the department's website at www.ent.iastate.edu. Curriculum assessment for the department can be viewed here: http://www.ent.iastate.edu/assessment.

Courses primarily for undergraduate students

Ent 110. Technical Lecture. Cr. R. F. Orientation to areas of and opportunities in entomology.

Ent 201. Introduction to Insects. (1-0) Cr. 1. F.S.SS. 5 weeks. S. Classroom section spring only. World Wide Web section of course offered summer and fall semesters. Biological and ecological aspects of insects.

Ent 211. Insects and Society. (2-0) Cr. 2. F.S. *Prereq: Ent 201.* 11 weeks. Classroom section spring only. World Wide Web section offered fall semester. Holscher. The importance of insects in human well-being. Insect-human interactions. Primarily for nonscience and nonagriculture majors.

Ent 283. Pesticide Application Certification. (Cross-listed with Agron, For, Hort). (2-0) Cr. 2. S. Holscher. Core background and specialty topics in agricultural, and Horticultural pesticide applicator certification. Students can Select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

Ent 370. Insect Biology. (2-3) Cr. 3. F. *Prereq: Biol 101 or 211.* Jurenka. Structure, physiology, evolution, behavior, life histories, and recognition of insects. Collection required. Nonmajor graduate credit.

Ent 371I. Introduction to Insect Ecology. (Cross-listed with Ia LL). (3-3) Cr. 4. Alt. SS., offered 2011. Field and laboratory study of insects, their diversity, life history; emphasis on ecology and behavior.

Ent 372. Livestock Entomology. (2-0) Cr. 2. Alt. S., offered 2011. Classroom and off-campus videotape sections. 12 weeks. Holscher. Recognition, biology, behavior, economic importance, and management of insects and other arthropods affecting livestock and poultry production. Nonmajor graduate credit.

Ent 374. Insects and Our Health. (Cross-listed with Micro). (3-0) Cr. 3. S. *Prereq: 3 credits in biological sciences.* Bartholomay. Identification, biology, and significance of insects and arthropods that affect the health of humans and animals, particularly those that are vectors of disease. Nonmajor graduate credit.

Ent 374L. Insects and Our Health Laboratory. (Cross-listed with Micro). (0-3) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in Ent 374.* Bartholomay. Laboratory and field techniques for studying medical or public health entomology, including: collection, identification and maintenance of medically significant arthropods and experimental design and execution related to the biology of arthropods or arthropod-pathogen interactions.

Ent 375. Plant Protection Using Natural Enemies. (Dual-listed with 575). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 370 or 376.* Bonning, Harris. Overview of the biology, ecology, and classification of insect pathogens, predators, and parasitoids. Discussion of the use of these organisms in plant protection, including an emphasis on genetic alteration of natural enemies. Nonmajor graduate credit.

Ent 376. Fundamentals of Entomology and Pest Management. (2-3) Cr. 3. S. *Prereq: Biol 101 or 211.* O'Neal. Introduction to entomology and insect-pest management, including life processes, ecology, economics, tactics of population suppression, and ecological backlash. Credit for either Ent 376 or 386, but not both, may be applied toward graduation. Nonmajor graduate credit.

Ent 386. Management of Insect Pests. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Biol 101 or 211.* Tollefson. Introduction to insects and their lifestyles. Theory and application of pest-management practices. Examples drawn primarily from field crops. Credit for either Ent 376 or 386, but not both, may be applied for graduation. Nonmajor graduate credit.

Ent 410. Insect-Virus Interactions: a Molecular Perspective. (Dual-listed with 510). (Cross-listed with Micro). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Permission of an instructor.* Bonning, Bartholomay. Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

Ent 425. Aquatic Insects. (Dual-listed with 525). (Cross-listed with A Ecl). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312 or equivalent.* Courtney. Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

Ent 452. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 552). (Cross-listed with Pl P, Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Ent 471. Insect Ecology. (Dual-listed with 571). (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 9 credits biological sciences.* O'Neal. The contribution of insects to ecosystem function is staggering. This course will focus on insect population ecology, predator-prey interaction and chemical ecology. The role of insects in nutrient cycling, pollination and pest management will be discussed with case studies used to highlight the applied nature of insect ecology and its relationship to agriculture.

Ent 478. Global Protozoology - Molecular Biology of Protozoa. (Dual-listed with 578). (Cross-listed with V Pth). (2-1) Cr. 3. F. *Prereq: Permission of instructor.* Analysis of cellular systems, molecules, and organelles of pathogenic protozoan parasites. Emphasis is placed on processes and systems that are unique to protozoa, are important to understanding vector-parasite-host biology/ecology, or are targets of disease prevention/treatment programs for international disease control. Nonmajor graduate credit.

Ent 490. Independent Study. Cr. arr. Repeatable. *Prereq: 15 credits in biological sciences, junior or senior classification.* A maximum of 6 credits of Ent 490 may be used toward the total of 128 credits required for graduation.
E. Research or work experience.
U. Laboratory teaching experience. For students registering to be undergraduate laboratory assistants.

Ent 493. Workshop on Insect Management. Cr. 1. SS. *Prereq: 370, 372, 376, or 386.* Holscher. Insect recognition and sampling will be practiced in agricultural systems. The applications of current pest management practices will be demonstrated in both crop and livestock systems. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Ent 510. Insect-Virus Interactions: a Molecular Perspective. (Dual-listed with 410). (Cross-listed with Micro). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Permission of an instructor.* Bonning, Bartholomay. Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

Ent 511. Integrated Management of Tropical Crops. (Cross-listed with Pl P, Hort). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Pl P 408 or 416 or Ent 370 or 376 or Hort 221.* Gleason, Lewis, Nonnecke. Applications of Integrated Crop Management principles (including plant pathology, entomology, and Horticulture) to tropical cropping systems. Familiarization with a variety of tropical agroecosystems and Costa Rican culture is followed by 10-day tour of Costa Rican agriculture during spring break, then writeup of individual projects. Tour expenses paid by students.

Ent 525. Aquatic Insects. (Dual-listed with 425). (Cross-listed with A Ecl). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312 or equivalent.* Courtney. Morphology, ecology, diversity and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

Ent 530. Ecologically Based Pest Management Strategies. (Cross-listed with Agron, Pl P, SusAg). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: SusAg 509.* Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

Ent 550. Pesticides in the Environment. (Cross-listed with Tox). (2-0) Cr. 2. S. *Prereq: 9 credits of biological sciences.* Coats. Fate and significance of pesticides in soil, water, plants, animals, and the atmosphere.

Ent 552. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 452). (Cross-listed with Pl P, Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Ent 555. Insect Physiology. (3-3) Cr. 4. S. *Prereq: 370.* Jurenka. Life processes of the insects, including reviews of current problems in insect physiology.

Ent 568. Advanced Systematics. (Cross-listed with EEOB). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Permission of instructor.* Principles and practice of systematic biology; taxonomy, nomenclature and classification of plants and animals; sources and interpretation of systematic data; speciation; fundamentals of phylogenetic systematics.

Ent 570. Plant-Insect Interactions. (2-0) Cr. 2. Alt. F., offered 2009. *Prereq: 370 or 376.* Gassman. Principles of insect and host interactions and mechanisms of insect control by host plant resistance.

Ent 571. Insect Ecology. (Dual-listed with 471). (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 9 credits biological sciences.* O'Neal. The contribution of insects to ecosystem function is staggering. This course will focus on insect population ecology, predator-prey interaction and chemical ecology. The role of insects in nutrient cycling, pollination and pest management will be discussed with case studies used to highlight the applied nature of insect ecology and its relationship to agriculture.

Ent 574. Medical Entomology. (3-3) Cr. 4. Alt. S., offered 2010. *Prereq: 9 credits in biological sciences.* Bartholomay. Identification, biology, and significance of insects and other arthropods that attack people and animals, particularly those that are vectors of disease.

Ent 575. Plant Protection Using Natural Enemies. (Dual-listed with 375). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 370 or 376.* Bonning, Harris. Overview of the biology, ecology, and classification of insect pathogens, predators, and parasitoids. Discussion of the use of these organisms in plant protection, including an emphasis on genetic alteration of natural enemies.

Ent 576. Systematic Entomology. (3-6) Cr. 5. Alt. F., offered 2009. *Prereq: 370.* Courtney. Classification, distribution, and natural history of insects, including fundamentals of phylogenetic systematics, biogeography, taxonomic procedures, and insect collection and curation.

Ent 578. Global Protozoology - Molecular Biology of Protozoa. (Dual-listed with 478). (Cross-listed with V Pth). (2-1) Cr. 3. F. *Prereq: Permission of instructor.* Analysis of cellular systems, molecules, and organelles of pathogenic protozoan parasites. Emphasis is placed on processes and systems that are unique to protozoa, are important to understanding vector-parasite-host biology/ecology, or are targets of disease prevention/treatment programs for international disease control.

Ent 590. Special Topics. Cr. arr. Repeatable. *Prereq: 15 credits in biological sciences..*
A. Biological Control and Pathology.
B. Chemical Ecology and Behavior.
C. Ecology and Pest Management.
D. Evolution and Systematics.
E. Special Research Topics.
F. Medical and Veterinary Entomology.
G. Molecular Entomology.
H. Physiology and Biochemistry.
I. Toxicology.
K. Teaching Experience.
L. Extension Internship.
M. Immature Insects.
N. Population Genetics.

Courses for graduate students

Ent 600. Seminar. Cr. 1. F.S.SS. Presentation of research results.

Ent 675. Insecticide Toxicology. (Cross-listed with Tox). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 555 or Tox 501.* Coats. Principles of insecticide toxicology; classification, mode of action, metabolism, and environmental effects of insecticides.

Ent 699. Research. Cr. arr. Repeatable.

Entrepreneurial Studies

www.isupjcenter.org/education/minor

(Interdepartmental Undergraduate Minor)

Supervisory Committee: Kay Palan (Business), Chair; Lisa Nolan (Vet Med); David Acker (Ag); Diane Rover (Engineering); Corly Brooke (Human Sciences); Kate Schwennsen (Design); Zora Zimmerman (LAS).

Entrepreneurial Studies is an interdisciplinary program that provides opportunities to students to learn about entrepreneurship—the process of creating value through recognizing and developing opportunities. It serves to complement the student's major area of study, in any college, by offering a means of putting theory and science into practice. The goal of the Entrepreneurial Studies program is to provide the knowledge and skills needed to create value through recognizing and developing opportunities. In addition to feasibility analysis and business planning, the program deals with the topics of innovation, opportunity recognition, technology transfer, industry analysis, and competitive strategy. Although the program introduces some fundamental concepts from accounting, finance, marketing, and management, it does not attempt to substitute for any business courses in these areas.

A minor in entrepreneurial studies is available to all undergraduate students at ISU. Students must follow college specific rules in selecting courses. The college representatives to the supervisory committee will be responsible for advising students in their college, and will inform students about the details of the college rules.

Minor

A student seeking a minor in entrepreneurial studies must successfully complete a minimum of 15 credits in courses approved for use in the entrepreneurial studies program, including the two required courses, Management 310 and 313. Management 310, *Entrepreneurship and Innovation*, is the introductory course and provides an overview of the entire field. Management 313, *Feasibility Analysis and Business Planning*, emphasizes developing an idea for a new venture, conducting a feasibility study, researching the potential market, analyzing the competition, and preparing a formal business plan. Students take two entrepreneurship-oriented electives (6 cr.), from an approved course list and must also take 3 cr. of experiential learning. Up to six of the 15 credits required for the minor may also be used in the student's required program of study. More information about the minor and the list of approved electives are available online.

Environmental Science

www.ensci.iastate.edu

(Interdepartmental Program)

William G. Crumpton: Coordinator

Environmental Science provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems. The magnitude and complexity of environmental problems are creating a growing need for scientists with rigorous, interdisciplinary training in environmental science. The Environmental Science program is designed to prepare students for positions of leadership in this rapidly changing discipline. Environmental Science graduates have a solid foundation in biological and physical natural sciences and the specialized training necessary for integrated analysis of environmental systems.

Undergraduate Study

The Environmental Science undergraduate major is offered through both the College of Agriculture and Life Sciences and the College of Liberal Arts and Sciences. Environmental Science majors complete foundation courses in biology, chemistry, earth science, geology, physics and mathematics, plus a major consisting of an integrated core of Environmental Science courses and additional advanced course work in Environmental Science. Scientific rigor is stressed throughout the program, beginning with the foundation courses in the first two years of the curriculum. The upper level core courses emphasize a dynamic systems approach that provides a framework for integrating physical, chemical, and biological aspects of environmental systems.

Students seeking an Environmental Science major complete the following: (1) A foundation of approved supporting courses in science and mathematics including biology, chemistry, earth science, physics, calculus, and Statistics, (2) 29 credits of course work in the major, including the Environmental Science core (EnSci 110, 201, 250, 381, and 382) and 15 additional credits of approved course work in Environmental Science. A combined average grade of C or higher is required in courses applied in the major.

Graduate Study

Environmental Science offers an interdisciplinary graduate program leading to the M.S. and Ph.D. degrees with a major in Environmental Science. Faculty from the colleges of Agriculture and Life Sciences, Engineering, and Liberal Arts and Sciences cooperate to offer courses and research opportunities covering a broad array of environmental topics.

Applicants should have completed an undergraduate or masters degree in one of the biological, chemical, physical, or engineering sciences or should have equivalent preparation.

The Environmental Science graduate program emphasizes fundamental concepts and research, which at the same time address major environmental issues. The curriculum is designed to provide the interdisciplinary approach needed in Environmental Science education and research. In addition to work in their chosen area of specialization, students are afforded a broad exposure to the biological, chemical and physical aspects of environmental systems and the specialized training necessary for integrated analysis of these systems.

Courses primarily for undergraduate students

EnSci 110. Orientation to Environmental Science. (1-0) Cr. 1. F. *Prereq: Freshman classification in EnSci.* Overview of Environmental Science curriculum and discussion of professional opportunities. Satisfactory-fail only.

EnSci 201. Introduction to Environmental Issues. (Cross-listed with Env S). (2-0) Cr. 2. F.S. Discussion of current and emerging environmental issues such as human population growth, energy use, loss of biodiversity, water resources, and climate change.

EnSci 250. Environmental Geography. (Cross-listed with Env S). (3-0) Cr. 3. F. The distribution, origins and functions of the earth's physical systems and the spatial relationship between human activity and the natural world.

EnSci 290. Apprenticeship. Cr. arr. Repeatable. F.S.SS. *Prereq: Approval of the Environmental Science Coordinator.* Practical experience in an approved setting such as a research laboratory, government office, or private office. Satisfactory-fail only.

EnSci 301. Natural Resource Ecology and Soils. (Cross-listed with NREM). (3-3) Cr. 4. F. *Prereq: Biol 211, 211L; for 201 or a second course in Biology.* Effects of environmental factors on ecosystem structure and function using forest, prairie and agricultural ecosystems as models. Special emphasis is given to soil-forming factors and the role of soil in nutrient and water cycling and ecosystem dynamics. Additional emphasis is given to human influences on natural ecosystems and the role of perennial plant communities in agricultural landscapes. Nonmajor graduate credit.

EnSci 312. Ecology. (Cross-listed with A Ecl, Biol). (3-3) Cr. 4. F.SS. *Prereq: Biol 211L and 212L.* Fundamental concepts and principles of ecology dealing with organisms, populations, communities and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats.

EnSci 312I. Ecology. (Cross-listed with A Ecl, Ia LL). Cr. 4. SS. An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

EnSci 345. Natural Resource Photogrammetry and Geographic Information Systems. (Cross-listed with NREM). (2-3) Cr. 3. F. *Prereq: Junior classification.* Measurement and interpretation of aerial photos in resource management. Introduction to Geographic Information Systems (GIS) using ArcGIS including digitizing, development and query of attribute tables, georeferencing, and use of multiple GIS layers in simple spatial analyses. Nonmajor graduate credit.

EnSci 360. Environmental Soil Science. (Cross-listed with Agron). (2-3) Cr. 3. S. *Prereq: Agron 260 or Geol 100 or 201.* Burras and Killorn. Application of soil science to contemporary environmental problems; comparison of the impacts that different management strategies have on short- and long-term environmental quality and land development. Emphasis on participatory learning activities.

EnSci 381. Environmental Systems I: Introduction to Environmental Systems. (Dual-listed with 581). (Cross-listed with Biol, Env S, Micro). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including Biology and chemistry.* Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

EnSci 382. Environmental Systems II: Analysis of Environmental Systems. (Dual-listed with 582). (Cross-listed with Biol). (2-4) Cr. 4. S. *Prereq: EnSci 381.* Continuation of EnSci 381. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

EnSci 390. Internship in Environmental Science. Cr. arr. Repeatable. F.S.SS. *Prereq: Approval of the Environmental Science coordinator.* Supervised off-campus work experience in the field of environmental science. Satisfactory-fail only.

EnSci 402. Watershed Hydrology. (Dual-listed with 502). (Cross-listed with Agron, Geol, Mteor, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or Biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

EnSci 402I. Watershed Hydrology and Surficial Processes. (Cross-listed with Agron, Ia LL). Cr. 4. SS. *Prereq: Four courses in physical or Biological sciences or engineering.* Effects of geomorphology, soils, and land use on transport of water and materials (nutrients, contaminates) in watersheds. Fieldwork will emphasize investigations of the Iowa Great Lakes watershed. Nonmajor graduate credit.

EnSci 404. Global Change. (Dual-listed with 504). (Cross-listed with Agron, Env S, Mteor). (3-0) Cr. 3. S. *Prereq: Four courses in physical or Biological sciences or engineering; junior standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Nonmajor graduate credit.

EnSci 405. Environmental Biophysics. (Dual-listed with 505). (Cross-listed with Agron, Mteor). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities. Nonmajor graduate credit.

EnSci 406. World Climates. (Cross-listed with Agron, Mteor). (3-0) Cr. 3. F. *Prereq: Agron/Mteor 206.* Arritt. Distribution and causes of different climates around the world. Effects of climate and climate variations on human activities including Society, economy and agriculture. Current issues such as climate change and international efforts to assess and mitigate the consequences of a changing climate. Semester project and in-class presentation required. Nonmajor graduate credit.

EnSci 407. Watershed Management. (Dual-listed with 507). (Cross-listed with Env S, NREM). (3-3) Cr. 4. S. *Prereq: A course in general Biology.* Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

EnSci 408. GIS and Natural Resources Management. (Dual-listed with 508). (Cross-listed with A E). (2-2) Cr. 3. F. *Prereq: Working knowledge of computers and Windows environment.* Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS.

EnSci 409. Field Methods in Hydrogeology. (Dual-listed with 509). (Cross-listed with Geol). (0-4) Cr. 2. Alt. SS., offered 2010. *Prereq: 402 or 411 or C E 473.* Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, electronic instrumentation for data collection, and geophysics. Field trips to investigate water resource, water quality, and remediation projects.

EnSci 411. Hydrogeology. (Dual-listed with 511). (Cross-listed with Geol). (3-2) Cr. 4. F. *Prereq: Geol 100 or 201; Math 165 or 181; Phys 111 or 221.* Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations. Nonmajor graduate credit.

EnSci 414. Applied Groundwater Flow Modeling. (Dual-listed with 514). (Cross-listed with Geol). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 411 or C E 473; Math 165 or 181.* Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course. Nonmajor graduate credit.

EnSci 415. Paleoclimatology. (Dual-listed with 515). (Cross-listed with Geol). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Four courses in Biological or physical science.* Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods, utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~1 million years). Nonmajor graduate credit.

EnSci 418. Stream Ecology. (Dual-listed with 518). (Cross-listed with A Ecl). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 486.* Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

EnSci 419. Environmental Geochemistry. (Dual-listed with 519). (Cross-listed with Geol). (2-2) Cr. 3. F. *Prereq: 402 or 411 or equivalent.* Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling. Nonmajor graduate credit.

EnSci 422l. Prairie Ecology. (Cross-listed with Ia LL). Cr. 4. SS. *Prereq: Familiarity with basic principles in Biological sciences and ecology.* Basic patterns and underlying physical and biotic causes of both regional and local distributions of plants and animals of North American prairies; field and laboratory analyses and projects. Nonmajor graduate credit.

EnSci 424. Air Pollution. (Dual-listed with 524). (Cross-listed with A E, C E). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology.
E. Agricultural sources of pollution

EnSci 426. Stable Isotopes in the Environment. (Dual-listed with 526). (Cross-listed with Geol). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Four courses in Biological or physical science.* Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, Biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance. Nonmajor graduate credit.

EnSci 434. Contaminant Hydrogeology. (Dual-listed with 534). (Cross-listed with Geol). (3-0) Cr. 3. S. *Prereq: Geol 411 or equivalent.* Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface Microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies. Nonmajor graduate credit.

EnSci 446. Integrating GPS and GIS for Natural Resource Management. (Dual-listed with 546). (Cross-listed with NREM). (2-3) Cr. 3. S. *Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS.* Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

EnSci 451. Applied and Environmental Geophysics. (Dual-listed with 551). (Cross-listed with Geol). (2-2) Cr. 3. S. *Prereq: Geol 100 or 201, Math 181 or equivalent experience.* Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic- and resistivity-imaging systems and radar. Nonmajor graduate credit.

EnSci 452. GIS for Geoscientists. (Dual-listed with 552). (Cross-listed with Agron, Geol). (2-2) Cr. 3. F. *Prereq: Geol 100, Geol 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses. Nonmajor graduate credit.

EnSci 459. Environmental Soil and Water Chemistry. (Dual-listed with 559). (Cross-listed with Agron). (3-3) Cr. 4. F. *Prereq: Agron 354 or EnSci 360; Chem 164, 165, or 178; Math 140. Chem 211 or 231 recommended.* Thompson. An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, and applications to contemporary environmental issues. Nonmajor graduate credit.

EnSci 461l. Introduction to GIS. (Cross-listed with Env S, Ia LL, L A). Cr. 4. SS. Descriptive and predictive GIS modeling techniques, spatial Statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management. Nonmajor graduate credit.

EnSci 463. Soil formation and Landscape Relationships. (Dual-listed with 563). (Cross-listed with Agron). (2-4) Cr. 4. S. *Prereq: 154 or 260.* Sandor. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for one of EnSci 463 or 463l may be applied for graduation. Nonmajor graduate credit.

EnSci 463l. Soil formation and Landscape Relationships. (Dual-listed with 563l).(Cross-listed with Agron, Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: Agron 154 or 260.* Burras. Relationships between soil formation, geomorphology, and environment. Soil description classification, geography, mapping, and interpretation for land use. Credit for one of EnSci 463 or 463l may be applied for graduation. Nonmajor graduate credit.

EnSci 479. Surficial Processes. (Dual-listed with 579). (Cross-listed with Geol). (2-2) Cr. 3. F. *Prereq: Geol 100 or 201 or equivalent experience.* Study of surficial processes in modern and ancient geological environments. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory emphasizes aerial photo and topographic map interpretation. Nonmajor graduate credit.

EnSci 480. Engineering Analysis of Biological Systems. (Dual-listed with 580). (Cross-listed with BSE). (2-2) Cr. 3. F. *Prereq: A E 216; Math 266; Biol 211 or 212; M E 330.* Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues.

EnSci 484. Ecosystem Ecology. (Cross-listed with Biol). (3-0) Cr. 3. S. *Prereq: Combined 12 credits in biology and chemistry.* Introduction of the study of ecosystems and the factors that influence their properties and dynamics. Conceptual foundations for ecosystem studies. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems.

EnSci 485. Soil and Environmental Microbiology. (Dual-listed with 585). (Cross-listed with Agron, Micro). (2-3) Cr. 3. F. *Prereq: 402 or Agron 154, Micro 201 (Micro 203 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues. Nonmajor graduate credit.

EnSci 486. Aquatic Ecology. (Dual-listed with 586). (Cross-listed with A Ecl, Biol). (3-0) Cr. 3. F. *Prereq: Biol 312 or EnSci 381 or EnSci 402 or NREM 301.* Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine and wetland ecology. Nonmajor graduate credit.

EnSci 486L. Aquatic Ecology Laboratory. (Dual-listed with 586L).(Cross-listed with A Ecl, Biol). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in 486.* Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts. Nonmajor graduate credit.

EnSci 487. Microbial Ecology. (Cross-listed with Biol, Micro). (3-0) Cr. 3. F. *Prereq: Six credits in biology and 6 credits in chemistry.* Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems. Nonmajor graduate credit.

EnSci 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval of the Environmental Science coordinator.*

EnSci 495. Current Topics and Case Studies in Environmental Science. Cr. arr. *Prereq: Junior classification in Environmental Science, permission of instructor.* Current topics and case studies related to the analysis and management of environmental systems. Individual and/or group projects.

EnSci 496. Travel Course. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Extended field trips to study environmental topics in varied locations. Location and duration of trips will vary. Trip expenses paid by students. Check with department for current offerings.
A. International Tour
B. Domestic Tour

EnSci 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of Environmental Science Coordinator.* Required of all cooperative education students. Students must register prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

EnSci 502. Watershed Hydrology. (Dual-listed with 402). (Cross-listed with Geol, Mteor). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

EnSci 504. Global Change. (Dual-listed with 404). (Cross-listed with Agron, Mteor). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior, senior, or graduate standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change.

EnSci 505. Environmental Biophysics. (Dual-listed with 405). (Cross-listed with Agron, Mteor). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities. Semester project required.

EnSci 507. Watershed Management. (Dual-listed with 407). (Cross-listed with NREM). (3-3) Cr. 4. S. *Prereq: A course in general biology.* Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

EnSci 508. GIS and Natural Resource Management. (Dual-listed with 408). (Cross-listed with A E). (2-2) Cr. 3. F. *Prereq: Working knowledge of computers and Windows environment.* Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS. In addition to other assignments, graduate students will prepare research literature reviews on topics covered in class and develop enterprise applications.

EnSci 508I. Aquatic Ecology. (Cross-listed with Ia LL, NREM). Cr. 4. SS. *Prereq: Courses in ecology, chemistry, and physics.* Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

EnSci 509. Field Methods in Hydrogeology. (Dual-listed with 409). (Cross-listed with Geol). (0-4) Cr. 2. Alt. SS., offered 2010. *Prereq: 402 or 411 or C E 473.* Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, electronic instrumentation for data collection, and geophysics. Field trips to investigate water resource, water quality, and remediation projects.

EnSci 511. Hydrogeology. (Dual-listed with 411). (Cross-listed with Geol). (3-2) Cr. 4. F. *Prereq: Geol 100 or 201; Math 165 or 181; Phys 111 or 221.* Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations.

EnSci 514. Applied Groundwater Flow Modeling. (Dual-listed with 414). (Cross-listed with Geol). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 411 or C E 473; Math 165 or 181.* Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course.

EnSci 515. Paleoclimatology. (Dual-listed with 415). (Cross-listed with Geol). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Four courses in biological or physical science.* Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods; utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~ 1 million years).

EnSci 518. Stream Ecology. (Dual-listed with 418). (Cross-listed with A Ecl). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 486.* Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

EnSci 519. Environmental Geochemistry. (Dual-listed with 419). (Cross-listed with Geol). (2-2) Cr. 3. F. *Prereq: 511 or equivalent.* Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling.

EnSci 520. Environmental Engineering Chemistry. (Cross-listed with C E). (2-3) Cr. 3. *Prereq: Chem 177 and 178, Math 166.* Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilibria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions and mass transfer principles. Individual laboratory practicals and group projects required. Term paper and oral presentation for graduate level only.

EnSci 521. Environmental Biotechnology. (Cross-listed with C E). (2-2) Cr. 3. *Prereq: C E 326.* Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, bioenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens and parasites, and disinfection. Term paper and oral presentation.

EnSci 522. Water Pollution Control Processes. (Cross-listed with C E). (2-2) Cr. 3. *Prereq: 521.* Fundamentals of biochemical processes, aerobic growth in a single CSTR, multiple events in complex systems, and techniques for evaluating kinetic parameters; unit processes of activated sludge system, attached growth systems, stabilization and aerated lagoon systems, biosolids digestion and disposal, nutrient removal, and anaerobic treatment systems.

EnSci 523. Physical-Chemical Treatment Process. (Cross-listed with C E). (2-2) Cr. 3. *Prereq: C E 520.* Material and energy balances. Principles and design of physical-chemical unit processes; including screening, coagulation, flocculation, chemical precipitation, sedimentation, filtration, lime softening and stabilization, oxidation, adsorption, membrane processes, ion exchange and disinfection; recovery of resources from residuals and sludges; laboratory exercises and demonstrations; case studies in mineral processing and secondary industries. Individual and group projects required.

EnSci 524. Air Pollution. (Dual-listed with 424). (Cross-listed with A E, C E). (1-0) Cr. 1. *Prereq: Either Phys 221 or Chem 178 and either Math 166 or 3 credits in statistics. Senior classification or above.* 1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
A. Air quality and effects of pollutants
B. Climate change and causes
C. Transportation constraints
D. Off-gas treatment technology
E. Agricultural sources of pollution

EnSci 526. Stable Isotopes in the Environment. (Dual-listed with 426). (Cross-listed with Geol). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Four courses in biological or physical science.* Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance.

EnSci 527. Solid Waste Management. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: C E 326.* Planning and design of solid waste management systems; includes characterization and collection of domestic, commercial, and industrial solid wastes, waste minimization and recycling, energy and materials recovery, composting, incineration, and landfill design.

EnSci 529. Hazardous Waste Management. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: C E 326.* Regulatory requirements for the classification, transport, storage and treatment of hazardous wastes. Analysis and design of alternatives for treatment and disposal technologies, including physical, chemical, and biological treatment, solidification, incineration, and secure landfill design. Regulatory requirements and procedures for hazardous waste contaminated site investigations and risk analysis. Analysis and design of remedial action alternatives for site restoration.

EnSci 531. Design and Evaluation of Soil and Water Conservation Systems. (Cross-listed with A E). (2-3) Cr. 3. F. *Prereq: E M 378 or Ch E 356.* Hydrology and hydraulics in agricultural and urbanizing watersheds. Design and evaluation of systems for the conservation and quality preservation of soil and water resources. Use and analysis of hydrologic data in

engineering design; relationship of topography, soils, crops, climate, and cultural practices in conservation and quality preservation of soil and water for agriculture. Small watershed hydrology, water movement and utilization in the soil-plant-atmosphere system, agricultural water management, best management practices, and agricultural water quality. Graduate students will prepare several research literature reviews on topics covered in the class in addition to the other assignments.

EnSci 533. Erosion and Sediment Transport. (Cross-listed with A E). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: A E 422 or C E 372, Math 266.* Soil erosion processes, modified universal soil loss equation and its application to conservation planning, sediment properties, initiation of sediment motion and over land flow, flow in alluvial channels and theory of sediment transport, channel stability, reserves sedimentation, wind erosion, BMPs for controlling erosion.

EnSci 534. Contaminant Hydrogeology. (Dual-listed with 434). (Cross-listed with Geol). (3-0) Cr. 3. S. *Prereq: Geol 511 or equivalent.* Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface Microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies.

EnSci 535. Restoration Ecology. (Cross-listed with EEOB, NREM). (2-3) Cr. 3. F. *Prereq: Biol 366 or 474 or graduate standing.* Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies.

EnSci 535l. Restoration Ecology. (Cross-listed with A Ecl, EEOB, Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: A course in ecology.* Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

EnSci 546. Integrating GPS and GIS for Natural Resource Management. (Dual-listed with 446). (Cross-listed with NREM). (2-3) Cr. 3. S. *Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS.* Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

EnSci 551. Applied and Environmental Geophysics. (Dual-listed with 451). (Cross-listed with Geol). (2-2) Cr. 3. S. *Prereq: Geol 100 or 201, Math 181 or equivalent experience.* Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic- and resistivity-imaging systems and radar.

EnSci 552. GIS for Geoscientists. (Dual-listed with 452). (Cross-listed with Agron, Geol). (2-2) Cr. 3. F. *Prereq: Geol 100, Geol 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

EnSci 553. Soil-Plant Relationships. (Cross-listed with Agron). (3-0) Cr. 3. F. *Prereq: Agron 354.* Killorn. Composition and properties of soils in relation to the nutrition and growth of plants.

EnSci 558. Laboratory Methods in Soil Chemistry. (Cross-listed with Agron). (2-3) Cr. 3. F. *Prereq: Agron 354 and Chem 178 or 211.* Tabatabai. Experimental and descriptive inorganic and organic analyses. Operational theory and principles of applicable instruments, including spectrophotometry, atomic and molecular absorption and emission spectroscopy, mass spectrometry, X-ray diffraction and fluorescence, gas and ion chromatography, and ion-selective electrodes.

EnSci 559. Environmental Soil and Water Chemistry. (Dual-listed with 459). (Cross-listed with Agron). (3-3) Cr. 4. F. *Prereq: Agron 354 or EnSci 360; Chem 164, 165, or 178; Math 140. Chem 211 or 231 recommended.* Thompson. An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, chemical-equilibrium speciation programs, and applications to contemporary environmental issues.

EnSci 563. Soil formation and Landscape Relationships. (Dual-listed with 463). (Cross-listed with Agron). (2-4) Cr. 4. S. *Prereq: Agron 154 or 260.* Sandor. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for only EnSci 563 or 563l may be applied for graduation.

EnSci 563l. Soil formation and Landscape Relationships. (Dual-listed with 463l).(Cross-listed with Agron, Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: Agron 154 or 260.* Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for one of EnSci 563 or 563l may be applied for graduation.

EnSci 564. Wetland Ecology. (Cross-listed with EEOB). (3-0) Cr. 3. S. *Prereq: 15 credits in biological sciences.* Ecology, classification, creation and restoration, and management of wetlands. Emphasis on North American temperate wetlands.

EnSci 564l. Wetland Ecology. (Cross-listed with EEOB, Ia LL). Cr. 4. SS. *Prereq: Ia LL 312l.* Ecology, classification, creation, restoration, and management of wetlands. Field studies will examine the composition, structure and functions of local natural wetlands and restored prairie pothole wetlands. Individual or group projects.

EnSci 571. Surface Water Hydrology. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: C E 372.* Analysis of hydrologic data including precipitation, infiltration, evapotranspiration, direct runoff and streamflow; theory and use of frequency analysis; theory of streamflow and reservoir routing; use of deterministic and Statistical hydrologic models. Fundamentals of surface water quality modeling, point and non-point sources of contamination. Design project.

EnSci 572. Analysis and Modeling Aquatic Environments. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: C E 372.* Principles of surface water flows and mixing. Introduction to hydrologic transport and water quality simulation in natural water systems. Advection, diffusion and dispersion, chemical and biological kinetics, and water quality dynamics. Applications to temperature, dissolved oxygen, primary productivity, and other water quality problems in rivers, lakes and reservoirs. Deterministic vs stochastic models.

EnSci 573. Groundwater Hydrology. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: C E 372.* Principles of groundwater flow, hydraulics of wells, super-position, slug and pumping tests, streamlines and flownets, and regional groundwater flow. Contaminant transport. Computer modeling. Individual and group projects.

EnSci 574. Environmental Impact Assessment. (Cross-listed with C E). (3-0) Cr. 3. *Prereq: Four courses in natural, biological, or engineering sciences and senior or above classification.* Review of federal and state requirements for environmental impact assessment, requirements of the National Environmental Policy Act and Council on Environmental Quality, methods of evaluating the environmental impacts on the physical, biological, socioeconomic, cultural/Historical, human health and psychological environments, public participation in EIS, review and evaluate project environmental impact statements. An environmental impact assessment of a proposed project will be completed in small teams.

EnSci 575. Soil formation and Transformation. (Cross-listed with Agron). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 463 or equivalent.* Advanced study of soil formation, emphasizing relationships among soils, landscapes, environment, humans, and land use.

EnSci 577. Soil Physics. (Cross-listed with Agron). (3-0) Cr. 3. S. *Prereq: Agron 354. Recommended: Math 166.* Horton. The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

EnSci 578. Laboratory Methods in Soil Physics. (Cross-listed with Agron). (0-3) Cr. 1. S. *Prereq: 577 concurrent.* Horton. Methods of measuring soil physical properties such as texture, density, and water content, and transport of heat, water, and gases.

EnSci 579. Surficial Processes. (Dual-listed with 479). (Cross-listed with Geol). (2-2) Cr. 3. F. *Prereq: Geol 100 or 201 or equivalent experience.* Study of surficial processes in modern and ancient geological environments. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory emphasizes aerial photo and topographic map interpretation.

EnSci 580. Engineering Analysis of Biological Systems. (Dual-listed with 480). (Cross-listed with BSE). (2-2) Cr. 3. F. *Prereq: 216; Math 266; Biol 211 or 212; M E 330.* Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues. Students enrolled in EnSci 580 will be required to answer additional exam questions and report on two journal articles.

EnSci 581. Environmental Systems I: Introduction to Environmental Systems. (Dual-listed with 381). (Cross-listed with EEOB). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including biology and chemistry.* Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

EnSci 582. Environmental Systems II: Analysis of Environmental Systems. (Dual-listed with 382). (2-4) Cr. 4. S. *Prereq: EnSci 581.* Continuation of EnSci 581. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

EnSci 584. Ecosystem Ecology. (Cross-listed with EEOB). (3-0) Cr. 3. S. *Prereq: Combined 12 credits in biology and chemistry.* Introduction to the study of ecosystems and the factors that influence their properties and dynamics. Conceptual foundations for ecosystem studies. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems.

EnSci 585. Soil and Environmental Microbiology. (Dual-listed with 485). (Cross-listed with Agron, Micro). (2-3) Cr. 3. F. *Prereq: 402 or Agron 154, Micro 201 (Micro 203 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

EnSci 586. Aquatic Ecology. (Dual-listed with 486). (Cross-listed with EEOB). (3-0) Cr. 3. F. *Prereq: EnSci 301 or 312 or 381 or 402.* Structure and function of

aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine and wetland ecology.

EnSci 586L. Aquatic Ecology Laboratory. (Dual-listed with 486L).(Cross-listed with EEOB). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in 586.* Field trips and laboratory exercises to accompany 586. Hands-on experience with aquatic research and monitoring techniques and concepts.

EnSci 587. Microbial Ecology. (Dual-listed with 487). (Cross-listed with EEOB, Micro). (3-0) Cr. 3. F. *Prereq: Six credits in biology and six credits in chemistry.* Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

EnSci 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of major professor in Environmental Science faculty.* Literature reviews and conference in accordance with needs and interest of the student.

EnSci 599. Creative Component. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of major professor in Environmental Science faculty.* Creative component for nonthesis master of science degree.

Courses for graduate students

EnSci 685. Advanced Soil Biochemistry. (Cross-listed with Agron, Micro). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Agron 585.* Tabatabai. Chemistry of soil organic matter and biochemical transformations brought about by Microorganisms and enzymes in soils.

EnSci 690. Seminar in Environmental Science. Cr. R. Repeatable. F.S. Reports and discussion of recent research and literature.

EnSci 699. Research. Cr. arr. Repeatable. F.S.SS.

Environmental Studies

www.envs.iastate.edu

(Interdepartmental Undergraduate Program)

William G. Crumpton: Coordinator

Environmental Studies deals with the relationship and interactions between humans and the environment. Students in any college at ISU may elect to take a secondary major or minor in Environmental Studies. The curriculum is designed to give students an understanding of current and emerging environmental issues and an appreciation of different perspectives regarding these issues. Courses are provided for students pursuing careers related to the environment and for others who simply want to know more about environmental issues.

Secondary Major

The Environmental Studies secondary major is taken in addition to one's first major and provides the breadth of preparation and integrated perspective necessary to understand environmental issues. Students seeking a major in Environmental Studies complete 24 credits of Env S coursework including (1) at least one general survey course chosen from Env S 101, 120, 173, and 201, (2) at least one integrative/issues course chosen from Env S 160, 204, 324, 342, 404, 424, and 450, and (3) at least two human/Societal perspectives courses chosen from Env S 293 320, 334, 345, 355, 380, 382, 384, 442, 472, 482, 484, and 491. Beyond these three requirements, any Environmental Studies course and up to six credits of approved departmental coursework may be applied toward the 24 credit total for the major. Regardless of their home college, Environmental Studies majors must complete 10 credits of approved coursework in natural science. Unless prohibited by program or college rules, courses used in the major may also be used to satisfy general education and other requirements of departments and colleges. A combined average grade of C or higher is required in courses applied to the major.

Regardless of their primary major, Environmental Studies graduates have a broad foundation in science and humanities, an understanding of major environmental issues, and an appreciation of the varied and sometimes opposing perspectives regarding these issues.

Minor

Students seeking a minor in Environmental Studies complete 15 credits of approved Environmental Studies coursework including (1) at least one general survey course chosen from Env S 101, 120, 173, and 201, (2) at least one integrative/issues course chosen from Env S 160, 204, 324, 342, 404, 424, and 450, and (3) at least two human/Societal perspectives courses chosen from Env S 293, 320, 334, 345, 355, 380, 382, 384, 442, 472, 482, 484, and 491. A combined average grade of C or higher is required in courses applied to the minor, and the minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

Courses primarily for undergraduate students

Env S 101. Environmental Geology: Earth in Crisis. (Cross-listed with Geol). (3-0) Cr. 3. F.S. An introduction to geologic processes and the consequences of human activity from local to global scales. Discussion of human population growth, resource depletion, pollution and waste disposal, global warming and ozone depletion, desertification, and geologic hazards such as earthquakes, landslides, flooding, and volcanism.

Env S 108. Introduction to Oceanography. (Cross-listed with Geol). (3-0) Cr. 3. F. Introduction to study of the oceans. Ocean exploration. Waves and currents. Shape, structure, and origin of the ocean basins. Sedimentary record of oceanic life. Composition of seawater and its significance for life. Ocean circulation and its influence on climate. Life of the oceans, including coral reefs. Use and misuse of ocean resources. Anthropogenic impacts on the oceanic environment.

Env S 120. Introduction to Renewable Resources. (Cross-listed with Agron, NREM). (3-0) Cr. 3. F.S. Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

Env S 130. Natural Resources and Agriculture. (Cross-listed with NREM). (3-0) Cr. 3. S. Survey of the ecology and management of fish, forest, and wildlife resources in areas of intensive agriculture, with emphasis on Iowa. Conservation and management practices for private agricultural lands. Designed for nonmajors.

Env S 160. Water Resources of the World. (Cross-listed with Agron, Geol, Mteor). (3-0) Cr. 3. S. Study of the occurrence, History, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in Society and the environment.

Env S 173. Environmental Biology. (Cross-listed with Biol). (3-0) Cr. 3. F.S. An introduction to the structure and function of natural systems at scales from the individual to the biosphere and the complex interactions between humans and their environment. Discussions of human population growth, biodiversity, sustainability, resource use, and pollution.

Env S 201. Introduction to Environmental Issues. (Cross-listed with EnSci). (2-0) Cr. 2. F.S. Discussion of current and emerging environmental issues such as human population growth, energy use, loss of biodiversity, water resources, and climate change.

Env S 204. Biodiversity. (Cross-listed with Biol). (4-0) Cr. 2. S. *Prereq: One course in life sciences.* Survey of the major groups of organisms and biological systems. Definition, measurements, and patterns of distribution of organisms. Sources of information about biodiversity. Not intended for major credit in the biological sciences. Half semester course.

Env S 250. Environmental Geography. (Cross-listed with EnSci). (3-0) Cr. 3. F. The distribution, origins and functions of the earth's physical systems and the spatial relationship between human activity and the natural world.

Env S 260. Soils and Environmental Quality. (Cross-listed with Agron). (3-0) Cr. 3. F.S. Burras. Role of soils in environmental quality and natural resources management. Emphasis on soil erosion and conservation, water quality, and environmental planning. Saturday field trip.

Env S 293. Environmental Planning. (Cross-listed with C R P, Dsn S). (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Comprehensive overview of the field of environmental relationships and the efforts being made to organize, control, and coordinate environmental, aesthetic, and cultural characteristics of land, air, and water.

Env S 320. Ecofeminism. (Cross-listed with W S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: W S 201 or 3 credits in W S at the 300 level or above.* Women's relationships with the earth, non-human nature, and other humans. The course explores the connections between the mastery of women and the mastery of nature; origins of ecofeminism and its relation to the science of ecology and to other branches of feminist Philosophies. Critique of modern science, technology, political systems as well as solutions will be included.

Env S 324. Energy and the Environment. (Cross-listed with Geol, Mteor). (3-0) Cr. 3. S. Renewable and non-renewable energy resources. Origin, occurrence, and extraction of fossil fuels. Nuclear, wind, and solar energy. Energy efficiency. Environmental effects of energy production and use, including air pollution, acid precipitation, groundwater contamination, nuclear waste disposal, and global climate change.

Env S 334. Environmental Ethics. (Cross-listed with Phil). (3-0) Cr. 3. F. *Prereq: Three credits in Philosophy or junior classification.* Thorough study of some of the central moral issues arising in connection with human impact on the environment, e.g., human overpopulation, species extinction, forest and wilderness management, pollution. Several world views of the proper relationship between human beings and nature will be explored. Nonmajor graduate credit.

Env S 342. World Food Issues: Past and Present. (Cross-listed with Agron, FS HN, T SC). (3-0) Cr. 3. F.S. *Prereq: Junior classification.* Zdorkowski, Ford. Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, Historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects. Nonmajor graduate credit.
H. Honors Section. (Honors Program students only.)

Env S 345. Population and Society. (Cross-listed with Soc). (3-0) Cr. 3. F. *Prereq: Soc 130 or 134.* Human population growth and structure; impact on food, environment, and resources; gender issues; trends of births, deaths, and migration; projecting future population; population policies and laws; comparison of the United States with other Societies throughout the world.

Env S 355. Literature and the Environment. (Cross-listed with Engl). (3-0) Cr. 3. *Prereq: Engl 250.* Study of literary texts that address the following topics, among others: the relationship between people and natural/urban environments, ecocriticism, and the importance of place in the literary imagination. Nonmajor graduate credit.

Env S 380. Environmental and Resource Economics. (Cross-listed with Econ). (3-0) Cr. 3. F. *Prereq: Econ 101.* Natural resource availability, use, conservation, and government policy, including energy issues. Environmental quality and pollution control policies.

Env S 381. Environmental Systems I: Introduction to Environmental Systems. (Cross-listed with Biol, EnSci, Micro). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including Biology and chemistry.*

Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

Env S 382. Environmental Sociology. (Cross-listed with Soc). (3-0) Cr. 3. F.S. *Prereq: Soc 130, 134, or 3 credits of Env S.* Environment-Society relations; social construction of nature and the environment; social and environmental impacts of resource extraction, production, and consumption; environmental inequality; environmental mobilization and movements; U.S. and international examples.

Env S 384. Religion and Ecology. (Cross-listed with Relig). (3-0) Cr. 3. Introduction to concepts of religion and ecology as they appear in different religious traditions, from both a Historical and contemporary perspective. Special attention to religious response to contemporary environment issues. Nonmajor graduate credit.

Env S 390. Internship in Environmental Studies. Cr. arr. Repeatable. F.S.SS. *Prereq: Approval of the Environmental Studies Coordinator.* Practical experience with nature centers, government agencies, schools, private conservation groups, and other organizations. Satisfactory-fail only.

Env S 404. Global Change. (Cross-listed with Agron, EnSci, Mteor). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Nonmajor graduate credit.

Env S 407. Watershed Management. (Cross-listed with EnSci, NREM). (3-3) Cr. 4. S. *Prereq: A course in general biology.* Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

Env S 424. Sustainable and Environmental Horticulture Systems. (Cross-listed with Hort). (2-0) Cr. 2. F. Inquiry into ethical issues and environmental consequences of Horticultural cropping systems and production practices. Emphasis on production systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

Env S 442. The Policy and Politics of Coastal Areas. (Cross-listed with Pol S). (3-0) Cr. 3. SS. Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, trade-offs between conservation and jobs, the quality of coastal lifestyle, ways in which citizens participate in policy for coastal areas.

Env S 450. Issues in Sustainable Agriculture. (Cross-listed with Agron). (3-0) Cr. 3. F. Zdorkowski. Agricultural science as a human activity; contemporary agricultural issues from agroecological perspective. Comparative analysis of intended and actual consequences of development of industrial agricultural practices.

Env S 460. Controversies in Natural Resource Management. (Cross-listed with NREM). (3-0) Cr. 3. F.S. *Prereq: 120, and A Ecl 312 or NREM 301, and Junior classification.* Analysis of controversial natural resource issues using a case approach that considers uncertainty and adequacy of information and scientific understanding. Ecological, social, political, economic, and ethical implications of issues will be analyzed. Nonmajor graduate credit.

Env S 461I. Introduction to GIS. (Cross-listed with EnSci, L A, Ia LL). Cr. 4. SS. Descriptive and predictive GIS modeling techniques, spatial Statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management. Nonmajor graduate credit.

Env S 472. U. S. Environmental History. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* Survey of the interactions of human communities with the North American environment. Focus on the period from presettlement to the present, with a particular concentration on natural resources, disease, settlement patterns, land use, and conservation policies. Nonmajor graduate credit.

Env S 482. Environmental Politics and Policies. (Cross-listed with Pol S). (3-0) Cr. 3. F. *Prereq: Three credits in Political Science or 3 credits in Environmental Studies; Junior classification.* Major ideologies relation to conservation and ecology. Processes, participants, and institutions involved in state, national, and global environmental policymaking. Case studies of environmental controversies and proposals for policy reform. Nonmajor graduate credit.

Env S 484. Sustainable Communities. (Cross-listed with C R P, Dsn S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Senior classification.* The History and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

Env S 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor and approval of Environmental Studies coordinator.* Satisfactory-fail only.

Env S 491. Environmental Law and Planning. (Cross-listed with C R P, Dsn S). (3-0) Cr. 3. S. *Prereq: Six credits in natural sciences.* Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

Env S 496. Travel Course. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Extended field trips to study environmental topics in varied locations. Location and duration of trips will vary. Trip expenses paid by students. Check with department for current offerings.
A. International Tour
B. Domestic Tour

Family and Consumer Sciences

Master of Family and Consumer Sciences (M.F.C.S.)

The College of Human Sciences offers a nonthesis master's degree program that might appeal to individuals with a bachelor's degree in family and consumer sciences/home economics subject area or related disciplines. This program is considered to be a professional master's degree. For students interested in further graduate study beyond the MFCS, the nonthesis degree program may mean additional requirements before completion of a Ph.D. or other terminal degree graduate program.

Students select either a comprehensive option or a specialization option. The comprehensive option can be followed on or off-campus and requires 36 credits covering a variety of family and consumer sciences subject matter. Off-campus courses are offered via the World Wide Web (WWW). Specializations are available in Nutrition; Dietetics; Human Development and Family Studies; Foodservice and Lodging Management; and Textiles and Clothing.

In addition, students may select a 42-credit specialization in Family Financial Planning (FFP), a 36-credit specialization in Gerontology or a 36-credit specialization in Dietetics. The FFP, Gerontology, and Dietetics specializations, offered in collaboration with six to eight other universities in the Great Plains Interactive Distance Education Alliance, are offered exclusively through courses on the Web. The FFP program has been approved by the Board of Examiners of the Certified Financial Planner Board of Standards as a program with the competencies required to permit those completing the degree to sit for the CFP® Certification Examination. CFP® is a certification mark owned by the Certified Financial Planner Board of Standards.

The Program of Study committee, in consultation with the student, establishes the courses to be taken and the acceptability of transfer credits. The major professor is selected from the discipline in which the concentration of coursework will be taken. Written and oral final integrative examinations are required in lieu of a thesis or creative component. A thesis or creative component could be included on mutual agreement of the student and major professor, with approval of the Graduate College.

Admission requirements for the MFCS include a bachelor's degree in a family and consumer sciences/home economics subject area or related disciplines, Graduate Record Examination (GRE) scores (not required for the FFP and Geron specializations), official transcripts, three letters of recommendation, a goal statement, and graduation in the upper one-half of class with a bachelor's degree from a regionally accredited U.S. institution or graduation in the upper one-half of class from a recognized foreign institution. Non-English speaking international students are required to have a TOEFL score of at least 550 at time of admission.

Graduate Certificates

An 18-credit graduate certificate in Family Financial Planning is offered for students who do not need a master's degree and want to obtain the educational requirements of the Certified Financial Planner Board of Standards CFP® Certification Examination.

A 21-credit graduate certificate in Gerontology is offered. For additional information, students should contact the Research and Graduate Education Office, E262 Lagomarcino, Ames, Iowa 50011-3191, mfcsinfo@iastate.edu

Family and Consumer Sciences Education and Studies

(Administrated by the Department of Apparel, Educational Studies and Hospitality Management.)

www.aeshm.hs.iastate.edu/fceds/

Robert Bosselman, Interim Chair of Department

Distinguished Professors (Emeritus): Fanslow, Moyer, Winakor

University Professors (Emeritus): Farrell-Beck

Professors: Bosselman, Damhorst, Fiore, Kadolph

Professors (Emeritus): Anderson, Beavers, Brun, Burnet, Cowan, Crabtree, Gilmore, Smith, Stone, Williams

Associate Professors: Baltzer, Hausafus, Niehm, Parsons

Associate Professors (Emeritus): Amos, Brackelsberg, Brown, Ebert, Huss, Kundel, Kunz, Walsh

Associate Professor (Adjunct): Strohbehn

Assistant Professors: Barker, Hurst, Karpova, Keino, Y. Lee, Marcketti, Rajagopal, Wohlsdorf-Arendt, Zheng

Assistant Professor (Adjunct): Glock

Instructor (Adjunct): Fratzke

Lecturers: Ackerman, Burger, Christensen, Fiihr, Fitzpatrick, Kramer, M. Lee, Sanger, Trost, Wirth, Wise

Undergraduate Study

The program offers one curriculum for the bachelor of science degree in Family and Consumer Sciences Education and Studies. Students in the curriculum choose one of three options, Teacher Licensure, Communications, or Professional Studies. Graduates of the teacher licensure option teach in general and occupational programs of family and consumer sciences in middle, junior, and senior high schools. Graduates of the Communications option have a broad-based knowledge of family and consumer sciences and the ability to communicate in a global and technologically changing Society. They are able to plan, develop, creatively present and evaluate information. Graduates of the Professional Studies option pursue individualized career goals in family and consumer sciences that apply integrative knowledge of family and consumer sciences in diverse careers for global settings.

Admission to all three options is initiated in the course FCEdS 206. In addition, students in Teacher Licensure follow program and university procedures for admission to the university teacher education program. This program option is approved by the Iowa Department of Education for the preparation of career and technical education family and consumer sciences teachers. Every teacher licensure student must demonstrate achievement of the identified teacher licensure standards. Standards will be assessed in all core courses including FCEdS 206, 214, 280, 306, 318, 403, 413, 417, and 460. For additional teacher education requirements, see *Teacher Education*.

Graduates in Family and Consumer Sciences Education and Studies have a broad understanding of individual and family well-being. Graduates apply knowledge of family and consumer sciences content in global professional settings. They use research findings to improve the well-being of individuals, families, and communities. Due to the integrative and synergistic nature of family and consumer sciences, graduates address and act on complex problems confronting individuals, families, and communities.

Opportunities are available for obtaining a minor from other programs through careful selection of elective credits and consultation with an adviser. For example, students pursuing the Communications and Professional Studies options are encouraged to consider obtaining a minor in journalism and mass communications or in one of the subject matter areas of family and consumer sciences such as family finance, housing, and policy. They also are encouraged to enhance their program by electing relevant additional courses in their area of interest. Students in the Teacher Licensure option may choose to add an additional endorsement such as Health Education or Coaching Interscholastic Athletics.

The program offers a minor in family and consumer sciences education. The minor is earned by successfully completing 15 credits including FCEdS 206, 306, 415, and 418. See program for details.

Communication Proficiency Requirement: C or better in Engl 150 and 250.

Graduate Study

The program offers work for the degrees master of science, master of education, and doctor of philosophy, each with the major, family and consumer sciences education. The M.S. degree requires a thesis; the M.Ed. degree requires a creative component; the Ph.D. requires a dissertation. Minors are available. The Family and Consumer Sciences Education Leadership Academy provides opportunity for completion of a graduate degree through condensed summer courses and distance education delivery. For additional information see http://www.aeshm.hs.iastate.edu/academy/.

Programs for advanced degrees with a major in family and consumer sciences education are tailored to fit the educational background, experience, and professional goals of the student. Areas of study provided by the department include program planning, curriculum, evaluation, research methods, supervision and administration, international education and development, and teacher education. Opportunities are available for strengthening one's background in subject matter in other programs in the College of Human Sciences.

Students who complete a graduate program are professional family and consumer sciences educators and teacher educators who foster program planning, implementation, and evaluation at state, national, and international levels. They are producers and disseminators of research and scholarship in family and consumer sciences education and are leaders in programs and services for clientele in diverse settings.

Courses primarily for undergraduate students

FCEdS 102. Learning Community Seminar. Cr. R. Repeatable. F.S. Learning Community seminar for Human Sciences entering transfer students. Group social and professional activities. Satisfactory-fail only.

FCEdS 110. Orientation. (1-0) Cr. arr. F.S. Orientation to the university, the college, and the college curricula. Adjustment to the university; discussion of student responsibilities; interpersonal, critical thinking, and study skills; and management of time and energy. Development of a long-term curriculum plan. Satisfactory-fail only.

FCEdS 206. Professional Roles in Family and Consumer Sciences. (2-3) Cr. 3. F. Historical development of family and consumer sciences. Overview of various roles in professional settings, e.g., community agencies, secondary schools, business and industry, Cooperative Extension. Completion of a 20-hour practicum in an educational setting.

FCEdS 214. Electronic Learning Portfolios. (0-2) Cr. 1. Repeatable. F. Development of an electronic learning portfolio. Selection, reflection and demonstration of evidence of achievement of program outcomes. Satisfactory-fail only.

FCEdS 280. Pre-Student Teaching Experience in Family and Consumer Sciences Education. (0-2) Cr. arr. Repeatable. F.S. *Prereq: Admission to teacher education.* Laboratory experience in foods, textiles and human development in family and consumer sciences secondary programs. Observation of family and consumer sciences laboratories in diverse classrooms. Planning, implementing, managing and assessing laboratory lessons in family and consumer sciences. Satisfactory-fail only.
A. Practicum in FCS Labs
B. Practicum in diverse settings

FCEdS 306. Educational Principles for Family and Consumer Sciences. (2-2) Cr. 3. F. *Prereq: 15 credits in family and consumer sciences subject matter; enrollment in Sp Ed 450.* Principles of teaching and learning applied to family and consumer sciences content. Instructional methods appropriate for formal and nonformal educational settings. Specific strategies for diverse audiences. May be used for family life certification.

FCEdS 318. Occupational, Career and Technical Programs. (Dual-listed with 518). (2-0) Cr. 2. S. *Prereq: 206 and 400 hours work experience in a family and consumer sciences related job.* Planning and implementing programs in occupational family and consumer sciences including FCCLA. Impact of selected legislation on family and consumer sciences programs. Techniques for cooperative education, school-to-work, and work-based education programs. May be used toward Multi-Occupation Cooperative endorsement.

FCEdS 403. Learner Assessment for Family and Consumer Sciences Programs. (2-2) Cr. 3. S. *Prereq: Enrollment in 413.* Philosophy of learner assessment. Development and critique of tests and authentic assessment tools to measure cognitive, affective, and psychomotor learning and to evaluate processes, performances, products, and dispositions. Procedures for grading, interpreting, and reporting assessment data.

FCEdS 413. Curriculum Planning for Family and Consumer Sciences and Family Life Education. (2-2) Cr. 3. S. *Prereq: 306.* Philosophy of career and technical education. Curriculum development in family and consumer sciences programs for school settings. Accommodating exceptional learners. May be used for family life certification.

FCEdS 415. Program Planning and Evaluation in Family and Consumer Sciences. (3-0) Cr. 3. S. *Prereq: 15 credits in Family and Consumer Sciences subject matter.* Program development principles including needs analysis, planning, instruction, promotion, evaluation, grant writing and reporting. Approaches appropriate for diverse groups. Environmental and cultural conditions affecting programs. Nonmajor graduate credit.

FCEdS 417. Supervised Teaching in Family and Consumer Sciences. Cr. arr. Repeatable. F.S. *Prereq: 413, 24 credits in family and consumer sciences subject matter, cumulative grade point of 2.50, full admission to teacher education.* Supervised teaching experience in secondary schools. Examination of ways to implement actions that reflect a professional Philosophy of family and consumer sciences for teaching middle and high school level students. Reservation required.
A. Vocational family and consumer sciences. Cr. 8.
B. Family and consumer sciences. Cr. 3 to 8.

FCEdS 418. Supervised Experiences in a Professional Setting. Cr. arr. Repeatable. F.S.SS. *Prereq: 24 credits in family and consumer sciences.* Supervised professional experience in an approved setting such as Cooperative Extension, business, community, human Service, or government agency. Reservation required.
A. Communications. Prereq: 415, 24 credits in family and consumer sciences.
B. Professional Studies. Prereq: 421, 24 credits in family and consumer sciences

FCEdS 460. Capstone Seminar. (1-0) Cr. 1. S. *Prereq: senior classification in Family and Consumer Sciences Education and Studies.* Ways professionals work across disciplines to address contemporary social issues that affect individuals and families. Methods to initiate public policy at the local, national, and international levels. Transition from student to professional role.

FCEdS 490. Independent Study. Cr. arr. F.S.SS.
A. Adult Education
C. Curriculum
D. Evaluation
E. Cooperative Extension
G. General
H. Honors
I. International
K. Occupational Education
N. Leadership and Human Relations
P. Special Needs/Mainstreaming
R. Vocational Education
S. Technology and Distance Education

Courses primarily for graduate students, open to qualified undergraduate students

FCEdS 500. Short Course: Current Family and Consumer Sciences Offerings. Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education.*
A. Adult Education
B. Supervision and Administration
C. Curriculum
D. Evaluation
E. Teacher Education
F. Occupational, Career and Technical Education
G. General
H. Research Methodology
I. International Education
J. Middle Level Education

FCEdS 501. Trends, Issues and Public Policy. (3-0) Cr. 3. Repeatable. Alt. SS., offered 2010. *Prereq: 6 credits in family and consumer sciences or education.* Discussion of current topics affecting the family and consumer sciences profession.

FCEdS 504. Intellectual Foundations of Family and Consumer Sciences Leadership. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Exposure to a variety of selected readings that provide an intellectual foundation and framework for the family and consumer sciences profession. Connects the historical and Philosophical structure of the profession with perspectives leading to innovative professional action.

FCEdS 506. Curriculum Development in Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2011. Analysis and development of family and consumer sciences curriculum related to Philosophy, design and adaptability within public education programming as influenced by subject matter, professional, national and state educational standards and legislation.

FCEdS 507. Program Development in Family and Consumer Sciences. (3-0) Cr. 3. SS. *Prereq: Professional experience in family and consumer sciences or related area.* Application of principles of program development to formal and nonformal educational settings, e.g., secondary school family and consumer sciences programs, training positions in business, Cooperative Extension, human Services agencies.

FCEdS 508. Models for Teaching Family and Consumer Sciences. (3-0) Cr. 3. S. *Prereq: 6 credits in family and consumer sciences.* Selecting teaching strategies and instructional materials based on theories of learning and human development that reflect a professional Philosophy of family and consumer sciences. Application to formal and nonformal educational settings with diverse audiences.

FCEdS 511. Research Methods. (3-0) Cr. 3. F. *Prereq: Graduate classification.* An overview of diverse research approaches focusing on methods for collecting and analyzing quantitative and qualitative data. Critique of research reports and development of research proposals.

FCEdS 515. Assessment in Family and Consumer Sciences. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Introductory Statistical and program development skills.* Role of assessment in family and consumer sciences education programs. Planning and constructing test items and other assessments of school and nonschool learning.

FCEdS 518. Occupational, Career and Technical Programs. (Dual-listed with 318). (2-0) Cr. 2. S. *Prereq: 400 hours work experience in a family and consumer sciences related job.* Planning and implementing programs in occupational family and consumer sciences including FCCLA. Impact of selected legislation on family and consumer sciences programs. Techniques for cooperative education, school-to-work, and work-based education programs. Critique of national occupational competency standards. May be used toward Multi-Occupation Cooperative endorsement.

FCEdS 519. Reflective Human Action Leadership. (2-0) Cr. 2. Alt. SS., offered 2011. Examination of the meaning and qualities of reflective human action. Analysis of the roles that reflective human action plays in Society, the profession, and family life. Critically and imaginatively address social needs, identify meaningful leadership opportunities and engage in worthwhile actions that benefit individuals, families and communities.

FCEdS 520. Supervision in Family and Consumer Sciences Programs. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: Professional experience or 6 credits in family and consumer sciences.* Examination of change, communication and leadership theories as related to supervision. Application of conferencing techniques, observation skills, and performance evaluation to professional leadership positions in educational settings.

FCEdS 521. International Perspectives of Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2010. *Prereq: 6 credits in family and consumer sciences.* Examination of family and consumer sciences from an international perspective; focus on the roles and responsibilities of women in development. Application and adaptation of content to working with families in other countries and cultures. Student participation in cultural activities and critique of international research articles.

FCEdS 524. International Study Abroad Seminar. Cr. arr. Repeatable. F.S.SS. Orientation to study abroad program considering topics related to country and location; travel arrangements and preparation for study abroad; on-site fieldwork and academic experiences in an international setting. Individually-developed research project on a topic related to study abroad.

FCEdS 579. Educational and Critical Science Perspectives of Family and Consumer Issues. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: Graduate classification.* Examination of social issues within a family and community context from a critical science perspective. Application of critical thinking, diverse perspectives, and reflection to family and social issues. Analysis of family and consumer sciences Philosophy, theory, and research to current social issues.

FCEdS 590. Special Topics. Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education.*
A. Adult Education
B. Administration
C. Curriculum
D. Evaluation E. Teacher Education
F. Occupational, Career and Technical Education
G. General
H. Research Methodology
I. International Education
J. Educational Gerontology
K. Leadership and Human Relations
L. Special Needs
M. Family Life Education
N. Human Sexuality
O. Technology
P. Supervision
Q. Family/Individual Health
R. Consumer Education
S. Distance Education
T. Professional Communications

FCEdS 593. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education.* Concentrated group study of new developments in family and consumer sciences education. Sections offered will vary from year to year.

FCEdS 599. Creative Component. Cr. arr. *Prereq: 9 graduate credits in Family and Consumer Sciences Education.*

Courses for graduate students

FCEdS 601. Advanced Philosophical Critique of Professional Issues. (3-0) Cr. 3. Alt. SS., offered 2010. A critical science examination of current topics affecting the family and consumer sciences profession. Concentrated group study with implications for action. Critical science approach applied to current topics, issues, and public policy. Group examination and exposure to various components of a contemporary problem within a global context.

FCEdS 607. Curriculum Theory and Philosophy in Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: 507 or curriculum development experience.* Integration of Philosophies of education and family and consumer sciences into an operative Philosophy of curriculum development. Study of various curriculum theories and approaches to curriculum development.

FCEdS 610. Seminar. Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Exploration of trends and issues in the profession. Satisfactory-fail only.

FCEdS 611. Program Evaluation in Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2010. *Prereq: 511, 515.* Application of program evaluation approaches and models to family and consumer sciences programs. Standards for program evaluation.

FCEdS 618. Coordination of Educational Programs in Family and Consumer Sciences. (2-0) Cr. 2. Alt. SS., offered 2011. *Prereq: 520.* Approaches to coordination of family and consumer sciences programs in adult education, extension, state department of education, and teacher education. Study of undergraduate programs in family and consumer sciences education, observation and participation in undergraduate courses, and practicum experience.

FCEdS 620. Theories of Administration in Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2010. *Prereq: Professional Experience.* Review of administrative theory; application to family and consumer sciences programs with emphasis on higher education. Administrative leadership roles and their interrelationships. Consideration of current issues.

FCEdS 626. Advanced Research Methods in Family and Consumer Sciences. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: 511.* Examination of various modes of inquiry used to conduct research in educational and social arenas culminating in development of a research project. Empirical/analytic, interpretive and critical/post-modern inquiries in relation to human context will be discussed.

FCEdS 690. Family and Consumer Sciences Education and Studies Advanced Topics. Cr. arr. *Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E.* Topics for the independent study will be in any of the following areas:
A. Adult Education
B. Administration
C. Curriculum
D. Evaluation
E. Teacher Education
F. Occupational, Career and Technical Education
G. General
I. International Education
J. Educational Gerontology
K. Leadership and Human Relations
L. Special Needs
M. Family Life Education
N. Human Sexuality
O. Technology
P. Supervision
Q. Family/Individual Health
R. Consumer Education
S. Distance Education
T. Professional Education
U. Research Methodology

FCEdS 699. Research. Cr. arr. Repeatable.

Family Financial Planning

www.hs.iastate.edu/online/mfcs/ffp/

(Interinstitutional Graduate Program)

Participating Faculty:

Iowa State University
College of Human Sciences
Pat Swanson, pswanson@iastate.edu

Kansas State University
College of Human Ecology
John Grable, grable@humec.ksu.edu
Esther Maddux, emaddux@humec.ksu.edu

Montanta State University
College of Education, Health and Human Development
George W. Haynes, haynes@montana.edu
Deborah C. Haynes, dhaynes@montana.edu

University of Nebraska
College of Human Resources and Family Sciences
Sheran Cramer, scramer@unomaha.edu

North Dakota State University
College of Human Development and Education
Greg Sanders, greg.sanders@ndsu.edu
Margaret Fitzgerald, margaret.fitzgerald@ndsu.edu

Oklahoma State University
College of Human Environmental Sciences
David Fournier, frcddgf@okstate.edu
Glenn Muske, muske@okstate.edu

South Dakota State University
College of Family and Consumer Sciences
Bernadine Enevdoldsen, bernadine.enevoldsen@sdstate.edu
Rui Yao, rui.yao@sdstate.edu

Family Financial Planning is an interinstitutional distance education program offered through the Web. The student selects a home institution, which grants the degree. After admission at the home institution, the student takes courses from each of the seven institutions: Iowa State University, Kansas State University, Oklahoma State University, Montana State University, University of Nebraska, North Dakota State University, and South Dakota State University.

At Iowa State University, Family Financial Planning is a specialization within the Master of Family and Consumer Sciences degree program (MFCS-FFP) that consists of 42 semester credits. Neither a thesis nor a creative component is required. Students typically complete the program in three years while employed full time. A computer with minimum specifications, Web access, and an email address are required for completing the program.

FFP Graduate Certificate Program
The Graduate Certificate in Family Financial Planning consists of the six courses from the MFCS-FFP that contain the competencies required for the CFP® Certification Examination. Students interested in attaining the CFP® credential and not a master's degree should enroll in the certificate program.

Courses included in the FFP graduate certificate program include: FFP 530, 540, 545, 555, 565, 583. Both the Master's degree and Graduate Certificate programs at Iowa State University are registered with Certified Financial Planner Board of Standards Inc. As a CFP Board-registered Program, ISU FFP courses satisfy CFP Board's education requirement, allowing an individual to sit for the CFP® Certification Examination.

Iowa State University does not certify individuals to use the CFP®, CERTIFIED FINANCIAL PLANNER™ title. CFP certification is granted only by Certified Financial Planner Board of Standards Inc. to those persons who, in addition to completing an educational requirement such as this CFP Board-Registered Program, have met its ethics, experience and examination requirements. (CFP Board of Standards web site: www.cfp.net.)

Certified Financial Planner Board of Standards Inc. owns the certification marks CFP®, CERTIFIED FINANCIAL PLANNER™ and the federally registered CFP (with flame logo), which it awards to individuals who successfully complete initial and ongoing certification requirements.

Admission Procedures: Admission to the FFP Certificate Program requires exactly the same procedures as admission to the Graduate College. See *Graduate College* section in the catalog.

Registration
Students choosing to receive their degree from Iowa State University complete all the admissions, registration and fee payment processes through ISU.

Courses primarily for graduate students

FFP 520. Family Systems. (3-0) Cr. 3. F.S. Research and theory related to family functioning throughout the life cycle, especially financial decision making during crisis and conflict. Emphasis on factors that shape family values, attitudes, and behaviors from a multicultural perspective. New and emerging issues critical to family functioning are addressed.

FFP 525. Family Economics. (3-0) Cr. 3. SS. Major issues related to the economics of families including household production, and human capital development; the economics of crises, public policy and family life cycle spending, saving and borrowing; new and emerging issues in the field of family economics; special attention to the role of ethics in family economic issues. A theoretical and research perspective are used to illuminate the concepts in the course.

FFP 530. Fundamentals of Family Financial Planning. (3-0) Cr. 3. F. The nature and functioning of financial systems, including currencies, markets, monetary and fiscal policy, and supply/demand for land, labor, and capital. Focus is on the impact of global financial interdependence on individuals and families in the U.S. Current and emerging issues, as well as current research and theory relative to financial systems.

FFP 535. Financial Counseling. (3-0) Cr. 3. S. Theory and research regarding the interactive process between the client and the practitioner, including communication techniques, motivation and esteem building, the counseling environment, ethics, and methods of data intake, verification, and analysis. Other topics include legal issues, compensation, uses of technology to identify resources, information management, and current or emerging issues.

FFP 540. Estate Planning for Families. (3-0) Cr. 3. S. Fundamentals of the estate planning process, including estate settlement, estate and gift taxes, property ownership and transfer, and powers of appointment. Tools and techniques used in implementing an effective estate plan, ethical considerations used in providing estate planning services, and new and emerging issues in the field. Case studies provide experience in developing estate plans suitable for varied family forms.

FFP 541. Housing and Real Estate in Family Financial Planning. (Cross-listed with HD FS). (3-0) Cr. 3. SS. www only. The role of housing and real estate in the family financial planning process, including taxation, mortgages, financial calculations, legal concerns, and ethical issues related to home ownership and real estate investments. Emphasis on emerging issues in the context of housing and real estate.

FFP 545. Retirement Planning, Employee Benefits, and the Family. (3-0) Cr. 3. F. Study of micro and macro considerations for retirement planning. Survey of various types of retirement plans, ethical considerations in providing retirement planning services, assessing and forecasting financial needs in retirement, and integration of retirement plans with government benefits.

FFP 555. Insurance Planning for Families. (3-0) Cr. 3. S. In-depth study of risk management concepts, tools, and strategies for individuals and families, including life insurance; property and casualty insurance; liability insurance; accident, disability, health, and long-term care insurance; and government-subsidized programs. Current and emerging issues and ethical considerations relative to risk management. Case studies provide experience in selecting insurance products suitable for individuals and family study of investment options for clients, including common stocks, fixed income securities, convertible securities, and related choices. Relationships between investment options and employee/employer benefit plan choices. Current and emerging issues and ethics are included.

FFP 565. Personal Income Taxation. (3-0) Cr. 3. F. In-depth information on income tax practices and procedures including tax regulations, tax return preparation, the tax audit processes, the appeals process, preparation for an administrative or judicial forum, and ethical considerations of taxation. New and emerging issues related to taxation. Family/individual case studies provide practice in applying and analyzing tax information and recommending appropriate tax strategies.

FFP 570. Professional Practices in Financial Planning. (3-0) Cr. 3. S. Challenges of managing financial planning practices including, but not limited to: business valuation, personnel, marketing, client services, ethics and technological applications. Relying both on a theoretical as well as an applied approach, students analyze case studies that provide relevant, practical exposure to practice management issues, with a strong emphasis on current research findings.

FFP 583. Investing for the Family's Future. (Cross-listed with HD FS). (3-0) Cr. 3. F. *Prereq: HD FS 483.* Evaluation of investment markets for the household. Analysis of how families choose where to put their savings. Emphasis is on using the family's overall financial and economic goals to help inform investment choices.

FFP 591. Practicum. Cr. arr. F.S.SS. Supervised experience in family financial planning.

FFP 595. Financial Planning - Case Studies. (3-0) Cr. 3. F.SS. *Prereq: FFP 530, 540, 545, 555, 565, 583.* Professional issues in financial planning, including ethical considerations, regulation and certification requirements, communication skills, and professional responsibility. Students are expected to utilize skills obtained in other courses and work experiences in the completion of personal finance case studies, the development of a targeted investment policy, and other related financial planning assignments.

Finance

Marvin Bouillon, Chair of Department

University Professor: Power

Professors: Carter, Cowan, Hayes, Stover

Associate Professors: Campbell, Dark, Sapp

Assistant Professors: Borisova, Floros, Porter, Yunus

Lecturers: Hoff, Mccullough, Nappinnai, Premkumar

Undergraduate Study

For undergraduate curriculum in business, major in finance, see *College of Business, Curricula*.

In addition to the basic business requirements, finance majors must also complete: (1) Fin 310, 320; (2) select four from Fin 330, 361, 371, 380, 415, 424, 425, 427, 445, 462, and 472 of which two must be at the 400 level; and (3) select one from Acct 383, 386, 387, any 400-level accounting course or Finance courses listed in (2) above. Statistics 326 is highly recommended to be taken prior to Fin 310 and Fin 320. Statistics 326 is required for Fin 380 and 400 level finance courses.

The courses in finance constitute a broad program of study designed to provide a descriptive, behavioral, and analytical background of financial management to enable students to qualify for opportunities in financial services, insurance, brokerage, government, real estate, and financial management of business enterprises. Finance is also an excellent area for those who wish to become more knowledgeable as consumers, particularly in the fields of investments, insurance, and real estate.

Areas of study in the field of finance include financial management, investments, insurance, real estate, and financial services. Upper-level courses include a review of contemporary literature in the field, case studies, and financial problem analysis integrating finance courses previously taken.

The instructional objective of the Finance program is to provide a well-rounded professional education in finance. Such an education should provide the student with: (1) a mastery of basic financial concepts and methods of analysis; (2) an

understanding of financial operations in a global setting and of the role of financial institutions in the economics system; (3) an ability to effectively communicate and work with others as the finance member of a team; (4) an ability to demonstrate leadership capabilities in financial analysis and portfolio management.

The department also offers a minor for non-Finance majors in the College of Business. The minor requires 15 credits from an approved list of courses, of which 9 credits must stand-alone. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

The department participates in the M.B.A. full-time and part-time programs. The M.B.A. program is a 48-credit, non-thesis, noncreative component curriculum. Twenty four of the 48 credits are core courses and the remaining 24 are graduate electives. Within the M.B.A. program, students may develop an area of specialization in finance. This specialization requires that 12 of the 24 credits of the graduate electives be from an approved list of graduate finance courses.

Courses primarily for undergraduate students

Fin 301. Principles of Finance. (3-0) Cr. 3. F.S.SS. *Prereq: Acct 284; Econ 101, Stat 226.* Introduction to financial management with emphasis on corporate financing and investment decision making, time value of money, asset valuation, capital budgeting decision methods, cash budgeting, and financial markets.

Fin 310. Corporate Finance. (3-0) Cr. 3. F.S.SS. *Prereq: 301.* Theory used in a firm's investment and financing decisions. Analysis of environment in which financial decisions are made; applications of analytical techniques to financial management problems.

Fin 320. Investments. (3-0) Cr. 3. F.S.SS. *Prereq: 301.* Introduction to various investment media and markets from the viewpoint of the individual investor. Emphasis on mechanics of trading, behavior of security prices, corporate stocks and bonds, mutual funds, individual asset and portfolio selection techniques, and performance evaluation.

Fin 327. Fixed Income Securities. (3-0) Cr. 3. *Prereq: 301; Stat 326.* Valuation of fixed income securities, including pricing conventions, term structure of interest rates, default, duration, and hedging of interest rate risk. Analysis of active and passive investment strategies for managing fixed income portfolios. Nonmajor graduate credit.

Fin 330. Financial Markets and Institutions. (3-0) Cr. 3. F.S. *Prereq: 301.* Introduction to the structure and operations of the United States financial system and its markets and institutions. Emphasis on developing and integrated understanding of markets and financial service providers including global linkages.

Fin 361. Personal Risk Management and Insurance. (3-0) Cr. 3. F.S. *Prereq: Econ 101.* Risk concepts and the use of insurance by individuals and families. Emphasis on the insurance mechanism and methods of dealing with income, property, and liability risks.

Fin 371. Real Estate Principles. (3-0) Cr. 3. SS. *Prereq: Econ 101.* Legal, economic, social and financial aspects of real estate, including property rights, contracts, mortgage instruments, tax factors, brokerage, valuation, risk and return analysis, financing techniques, and investments.

Fin 415. Business Financing Decisions. (3-0) Cr. 3. *Prereq: 301 and Stat 326.* In depth study of the firm's external financing decision. Emphasis on the development of cash flow statements, projected financing needs and the selection of the appropriate financing instrument. Focus on case studies and application of developed techniques on actual field project. Nonmajor graduate credit.

Fin 424. Financial Futures and Options. (3-0) Cr. 3. *Prereq: 320 and Stat 326.* Advanced study of the pricing and use of derivative market instruments, current topics and issues. Nonmajor graduate credit.

Fin 425. Security Analysis and Portfolio Management. (3-0) Cr. 3. F.S. *Prereq: 320, Stat 326 and permission of instructor.* Advanced study of security analysis, security selection techniques and portfolio management. Emphasis on the applications of methods learned via the selection and evaluation of a portfolio of actual securities purchased in securities markets in the U.S. or abroad. Tracking and periodic reporting of the portfolio's performance relative to standard benchmarks is also required.

Fin 428. Advanced Fixed Income Analysis and Portfolio Management. (3-0) Cr. 3. *Prereq: 327, 320, Stat 326 and permission of the instructor.* Advanced analysis of fixed income markets and securities, including valuation and trading of treasury securities, corporate bonds, mortgage backed securities. Students are also required to manage a fixed income portfolio for an institutional investor. A top-down approach to portfolio management is assumed, with active bets taken on market direction, duration, yield curve, and credit spreads. Nonmajor graduate credit.

Fin 445. Bank Management Decisions. (3-0) Cr. 3. F.S. *Prereq: Stat 326 and Fin 330 or Econ 353.* Analysis of operations of depository financial institutions from management viewpoint. Emphasis on evaluating performance, policy formation, asset and liability management, the role of capital, and the operating environment. Nonmajor graduate credit.

Fin 462. Corporate Risk Management and Insurance. (3-0) Cr. 3. F. *Prereq: 301 and Stat 326.* Analysis of an organization's approaches to the management of price, credit, and pure risk. Emphasis on the consideration and selection of risk control and financing treatments and the decision making framework underlying the alternatives selected. Covers commercial insurance, self-insurance, and alternative financing arrangements. Nonmajor graduate credit.

Fin 472. Real Estate Finance. (3-0) Cr. 3. *Prereq: 301 and Stat 326.* Introduction to the techniques of assessing the value of real estate and real estate financing instruments. Nonmajor graduate credit.

Fin 480. International Finance. (3-0) Cr. 3. F.S. *Prereq: 301 and Stat 326.* Advanced study of contemporary topics and issues in international finance.

Fin 490. Independent Study. Cr. arr. Repeatable. *Prereq: 301, Stat 326 and permission of instructor.*

Fin 499. Finance Internship. (3-0) Cr. arr. F.S.SS. *Prereq: GPA 2.5; permission of internship coordinator; Stat 326; 499A: 330, 445; 499B: 361; 499C: 301 plus 3 additional credits in finance; 499D: 320.* Supervised experience in a private sector banking, insurance, real estate or investments organization or in a governmental agency that regulates such organizations. Satisfactory-fail only.
A. Banking
B. Insurance
C. Real Estate
D. Investments

Courses primarily for graduate students, open to qualified undergraduate students

Fin 505. Financial Valuation and Corporate Financial Decisions. (2-0) Cr. 2. *Prereq: Graduate classification.* Shareholder wealth maximization as the goal of the firm, financial Math, valuation of securities, the financial market place as the test of value, estimation of cost of capital, capital investment decisions, capital structure policy, working capital management.

Fin 510. Advanced Financial Management. (3-0) Cr. 3. *Prereq: 505.* Modern theory of corporate finance and its application to financial management problems. Advanced treatment of firm's investment, financing, and dividend decisions and survey of related research. Examples of potential topics are the investment banking process, convertible securities and warrants, financial derivatives, asset leasing, mergers and divestitures, leveraged buyouts, international financial management, executive compensation, and pension fund strategy.

Fin 515. Case Studies in Financial Decision Making. (3-0) Cr. 3. *Prereq: 505.* This course focuses on case studies to develop an integrated set of financial decisions. Topic areas include fixed asset, working capital, capital structure, dividend and merger/acquisition decisions. The objective of the course is to examine different firm settings and establish a framework within which to apply financial tools.

Fin 520. Investments. (3-0) Cr. 3. *Prereq: 505.* A comprehensive survey of the classical and contemporary theories of optimum portfolio construction; determinants of risk-return trade-off in selection of securities; emphasis on the theory and evidence of efficient capital markets and implications for security selection and portfolio management.

Fin 534. Financial Derivatives. (3-0) Cr. 3. F. *Prereq: Graduate classification.* An applied course in derivative markets. Topics covered include futures and options markets, option pricing, swaps, use and rating of insurance products, and alternative forms of reinsurance. Emphasis will be placed on agricultural commodity markets, but energy, interest, currency and stock index contracts will also be covered.

Fin 572. Real Estate Finance. (3-0) Cr. 3. *Prereq: MBA Core.* Survey of techniques for assessing the value of real estate assets. Introduction to real estate financing instruments, their use and appropriateness.

Fin 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor. For students* wishing to do individual research in a particular area of finance.

Food Science and Human Nutrition

www.fshn.hs.iastate.edu

Ruth MacDonald, Chair of Deartment

Distinguished Professors: Birt, Sebranek

Distinguished Professors (Emeritus): N. Jacobson, Roderuck

University Professors: Murphy, P. White, Wilson

University Professors (Emeritus): Glatz, Hammond, Parrish

Professors: Alekel, Hendrich, Hurburgh, Jane, L. Johnson, MacDonald, Nikolau, Prusa, Reitmeier, Robson, Sharp, Spurlock, Van Leeuwen, Wurtele

Professors (Emeritus): Dupont, Garcia, Kaplan, Kraft, Lagrange, Mcmillan, Runyan, Rust, Schafer, Stromer, Swan, Topel, Walker

Professor (Collaborator): Pometto

Associate Professors: Boylston, Campbell, Ford, Love, Mendonca, Reddy, Schalinske, Wang, W. White

Associate Professors (Emeritus): Bohnenkamp, Madden, Mccomber, Oakland

Associate Professor (Collaborator): Marquis

Assistant Professors: Beattie, Brehm-Stecher, Hollis, Jung, Lamsal, Lanningham-Foster, Litchfield, Rowling

Assistant Professors (Collaborators): Beauvais, Klucinec, Lopes

Lecturers: Bassler, Martin

Lecturers: Beirman, Bergquist, Dahlstrom, Hanson, Oldham, St. Germain, Strohl, Svendsen

Senior Clinician: Anderson

Clinicians: Barclay, J. Johnson

The Department of Food Science and Human Nutrition is jointly administered by the College of Agriculture and Life Sciences and the College of Human Sciences. All curricula offered by the department are available to students in either college. These curricula include culinary science,

dietetics, diet and exercise, food science, and nutritional science. Visit the department web site at: www.fshn.hs.iastate.edu/.

Undergraduate Study

Culinary science is an interdisciplinary degree combining a strong food science foundation with acquisition of culinary skills. The program includes chemistry, organic chemistry, biology, microbiology, and biochemistry as well as quantity food production, fine dining management, and food safety and sanitation. Internships in the food industry and culinary business are required. Culinary science graduates are qualified to work as managers and specialists in food research, product development, culinary applications, and food marketing and sales.

The Didactic Program in Dietetics (DPD) is accredited by the American Dietetic Association (ADA) . The dietetics undergraduate curriculum meets the academic requirements as the DPD. Additionally, the curriculum for concurrent Bachelor's and Master's degrees in diet and exercise meets the academic requirements of the DPD. Graduates of the program are eligible to apply for admission to accredited/approved dietetic internships/supervised practice programs. Upon successful completion of the experience program, graduates are eligible to take the national examination administered by the Commission on Dietetic Registration to become a Registered Dietitian (R.D.) and to practice in the field of dietetics. The dietetic program includes study in basic sciences, nutrition, and food science with applications to medical dietetics, nutrition counseling and education, and community nutrition. Foodservice management is also an important aspect of the program. Graduates work in clinical settings, consulting, food companies, food services, sports or athletic programs, corporate wellness programs, care facilities for patients from neonatal to geriatric, and community or school health programs. There is a $30 fee for a statement of verification of completion of the DPD. For information about verification statements provided to non-ISU students or students with degrees from international universities, see the departmental website:www.dietetics.iastate.edu/.

Food science is a discipline in which the principles of biological and physical sciences are used to study the nature of foods, the causes of their deterioration, and the principles underlying the processing and preparation of food. It is the application of science and technology to the provision of a safe, wholesome, and nutritious food supply. Biotechnology and toxicology interrelate with food science in the area of food safety. In the food industry, food scientists work in research and development of products or processes, production supervision, quality control, marketing and sales, test kitchens and recipe development, product promotion and communication. Food scientists also serve in government regulatory agencies and academic institutions.

Three options are available in food science: food science and technology, food science and industry, and consumer food science. The food science and technology and food science and industry options are approved by the Institute of Food Technologists, the national professional organization of food science. Students interested in quality control/assurance; production supervision; management and sales; or research careers in the food industry, government, or academia should elect either the food science and technology or the food science and industry option. Students who wish to go to graduate or professional schools or who are College of Agriculture Scholars of Excellence should elect food science and technology. Students who wish to emphasize business, journalism, or special aspects of food science should elect food science and industry. Students interested in test kitchen positions, food product formulation and recipe development, food promotion, and consumer services in government and industry should elect the consumer food science option.

Students who wish to combine education in engineering with food science may select additional courses in chemical or agricultural engineering. Double majors are available and may require an additional year.

Nutritional science offers students a strong basic science education along with human nutrition expertise that enables them to gain the knowledge and skills necessary to work in research laboratories of colleges and universities, government agencies, industries, and foundations. The curriculum can Serve as a preprofessional program for medicine, dentistry, veterinary medicine, or for graduate study in nutrition or other biological sciences.

Students graduating with degrees in culinary science, dietetics, diet and exercise, food science, or nutritional science will be able to: 1) demonstrate a high level of technical competence in their chosen field, perform successfully in a graduate program, supervised practice program or entry-level professional position; 2) communicate effectively as professionals; 3) successfully solve complex problems on their own and as members of a team; 4) correctly interpret and critically evaluate research literature as well as data from professional practice; 5) critically evaluate information related to food science and nutrition issues appearing in the popular press; 6) prepare and deliver effective presentations, orally and in writing, of technical information to professionals and to the general public; 7) thoughtfully discuss ethical, social, multicultural, and environmental dimensions of issues facing professionals in their chosen field.

Communication Proficiency is certified by a grade of C or better in 6 credits of coursework in composition (Engl 150 and 250 or other communication-intensive courses) and a grade of C or better in 3 credits of coursework in oral communication.

A combined Bachelor of Science and Master of Science (B.S./M.S.) degree in diet and exercise is available. The program is jointly administered by the Department of Food Science and Human Nutrition (FS HN), within the College of Agriculture and Life Sciences and College of Human Sciences, and the Department of Kinesiology within the College of Human Sciences. Students interested in this program enroll as freshmen in the pre-diet and exercise program. In the fall of the junior year, students apply for admission to the B.S./M.S. program. Students not accepted into the program continue toward completion of a B.S. degree in dietetics or kinesiology and health. Coursework has been designed to facilitate a 4-year graduation date for those students not accepted into the program and electing to complete a single undergraduate degree. Students accepted into the program will progress toward completion of B.S./M.S. degrees in diet and exercise.

Well qualified students in food science and technology or in nutritional science who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both B.S. and M.S. degrees in which students take both undergraduate and graduate courses. See the B.S./M.S. program under *Graduate Study.*

The department offers work for minors in food science and in nutrition and participates in the interdepartmental minor in food safety. See department office or web site for requirements: www.fshn.hs.iastate.edu/ugrad/ugminors.php.

Food Safety Minor

Patricia A. Murphy (Coordinator)

The Interdepartmental food safety minor is designed to provide undergraduate students with exposure to the principles of food safety to complement their current major and offer new opportunities for their future careers. Depending on the student's major, the minor enhances the student's expertise in food safety issues pertinent to the student's major. Student learning outcomes include: awareness of food safety issues as they appear in each step of the food chain; ability to analyze a situation, identify food safety problems, use resources to gain additional information; develop a procedure or solution to identified problems; examine proposed solutions for viability and effectiveness; and to be able to speak and write about food safety issues. Graduates with a food safety minor are better prepared for employment in agricultural, medical, and veterinary medical agencies and with state, national and international businesses.

The food safety minor requires 15 credits of coursework with 9 credits from 3 core courses and elective courses to supplement the training in the minor. See approved list for minor courses at www.fshn.hs.iastate.edu/ugrad/ugminors.php.

Postbaccalaureate Program

The dietetic internship program has received initial accreditation from the American Dietetic Association. For more information, refer to Special Interest Programs listed under the College of Human Sciences or visit the website at www.dietetics.iastate.edu. There is a nonrefundable application fee of $75 and a program fee of $500 payable upon acceptance into the program.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in food science and technology and in nutritional sciences, and minors in food science and technology and in nutrition. Graduate work in meat science is offered as a co-major in animal science and food science and technology.

Prerequisite to major work is a baccalaureate degree in food science, nutrition, or other physical or biological sciences or engineering that is substantially equivalent to those at Iowa State University.

Students taking major work for the degree doctor of philosophy either in food science and technology or in nutritional sciences may choose minors from other fields including anthropology, chemistry, biochemistry, economics, education, journalism, microbiology, psychology, physiology, sociology, statistics, toxicology, or other related fields.

The interdepartmental graduate program in nutritional sciences, administered through the Graduate College, under the auspices of the Chairs of FSHN and Animal Science, will provide the structure for coordinating and enhancing interdisciplinary nutrition research and graduate education. Graduate students will be able to select from three specializations: animal nutrition, human nutrition, or molecular/biochemical nutrition.

The two main departments are FSHN and Animal Science, whereas other departments (such as Kinesiology; Biochemistry, Biophysics, and Molecular Biology; Agronomy; Sociology; and Statistics) may also be involved. (See Nutritional Sciences interdepartmental graduate major.)

The department, offers an online Graduate Certificate in Food Safety and Defense, in conjunction with the University of Nebraska, Lincoln, Kansas State University and the University of Missouri through the Great Plains Interactive Distance Education Alliance. Students eligible for admission to the food science master's degree program may be admitted.

The department participates in an online Masters of Family and Consumer Sciences/Dietetics in conjunction with Colorado State University, Kansas State University, North Dakota State University, Oklahoma State University, South Dakota State University, University of Kansas Medical Center, and University of Nebraska through the Great Plains Interactive Distance Education Alliance. Students who are registered dietitians and are eligible for admission to the FSHN Master's degree program may be admitted. The department, in conjunction with the Hotel, Restaurant, and Institution Management department, offers three dietetics certificates of 12 credits each and participates in the master of family and consumer sciences with a dietetics specialization. The certificate program meets continuing education requirements of The American Dietetic Association for advanced preparation in communication and counseling, dietetics management, and medical nutrition therapy. The graduate certificate courses may be applied to the master of family and consumer sciences - dietetics specialization. These programs are open only to registered dietitians. A second master of family and consumer sciences specialization, offered in the area of nutrition, does not require certification as a registered dietitian for admittance. Those interested in these programs should contact the department for details.

The department offers work for concurrent B.S. and M.S. degree programs that allow students to obtain both the B.S. and M.S. degrees in 5 years. The programs are available to students majoring in food science (food science and technology option) nutritional science, or pre-diet and exercise, and students progress toward M.S. degrees in food science and technology, nutritional sciences, or diet and exercise, respectively. Students interested in these programs should contact the department for details. Application for admission to the Graduate College should be made during the junior year. Students begin research for the M.S. thesis during the summer after their junior year and are eligible for research assistantships.

Students graduating with advanced degrees in nutritional sciences and in food science and technology will demonstrate competency in their chosen discipline. Measurable outcomes will include the ability to: 1) design, conduct, and interpret research; 2) apply theoretical information to solve practical problems; 3) prepare and communicate discipline-specific information in written and oral forms to scientific and lay audiences; 4) facilitate learning in the classroom; 5) submit a paper for publication in a peer-reviewed journal; and 6) secure professional-level positions in academia, industry, government, or health care.

Courses primarily for undergraduate students

FS HN 101. Food and the Consumer. (3-0) Cr. 3. F.S. *Prereq: High school biology and chemistry or 3 credits each of biology and chemistry.* The food system from point of harvest to the consumption of the food by the consumer. Properties of food constituents. Protection of food against deterioration and microbial contamination. Introduction of foods into the marketplace. Processes for making various foods. Government regulations. Use of food additives. Current and controversial topics. Electronic communication from web emphasized for class reports, notes and assignments.

FS HN 104. Introduction to Professional Skills in Culinary Science. (0-6) Cr. 1. S. Introduction to culinary science. Students will develop fundamental culinary skills by arranged on-campus work experience (100 hours). Sessions with instructor arranged.

FS HN 110. Professional and Educational Preparation. (1-0) Cr. 1. F.S. Introduction to professional and educational development within the food science and human nutrition disciplines. Focus is on university and career acclimation, enhancement of communication skills, and portfolio development. Satisfactory-fail only.

FS HN 111. Fundamentals of Food Preparation. (2-3) Cr. 3. F.S. *Prereq: 101 or 167; high school chemistry or Chem 160.* Principles involved in preparation of food products of standard quality. Influence of composition and techniques on properties of food products. Standard methods of food preparation with emphasis on quality, nutrient retention, and safety.

FS HN 112. Orientation to Learning and Productive Team Membership. (Cross-listed with NREM, Aer E, Hort, TSM). (2-0) Cr. 2. F. Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

FS HN 114. Developing Responsible Learners and Effective Leaders. (Cross-listed with Hort, NREM, TSM). (2-0) Cr. 2. S. Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

FS HN 167. Introduction to Human Nutrition. (3-0) Cr. 3. F.S.SS. *Prereq: High school biology or 3 credits of biology.* Understanding and implementing present day knowledge of nutrition. The role of nutrition and food intake in the health and well being of the individual and family.

FS HN 203. Contemporary Issues in Food Science and Human Nutrition. (1-0) Cr. 1. F.S. Introduction to published research and discussion of current issues in food science and human nutrition. Emphasis on sources of credible information, ethics, communication and portfolio development.

FS HN 214. Scientific Study of Food. (3-6) Cr. 5. F.S. *Prereq: 167 or 261; Chem 231 or 331.* Composition and structure of foods. Principles and practice of preparation of standard quality food products. Behavior and interactions of food constituents.

FS HN 265. Nutrition for Active and Healthy Lifestyles. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in BBMB 301.* Fundamentals of nutrient metabolism and nutrient requirements. Role of macronutrient metabolism in physical performance and disease prevention. Effect of manipulation of macronutrient metabolism on physical performance and disease prevention. Applications of nutrient metabolism principles to dietary recommendations and planning.

FS HN 272. Basic Principles of Food Processing. (1-6) Cr. 3. F. *Prereq: Credit or enrollment in Chem 231 & 231L and Biol 212.* Biological and physico-chemical principles of food processing as they determine the quality of foods.

FS HN 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department chair; sophomore classification.* Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

FS HN 311. Food Chemistry. (3-3) Cr. 4. F. *Prereq: 203, TSM 115, Chem 231 and 231L or 331 and 331L; credit or enrollment in BBMB 301.* The structure, properties, and chemistry of food constituents and animal and plant commodities. Nonmajor graduate credit.

FS HN 314. Foundations of Culinary Science. (1-0) Cr. 1. S. *Prereq: 214 and junior classification.* Introduction to the roles culinary scientists hold within industry including product development, research, and quality assurance. Discussions focused on professional and educational development, enhancement of communication skills, ethics and emerging issues and trends in culinary science.

FS HN 340. Foundations of Dietetic Practice. (1-0) Cr. 1. F. *Prereq: Junior classification.* Introduction to the profession of dietetics and responsibilities associated with dietetic professional practice. Emphasis on development of a pre-professional portfolio, career options in dietetics and preparation for a dietetic internship. Leadership and professional career development for the dietitian is addressed through self reflection, creation of materials for post-baccalaureate programs and job shadowing experience. Professional issues related to dietetic practice include Code of Ethics, legal credentialing and standards of professional practice, leadership and future trends in the profession. Satisfactory-fail only.

FS HN 342. World Food Issues: Past and Present. (Cross-listed with Agron, Env S, T SC). (3-0) Cr. 3. F.S. *Prereq: Junior classification.* Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects. Nonmajor graduate credit.
H. Honors Section. (Honors Program students only.)

FS HN 351. Unit Operations in Food Processing. (3-0) Cr. 3. S. *Prereq: A course in calculus and Phys 106.* Introduction to material and energy balances. Fluid flow, physical and thermal properties of food materials. Fundamentals of heat and mass transfer. Application of momentum and heat transfer to unit operations in food processing. Calculations and computer applications in food processing. Field trip. Nonmajor graduate credit.

FS HN 360. Advanced Human Nutrition and Metabolism. (3-0) Cr. 3. F. *Prereq: 261, 3 credits in biochemistry; 3 credits in physiology recommended.* Physiological and biochemical basis for nutrient needs; assessment of nutrient deficiency and toxicity; examination of nutrient functions and regulation of metabolism; nutrient-gene interactions. Nonmajor graduate credit.

FS HN 361. Nutrition and Health Assessment. (1-3) Cr. 2. F.S. *Prereq: Credit or enrollment in 360; 3 credits in statistics.* The assessment of nutritional status in healthy individuals. Laboratory experiences in food composition and assessment of dietary intake, body composition, and biochemical indices of nutritional status. Nonmajor graduate credit.

FS HN 362. Nutrition in Growth and Development. (3-0) Cr. 3. S. *Prereq: 360; credit or enrollment in a course in physiology.* Nutrient needs throughout the life cycle. Interrelationships of genes, gene expression and nutrients with physiological outcomes during

human development and aging. Nonmajor graduate credit.

FS HN 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department chair; junior classification.* Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

FS HN 403. Food Laws, Regulations, and the Regulatory Process. (2-0) Cr. 2. S.SS. *Prereq: 3 credits in food science coursework at 200 level or above.* History of the development of the current federal and state food regulations. Guidelines that govern the practice of regulating the wholesomeness of red meats, poultry, and eggs. Presentations by state and federal food regulators. Nonmajor graduate credit.

FS HN 405. Food Quality Assurance. (2-2) Cr. 3. S. *Prereq: 214 or 272 or 471; Stat 101 or 104.* Basis of food quality control/assurance programs and establishment of decision-making processes using official (government and industry) instrumental, chemical, and sensory procedures. Statistical process and quality control procedures and their applications to various food systems. Development of hazard analysis procedures, specifications, grades, and standards. Nonmajor graduate credit.

FS HN 406. Sensory Evaluation of Food. (Dual-listed with 506). (2-3) Cr. 3. F. *Prereq: 214 or 311 or An S 360; 3 credits in statistics.* Sensory test methods and procedures used to evaluate the flavor, color and texture of foods. Relationships between sensory and instrumental measurements of color and texture. Acceptance and preference testing.

FS HN 407. Microbiological Safety of Foods of Animal Origins. (Dual-listed with 507). (Cross-listed with Micro). (3-0) Cr. 3. S. *Prereq: 420.* Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

FS HN 410. Food Analysis. (2-3) Cr. 3. S. *Prereq: 214 or 311 or BBMB 311 or Chem 211; TSM 115.* An introduction to the theory and application of physical and chemical methods for determining the constituents of food. Modern separation and instrumental analysis. Use of food composition data bases. Nonmajor graduate credit.

FS HN 411. Food Ingredient Interactions and Formulations. (1-3) Cr. 2. F.S. *Prereq: 214 or 311.* Application of food science principles to ingredient substitutions in food products. Laboratory procedures for standard formulations and instrumental evaluation, with emphasis on problem-solving and critical thinking. Nonmajor graduate credit.

FS HN 412. Food Product Development. (Dual-listed with 512). (2-6) Cr. 4. S. *Prereq: 311 or 411, 471.* Principles of developing consumer packaged food products. Application of skills gained in food chemistry, formulation, microbiology, and processing. Some pilot plant experiences. Electronic communication from web emphasized for class reports, notes and assignments. Nonmajor graduate credit.

FS HN 419. Foodborne Hazards. (Cross-listed with Micro, Tox). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Micro 201 or 302, a course in biochemistry.* Pathogenesis of human microbiological foodborne infections and intoxications, principles of toxicology, major classes of toxicants in the food supply, governmental regulation of foodborne hazards. Only one of FS HN 419 and 519 may count toward graduation. Nonmajor graduate credit.

FS HN 420. Food Microbiology. (Cross-listed with Micro, Tox). (3-0) Cr. 3. F. *Prereq: Micro 201 or 302.* Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications. Nonmajor graduate credit.

FS HN 421. Food Microbiology Laboratory. (Cross-listed with Micro). (0-6) Cr. 3. F. *Prereq: Micro 201 or 302; 201L or 302L. Credit or enrollment in Micro 420, FS HN 203.* Standard techniques used for the microbiological examination of foods. Independent and group projects on student-generated questions in food microbiology. Emphasis on oral and written communication and group interaction. Nonmajor graduate credit.

FS HN 429. Foodborne Toxicants. (Dual-listed with 529). (0-2) Cr. 2. Alt. F., offered 2009. *Prereq: A course in biochemistry.* Mechanisms of action, metabolism, sources, remediation or detoxification, risk assessment of major foodborne toxicants of current interest. Taught online only.

FS HN 441. Dietetics Management. (1-9) Cr. 5. F.SS. For students enrolled in the dietetic internship program. Supervised participation in and analysis of organizational leadership, human resource management, budget and quantity food production management including quality control, menu planning, work methods and other functions related to business management in food service, health care and other institutions. Satisfactory-fail only.

FS HN 442. Medical Dietetics I. (3-15) Cr. 8. S.SS. For students enrolled in the dietetic internship program. Biological basis of medical, drug, and diet therapy for selected pathologies. Consideration of factors in planning and conducting nutritional care of patients. Integration of principles with clinical experience. Satisfactory-fail only.

FS HN 443. Medical Dietetics II. (1-9) Cr. 5. F.SS. *Prereq: Concurrent enrollment in 442.* For students enrolled in the dietetic internship program. Supervised clinical experience in assessing, implementing and evaluating nutritional care of patients in specialized clinical settings. Satisfactory-fail only.

FS HN 445. Experience in Community Dietetics. (1-6) Cr. 3. S.SS. For students enrolled in the dietetic internship program. Supervised experience in planning and providing nutritional care for individuals and groups in a variety of community settings. Satisfactory-fail only.

FS HN 446. Experience in Dietetics. (2-0) Cr. 2. F.SS. For students enrolled in dietetic internship. Supervised experience in planning and providing nutrition education for individuals and groups in a variety of dietetic settings. Satisfactory-fail only.

FS HN 448. Professional Development Assessment. (Dual-listed with 548). (1-0) Cr. 1. S.SS. For students enrolled in the dietetic internship program. Web-based course providing information and practice for students to assess and evaluate their own professional development and continuing professional education needs. Satisfactory-fail only.

FS HN 461. Medical Nutrition and Disease I. (4-0) Cr. 4. F. *Prereq: 360, 361, 3 credits in physiology at 300 level or above.* (Dual-listed with NutrS 561) Pathophysiology of selected chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state. Recitation section (1 cr.) will focus on refinement of assessment skills, diagnosis of nutritional problem, nutrition care, and documentation.

FS HN 463. Community Nutrition. (3-0) Cr. 3. F. *Prereq: 362.* Dual-listed with NutrS 563. Survey of current public health nutrition problems among nutritionally vulnerable individuals and groups. Discussion of the multidimensional nature of those problems and of community programs addressing them. Grant writing as a means for funding community nutrition program development. Significant emphasis on written and oral communication at the lay and professional level. Field trip. Nonmajor graduate credit.

FS HN 464. Medical Nutrition and Disease II. (3-0) Cr. 3-4. S. *Prereq: 360, 461, 3 credits in physiology at 300 level or above.* (Dual-listed with NutrS 564) Pathophysiology of selected acute and chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state. Recitation section (1 credit) will focus on refinement of assessment skills, diagnosis of nutritional problem, nutrition care, and documentation. Course must be taken for 4 credits for dietetics degree, diet and exercise degree, or if Didactic Program in Dietetics (DPD) verification statement of completion is desired. Students in non-dietetics majors may take the (3 credit) lecture portion without the recitation section.

FS HN 466. Nutrition Counseling and Education Methods. (2-2) Cr. 3. F.S. *Prereq: 362.* Dual listed with Diet 566. Application of counseling and learning theories with individuals and groups in community and clinical settings. Includes discussion and experience in building rapport, assessment, diagnosis, intervention, monitoring, evaluation, and documentation.

FS HN 471. Food Processing. (3-0) Cr. 3. F. *Prereq: Micro 201 or 302; Chem 163; Phys 106.* Food preservation, including packaging, fermentation, irradiation, canning, freezing, dehydration, additives. Sanitation and plant design. Applications to food products. Nonmajor graduate credit.

FS HN 472. Food Processing Laboratory. (Dual-listed with 572). (1-3) Cr. 2. F. *Prereq: 351; credit or enrollment in 471.* Pilot plant experiences such as thermal processing, food fermentations, oil seed processing, high pressure processing, corn wet milling, industrial baking, and waste treatment. Special emphasis on interpreting data, writing project reports, and applying engineering principles from FS HN 351.

FS HN 480. Professional Communication in Food Science and Human Nutrition. (1-0) Cr. 1. F.S. *Prereq: 203, senior classification in the department.* Presentation of current topics and issues of public policy. Emphasis on communication in the profession and portfolio assessment.

FS HN 489. Issues in Food Safety. (Cross-listed with An S, HRI, VDPAM). (1-0) Cr. 1. S. *Prereq: Credit or enrollment in FS HN 101 or 272 or HRI 233; FS HN 419 or 420; FS HN 403.* Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

FS HN 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Independent work in food science, nutrition, or dietetics. A maximum of 6 credits of FS HN 490 may be used toward graduation.
A. Dietetics
B. Food Science
C. Nutrition
D. International Experience
E. Entrepreneurship
H. Honors

FS HN 491. Supervised Work Experience. Cr. arr. Repeatable. F.S.SS. *Prereq: Advance approval of instructor and adviser.* Supervised off-campus work experience relevant to the academic major. A maximum of 4 credits of FS HN 491 may be used toward graduation. Satisfactory-fail only.
A. Dietetics
B. Food Science
C. Nutrition
D. Culinary Science

FS HN 492. Research Concepts in Human Nutrition. (1-3) Cr. 2. F. *Prereq: junior or senior classification.* Students will develop and implement a research project with faculty supervision, based on knowledge gained from nutrition, biology and chemistry courses. Students will prepare a research proposal, conduct research and report results. Students will gain appreciation for independent research and experience creative and innovative aspects of nutrition research.

FS HN 496. Food Science and Human Nutrition Travel Course. (Dual-listed with 596). Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* (One credit per week traveled.) Limited enrollment. Tour and study of food industry, dietetic and nutritional agencies in different regions of the world. Pre-travel session arranged. Travel expenses paid by students.
A. International travel
B. Domestic travel

FS HN 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department chair; senior classification.* Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

FS HN 499. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of staff member with whom student proposes to work.* Research under staff guidance. A maximum of 6 credits of FS HN 499 may be used toward graduation.

Courses primarily for graduate students, open to qualified undergraduate students

FS HN 502. Advanced Food Science-Chemistry. (1-0) Cr. 1. S. *Prereq: 3 credits in organic chemistry.* Key principles and applications in the chemistry of food.

FS HN 503. Advanced Food Science-Processing. (1-0) Cr. 1. Alt. S., offered 2010. *Prereq: 3 credits each in physics and mathematics.* Key principles and applications in the processing of food.

FS HN 504. Advanced Food Science-Microbiology. (1-0) Cr. 1. S. *Prereq: 3 credits each in Microbiology and organic chemistry.* Key principles and applications in the Microbiology of food.

FS HN 505. Short Course in Food Science. Cr. arr. F.S.SS. *Prereq: Permission of instructor.*

FS HN 506. Sensory Evaluation of Food. (Dual-listed with 406). (2-3) Cr. 3. F. *Prereq: 214 or 311 or An S 360; 3 credits in statistics.* Sensory test methods and procedures used to evaluate the flavor, color and texture of foods. Relationships between sensory and instrumental measurements of color and texture. Acceptance and preference testing.

FS HN 507. Microbiological Safety of Foods of Animal Origins. (Dual-listed with 407). (Cross-listed with Micro). (3-0) Cr. 3. S. *Prereq: Micro 420.* Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

FS HN 512. Food Product Development. (Dual-listed with 412). (2-6) Cr. 4. S. *Prereq: 311 or 411, 471.* Principles of developing consumer packaged food products. Application of skills gained in food chemistry, formulation, microbiology, and processing. Some pilot plant experiences. Electronic communication from web emphasized for class reports, notes and assignments.

FS HN 515. Regulatory Toxicology. (Cross-listed with Tox). (1-0) Cr. 1. Alt. F., offered 2010. *Prereq: BBMB 404 or FS HN 403.* Regulatory toxicology in the real world. Approaches used by toxicologists in regulatory agencies for generating, enforcing and complying with laws and regulations in an unambiguous, defensible manner. Different obligations of scientists in research and regulatory settings. Perform simple risk assessments and suggest way to dealing with data gaps. Examine strengths and weaknesses of common approaches used by regulatory agencies.

FS HN 519. Food Toxicology. (Cross-listed with Tox, NutrS). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: A course in biochemistry.* Basic principles of toxicology. Toxicants in the food supply: modes of action, toxicant defense systems, toxicant and nutrient interactions, risk assessment. Only one of FS HN 419 and 519 may count toward graduation.

FS HN 529. Foodborne Toxicants. (Dual-listed with 429). (0-2) Cr. 2. Alt. F., offered 2009. *Prereq: a course in biochemistry.* Mechanisms of action, metabolism, sources, remediation or detoxification, risk assessment of major foodborne toxicants of current interest, design of HACCP plans for use in food industries targeting foodborne toxicants. Taught online only.

FS HN 542. Introduction to Molecular Biology Techniques. (Cross-listed with BBMB, BCB, B M S, EEOB, GDCB, Hort, NREM, NutrS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

FS HN 543. Medical Dietetics II. (1-6) Cr. 3. F.SS. *Prereq: Concurrent enrollment in dietetic internship or MFCS Dietetic Option.* Discussion of the assessment, diagnosis, intervention, and outcomes of nutritional problems in complex medical conditions.

FS HN 548. Professional Development Assessment. (Dual-listed with 448). (Cross-listed with Diet). (1-0) Cr. 1. F.S.SS. *Prereq: RD credential or enrollment in GPIDEA MFCS in Dietetics.* Web-based course providing information and practice for student to assess and evaluate own professional development and continuing professional education needs. Completion of professional 5-year plan. Satisfactory-fail only.

FS HN 566. Nutrition Counseling and Education Methods. (Dual-listed with 466). (Cross-listed with Diet). (2-2) Cr. 3. F.S. *Prereq: Graduate student status.* Application of counseling and learning theories with individuals and groups in community and clinical settings. Includes discussion and experience in building rapport, assessment, diagnosis, intervention, monitoring, evaluation, and documentation. Literature review of specific counseling and learning theories.

FS HN 567. Nutrition for Dietitians. (Cross-listed with Diet). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 360; BBMB 301, undergraduate course in physiology. RD credential or enrollment in GPIDEA MFCS in Dietetics.* Study of the current scientific literature to evaluate current trends and issues in nutrition science and dietetic practice. Emerging areas of research investigating the role of nutrients in health and disease in humans will be explored. Emphasis on the impact of emerging research on nutrition recommendations and interventions designed to promote human health.

FS HN 572. Food Processing Laboratory. (Dual-listed with 472). (1-3) Cr. 2. F. *Prereq: 503 or equivalent.* Pilot plant experiences such as thermal processing, food fermentation, oil seed processing, high pressure processing, corn wet milling, industrial baking, and waste treatment. Special emphasis on interpreting data, writing project reports, applying engineering principles from FS HN 351, and special projects for each exercise.

FS HN 575. Processed Foods. (3-0) Cr. 3. F. *Prereq: 214 or 311; a course in nutrition.* Survey of the effects of home and commercial food preparation and processing on the nutrients in food.

FS HN 580. Orientation to Food Science and Nutrition Research. (1-0) Cr. 1. F. Orientation to and discussion of research interests in food science and nutrition. Discussion of policy and ethical issues in the conduct of research. Intended for entering students in FS HN and related disciplines. Satisfactory-fail only.

FS HN 581. Seminar. (1-0) Cr. 1. S. Discussion and practice of oral presentation of scientific data in a professional setting. Discussion of issues related to data presentation. Satisfactory-fail only.

FS HN 590. Special Topics. Cr. arr. Repeatable. F.S.SS.
A. Nutrition
B. Food Science
C. Teaching

FS HN 595. Grant Proposal Writing for the Working Professional. (Cross-listed with Diet). (1-0) Cr. 1. Alt. F., offered 2009. *Prereq: Enrollment in GPIDEA MFCS in Dietetics* Grant proposal preparation experiences including writing and critiquing of proposals and budget planning. Designed for the working professional. Not intended for the MS or PhD student. Satisfactory-fail only.

FS HN 596. Food Science and Human Nutrition Travel Course. (Dual-listed with 496). Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* (One credit per week traveled.) Limited enrollment. Tour and study of food industry, dietetic and nutritional agencies in different regions of the world. Pre-travel session arranged. Travel expenses paid by students.
A. International travel
B. Domestic travel

FS HN 599. Creative Component. Cr. arr. Nonthesis option only.

Courses for graduate students

FS HN 606. Instrumental Measurement of Food Quality. (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: 311 or 411 or 502 or BBMB 404.* Principles of instrumental measurements of color, aroma, flavor, texture, and rheology. Techniques and instrumentation for measuring the quality of foods; relationship of these methods to food color, taste, flavor, texture, and rheological quality. Application of methods to various foods and biorenewable materials.

FS HN 610. Food Enzymology. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 311 or 411 or 502 or BBMB 404.* Properties of enzymes important in food processing and production including flavor, texture and color. Quantitative evaluation of substrates, enzyme, and inhibitors, pH, pressure and temperature on enzyme activity. Experimental determination of specificity and mechanisms important to food biochemistry. Techniques to purify food enzymes.

FS HN 612. Lipid Chemistry and Applications. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 311 or 411 or 502 or BBMB 404.* Structure and analysis of lipids; glyceride structure; crystal form and texture; autoxidation and chemical modification; extraction, refining and processing; applications of fats and oils in food, biofuel and biobased products.

FS HN 613. Food Proteins. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 311 or 411 or 502 or BBMB 404.* Properties of proteins found in milk, eggs, meat, legumes, and cereal grains. Effect of processing on food proteins.

FS HN 614. Carbohydrates: Structures, Properties, and Applications. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 311 or 411 or 502 or BBMB 404.* Study of chemical structures and physical properties of carbohydrates, applications of carbohydrates in foods and as biomaterial, and changes they undergo during processing and storage.

FS HN 626. Advanced Food Microbiology. (Cross-listed with Micro, Tox). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 420 or 421 or 504.* Topics of current interest in food Microbiology, including new foodborne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials.

FS HN 627. Rapid Methods in Food Microbiology. (Cross-listed with Micro, Tox). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 420 or 421 or 504.* Provides an overview of rapid microbial detection methods for use in foods. Topics include historical aspects of rapid microbial detection, basic categories of rapid tests

(phenotypic, genotypic, whole cell, etc.), existing commercial test formats and kits, automation in testing, sample preparation and "next generation" testing formats now in development.

FS HN 681. Seminar. (1-0) Cr. 1. F.S.SS. Presentation of thesis or dissertation research. May be taken once for M.S. program and twice for the Ph.D. program.

FS HN 690. Special Problems. Cr. arr. Repeatable. F.S.SS. *Prereq: 502 or 503 or 504 or 553 or 554.*

FS HN 695. Grant Proposal Writing. (Cross-listed with NutrS). (1-0) Cr. 1. F. *Prereq: 3 credits of graduate course work in food science and/or nutrition.* Grant proposal preparation experiences including writing and critiquing of proposals and budget planning. Formation of grant writing teams in food science and/or nutrition. Satisfactory-fail only.

FS HN 699. Research in Food Science and Technology. Cr. arr. Repeatable. F.S.SS. Satisfactory-fail only.

Genetics, Development and Cell Biology

www.gdcb.iastate.edu/

Martin Spalding, Chair of Department

University Professor: Horner

University Professors (Emeritus): Dolphin, Stadler

Professors: Brendel, Dobbs, Enger, Gu, Henderson, Howell, Johansen, Lee, Mayfield, Oliver, P. Peterson, T. Peterson, Rodermel, Schnable, Shen, Spalding, Wurtele

Professors (Emeritus): Atherly, Bishop, Buss, Imsande, Lamotte, Miller, Pattee, Pollak, Robertson, Smith, Stewart, Swenson, Welshons

Professors (Collaborators): Link, Shoemaker, Voytas

Associate Professors: Bassham, Becraft, Chou, Colbert, Dorman, Ingebritsen, McCloskey, Powell-Coffman, Sakaguchi, Viles

Associate Professor (Adjunct): Duvick

Associate Professors (Collaborators): Danilevskaya, Tucker

Assistant Professors: Coffman, Essner, Kuhlman, Schneider, Vollbrecht, Yang, Yin

Assistant Professors (Adjunct): Ilarslan, McGrail, Muszynski

Assistant Professors (Collaborators): Buell, Hopkins, Lawrence, Sen

Lecturer: Bastawros, Krumhardt

The Department of Genetics, Development and Cell Biology (GDCB) is dedicated to biological discovery and excellence in undergraduate and graduate education. The research and teaching mission of the department is to achieve a greater understanding of fundamental principles of life by focusing on basic cellular and subcellular processes, including genome dynamics, cell structure and function, cellular response to environmental and developmental signals, and molecular mechanisms of development. Recognizing that student education is of paramount importance, GDCB strives for excellence in teaching and research. GDCB plays a leading role in undergraduate and graduate training through a variety of activities including traditional courses, undergraduate internships in research laboratories, and advanced graduate seminar and literature-based courses. Innovative approaches to learning are emphasized throughout the curriculum.

Undergraduate Study

The GDCB Department offers undergraduate majors in conjunction with other departments. Students interested in the areas of genetics, development and cell biology should major in Biology, Genetics Bioinformatics and Computational Biology (BCBio). The Biology Major is administered and offered jointly by the GDCB and EEOB departments. The GDCB faculty, together with those in EEOB and BBMB, administer and offer the Genetics Major. Each of these majors is available through the College of Liberal Arts and Sciences or through the College of Agriculture and Life Sciences. BCBio is administered by the Departments of Computer Science, GDCB, and mathematics and is available through the college of Liberal Arts and Sciences.

The Biology Major and the Genetics Major prepare students for a wide range of careers in biological sciences. Training in Biology or Genetics may lead to employment in teaching, research, or any of a variety of health-related professions. Some of these careers include biotechnology, human and veterinary medicine, agricultural sciences and life science education. BCBio majors are prepared for careers at the interfaces of biological, informational and computational sciences in the above fields. These majors are also excellent preparation for graduate study in bioinformatics, molecular genetics, cell and developmental biology, neuroscience and related fields. Faculty members in GDCB contribute to the undergraduate courses listed below. The full descriptions of these courses can be found in the Biology, Genetics and BCBio sections of the catalog.

Biol 101, 110, 111, 155, 211, 211L, 212, 212L, 255, 255L, 256, 256L, 258, 305, 305L, 313, 313L, 314, 314L, 330, 352, 394, 423, 423L, 428, 436, 444, 490, 494, 495, Gen 110, 260, 308, 410, 411, 490, 491, 495, BCBio 110, 211, 401, 402 and 442.

Graduate Study

Understanding the genetic blueprint and the functions of cells is critical to virtually all aspects of biology. The basic mission of the Department of Genetics, Development and Cell Biology is to achieve a greater understanding of fundamental principles of life. The GDCB faculty and students conduct hypothesis-driven research into the biology of animals, plants and microbes. While research in GDCB is often based on discovery and analysis of molecular mechanisms of life processes, a true understanding of living organisms will ultimately require the integration of molecular mechanisms in the context of dynamic structural components of the living cell. Thus, research efforts within GDCB use molecular, genetic, biochemical, computational and imaging techniques to study systems at increasingly complex levels of organization.

GDCB faculty contribute to a broad but integrated array of cutting-edge research topics, implementing interactive and multidisciplinary approaches that bridge conventional boundaries, and incorporating experimental and computational biology as complementary approaches. Examples include using genetics and molecular biology to investigate the cellular basis of development, or combining biochemical and computational approaches to study basic subcellular functions, signal transduction or metabolism.

The faculty in the GDCB department train graduate students in several interdepartmental majors/programs including Bioinformatics and Computational Biology, Ecology and Evolutionary Biology, Genetics, Immunobiology, Plant Physiology, Interdisciplinary Graduate Studies, Microbiology, Molecular, Cellular and Developmental Biology, Neuroscience and Toxicology. Graduate work leading to both Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees are available.

Prospective graduate students need a sound background in the physical and biological sciences, as well as Mathematics and English. Interested students should check the links on the GDCB web site (www.gdcb.iastate.edu/) for specific admissions procedures and the latest information about individual faculty and their research programs. The interdepartmental majors and programs require submission of Graduate Record Examination (GRE) aptitude test scores. Advanced GRE scores are recommended. International students whose native language is other than English must also submit TOEFL scores with their application.

Students who are enrolled in the interdepartmental graduate majors with affiliations with GDCB are required to actively participate in seminars, research activities, and to show adequate progress and professional development while pursuing their degree. For both the M.S. and Ph.D. degrees, it is expected that research conducted by the student will culminate in the writing and presentation of a thesis or dissertation. The Graduate College, the GDCB Faculty, and the individual student's major professor and Program of Study Committee provide requirements and guidelines for study. General information about graduate study requirements can be found at the web site for the Graduate College (www.grad-college.iastate.edu/) and requirements for the interdepartmental majors can be found by following the links from the GDCB web site above. Although not a formal requirement, the GDCB faculty recommends that students pursuing the Ph.D. include teaching experience in their graduate training.

Courses primarily for graduate students, open to qualified undergraduate students

GDCB 508. Biotechnology in Agriculture, Food, and Human Health. (3-0) Cr. 3. F.S. *Prereq: Biol 211 and 212.* Scientific principles and techniques in biotechnology. Products and applications in agriculture, food, and human health. Ethical, legal, and social implications of biotechnology. A research paper is required for graduate credit.

GDCB 510. Transmission Genetics. (3-0) Cr. 3. F. *Prereq: Gen 410 or graduate standing.* An in-depth investigation of the modern research practices of transmission genetics. Designed for students interested in genetic research. Topics include: Mendelian genetic analysis, analysis of genetic pathways, mutational analysis of gene function, chromosomal mechanics, gene mapping, extranuclear inheritance, human genetic analysis.

GDCB 511. Molecular Genetics. (Cross-listed with MCDB). (3-0) Cr. 3. S. *Prereq: Biol 313 and BBMB 405.* The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes.

GDCB 512. Plant Growth and Development. (Cross-listed with MCDB, PlBio). (2-0) Cr. 2. S. *Prereq: Biol 330 or a course in developmental biology; GDCB 545 or BBMB 404, 405 or GDCB 520.* Plant growth and development and its molecular genetic regulation. Hormone biosynthesis, metabolism, and action. Signal transduction in plants.

GDCB 513. Plant Metabolism. (Cross-listed with PlBio). (2-0) Cr. 2. F. *Prereq: Biol 330, Phys 111, Chem 331; one semester of biochemistry recommended.* Photosynthesis, respiration, and other aspects of plant metabolism.

GDCB 520. Genetic Engineering. (Cross-listed with BBMB, MCDB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Gen 411 or BBMB 405.* Strategies and methods of gene cloning, restriction endonuclease mapping, southern hybridization, isolation and manipulation of plasmid DNA, and detection of specific genes in bacteria.

GDCB 528. Cellular Growth and Regulation. (Cross-listed with MCDB). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Courses in cell biology and BBMB 404, 405.* Cell cycle, regulation of cell growth, cell division, membranes, transport processes, and regulation of cellular activities.

GDCB 529. Plant Cell Biology. (Cross-listed with MCDB). (2-0) Cr. 2. *Prereq: Biol 313, 314, 330 or BBMB 405.* Organization, function, and development of plant cells and subcellular structures.

GDCB 533. Principles of Developmental Biology. (Cross-listed with MCDB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 314.* Fundamental principles in multicellular development. Emphasis on cellular and molecular regulation of developmental processes, and experimental approaches as illustrated in classical studies and current literature.

GDCB 536. Statistics for Population Genetics. (Cross-listed with Stat). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Stat 401, 447; Gen 320 or Biol 313.* Statistical models for population genetics covering: selection, mutation, migration, population structure, and linkage disequilibrium. Applications to gene mapping (case-control, TDT), inference about population structure, DNA and protein sequence analysis, and forensic and paternity identification.

GDCB 537. Statistics for Molecular Genetics. (Cross-listed with Stat). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 401, 447; Gen 320 or Biol 313.* Statistical models, inference, and computational tools for linkage analysis, quantitative trait analysis, and molecular evolution. Topics include; quantitative trait models, variance component mapping, interval and composite-interval mapping, and phylogenetic tree reconstruction.

GDCB 538. Computational Genomics and Evolution. (Cross-listed with BCB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 313.* Introduction to evolutionary sequence analysis at the genome level. Topics include sequence alignment, phylogenetic inference, molecular clock analysis, ancestral state inference, sequence/structure relation, functional divergence and prediction, evolutionary development, genome duplication, and comparative genomics. Focus will be on data analysis and biological interpretation.

GDCB 539. Statistical Methods for Computational Biology. (Cross-listed with BCB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: BCB 568.* Gu. Advanced discussion about statistical modeling of DNA and amino acid sequences, microarray expression profiles and other genome-wide data interpretation.

GDCB 542. Introduction to Molecular Biology Techniques. (Cross-listed with B M S, BBMB, BCB, EEOB, FS HN, Hort, NREM, NutrS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

GDCB 544. Introduction to Bioinformatics. (Cross-listed with BCB, Cpr E, Com S). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics.

GDCB 545. Plant Molecular Biology. (Cross-listed with MCDB, PlBio). (3-0) Cr. 3. F. *Prereq: Biol 314, 330.* Organization and function of plant nuclear and organelle DNA; regulation of gene expression. Methods of generating novel genetic variation. Impact of plant biotechnology on agriculture.

GDCB 556. Cellular, Molecular and Developmental Neuroscience. (Cross-listed with Neuro, B M S). (3-0) Cr. arr. F. *Prereq: Biol 335 or Biol 436; physics recommended.* Fundamental principles of neuroscience including cellular and molecular neuroscience, nervous system development, sensory, motor and regulatory systems.

GDCB 557. Advanced Neuroscience Techniques. (Cross-listed with Neuro). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Neuro 556 or equivalent course.* Research methods and techniques; exercises and/or demonstrations representing individual faculty specialties.

GDCB 568. Bioinformatics II (Advanced Genome Informatics). (Cross-listed with BCB, Stat, Com S). (3-0) Cr. 3. S. *Prereq: BCB 567, BBMB 301, Biol 315, Stat 430, credit or enrollment in Gen 411.* Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

GDCB 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology). (Cross-listed with Com S, BCB, Stat, Cpr E). (3-0) Cr. 3. S. *Prereq: BCB 567, Biol 315, Com S 311 and either 208 or 228, Gen 411, Stat 430.* Algorithmic and Statistical approaches in computational functional genomics and systems biology. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Ontology-driven, network based, and probabilistic approaches to information integration.

GDCB 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

GDCB 596. Genomic Data Processing. (Cross-listed with Com S, BCB). (3-0) Cr. 3. F. *Prereq: Some basic knowledge of programming.* Study the practical aspects of genomic data processing with an emphasis on hands-on projects. Students will carry out common data processing steps using bioinformatics tools. Topics include base-calling, raw sequence cleaning and contaminant removal; shotgun assembly procedures and EST clustering methods; genome closure strategies and practices; sequence homology search and function prediction; annotation and submission of GenBank reports; and data collection and dissemination through the Internet. Important post-genomic topics like microarray design and data analysis will also be covered.

Courses for graduate students

GDCB 632. Current Topics in Signal Transduction. Cr. 2-3. *Prereq: Permission of instructor.* Selected topics in signal transduction events, their molecular mechanisms and their relation to cellular processes. Topics may include cell recognition, second messenger systems, information integration and transfer, cell cycle, cell differentiation, and pattern formation.

GDCB 640. Signal Transduction. (Cross-listed with BBMB, MCDB). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: GDCB 528, BBMB 404.* Mechanisms and components of cellular signal transduction including receptors, G-proteins, second messengers, protein phosphorylation, other post-translational protein modifications, and transcriptional regulation.

GDCB 661. Current Topics in Neuroscience. (Cross-listed with Neuro, BBMB). Cr. arr. Alt. S., offered 2010. Repeatable. *Prereq: Permission of instructor.* Topics may include communication, hormones and behavior, neural integration, membrane biophysics, molecular and cellular neuroscience, developmental neurobiology, neuroanatomy and ultrastructure, sensory biology, social behavior, techniques in neurobiology and behavior.

GDCB 679. Light Microscopy. (Cross-listed with Micro, EEOB). (2-9) Cr. 5. Alt. F., offered 2010. *Prereq: Permission of instructor.* Current theories encompassing light optics and their applications for specimen preservation, paraffin and resin sectioning, general staining, histochemistry, cytophotometry, immunocytochemistry, autoradiography, image digitization, processing and presentation, and digital macro- and micrography. Limit of 10 students.

GDCB 680. Scanning Electron Microscopy. (Cross-listed with Micro, EEOB). (2-9) Cr. 5. Alt. F., offered 2009. *Prereq: Permission of instructor.* Current theories encompassing scanning electron optics and their applications for high and low vacuum microscopy, specimen chemical and cryopreservation methods, x-ray microanalysis, backscattered and topographic imaging, image digitization, processing and presentation. Limit of 10 students.

GDCB 681. Transmission Electron Microscopy. (Cross-listed with Micro, EEOB). (2-9) Cr. 5. Alt. S., offered 2011. *Prereq: GDCB 679 and permission of instructor.* Current theories encompassing electron optics and their applications for chemical and physical specimen preservation, ultramicrotomy, general staining and cytochemistry, immunocytochemistry, autoradiography, negative staining and shadowing, x-ray microanalysis, image digitization, processing and presentation.

GDCB 690. Seminar in GDCB. Cr. 1. Repeatable. Journal article critique and discussion by faculty and graduate students. Satisfactory-fail only.
A. Cellular, Molecular, and Developmental Biology
C. Neurobiology
D. Physiology
E. Evolution
F. Animal Models of Gene Therapy
H. Bioinformatics and Computational Biology

GDCB 691. Faculty Seminar. Cr. 1. Repeatable. Faculty research series.
G. Genetics. F. Prereq: Permission of instructor.
H. Bioinformatics and Computational Biology. (Same as BCB 691H).
P. Plant Development. S. Prereq: GDCB 512 (can be taken concurrently).

GDCB 696. Research Seminar. (Cross-listed with Agron, BBMB, PlBio, Hort, for). Cr. 1. Repeatable. Research seminars by faculty and graduate students. Satisfactory-fail only.

GDCB 698. Seminar in Molecular, Cellular, and Developmental Biology. (Cross-listed with MCDB, BBMB, Micro, V MPM). (2-0) Cr. arr. Repeatable. F.S. Student and faculty presentations.

GDCB 699. Research. Cr. arr. Repeatable. Research for thesis or dissertation. Satisfactory-fail only.

GDCB 699I. Research. (Cross-listed with Ia LL, A Ecl, Anthr, EEOB). Cr. arr. Repeatable.

Genetics - Interdisciplinary

www.genetics.iastate.edu

e-mail: genetics@iastate.edu

(Interdepartmental Graduate Major)

Supervisory Committee: P. Becraft, Chair; Jo Anne Powell-Coffman, Associate Chair; D. Hannapel, T. Peterson, D. Spurlock, T. Lubberstedt.

Participating Faculty: D. Bassham, T. Baum, G. Beattie, P. Becraft, J. Beetham, M. Bhattacharyya, D. Birt, J. Blanchong, T. Bobik, A. Bogdanove, B. Bonning, V. Brendel, A. Bronikowski, H. H. Chou, C. Coffman, J. Dekkers, D. Dobbs, M. Ellinwood,

J. Essner, S-Z Fei, R. Fernando, D. Garrick,J. R. Girton, X. Gu, R. B. Hall, L. Halverson, D. J. Hannapel, E. R. Henderson, F. Janzen, K. M. Johansen, A. Kanthasamy, S. J. Lamont, N. Lauter, D. Lavrov, C. Lawrence, M. Lee, T. Lubberstedt, G. MacIntosh, W. A. Miller, F. C. Minion, J. Nason, B. J. Nikolau, M. Nilsen-Hamilton, L. Nolan, D. Oliver, P. A. Peterson, T. Peterson, G. Phillips, J. Powell-Coffman, J. Reecy, K. Roe, M. Rowling, S. R. Rodermel, M. F. Rothschild, P. S. Schnable, M. P. Scott, J. Serb, R. C. Shoemaker, R. Singh, M. H. Spalding, D. Spurlock, C. K. Tuggle, N. Valenzuela, E. Vollbrecht, K. Wang, J. F. Wendel, S. Whitham, R. P. Wise, E. Wurtele, B. Yang, Y. Yin, Q. Zhang

Undergraduate Preparation

Undergraduates wishing to prepare for graduate study in Genetics should elect courses in basic biology, chemistry at least through organic chemistry, one year of college-level physics, mathematics at least through calculus, and at least one thorough course in basic transmission and molecular genetics. One year of upper level statistics and a year of biochemistry are strongly encouraged.

See Genetics - Undergraduate for information on a bachelor of science degree in Genetics.

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in Genetics in thirteen cooperating departments: Agronomy; Animal Science; Biochemistry, Biophysics and Molecular Biology; Biomedical Sciences; Ecology, Evolution and Organismal Biology; Entomology; Food Science and Human Nutrition; Genetics, Development and Cell Biology; Horticulture; Plant Pathology; Natural Resource Ecology and Managment; Veterinary Microbiology and Preventive Medicine; and Veterinary Pathology.

The diversity of faculty in the Interdepartmental Genetics major ensures a broad, well-balanced education from the best instructors, while offering flexibility in choice of research area. Genetics faculty have strengths in many areas, from fundamental studies at the molecular, cellular, organismal, and population levels, to research with immediate practical application. Ongoing research projects span all the major areas of theoretical and experimental genetics, including genomics, molecular studies of gene regulation, gene mapping, transposable element studies, developmental genetics, quantitative and mathematical genetics, computational molecular biology, evolutionary genetics, and population genetics.

Students are admitted by the approval of the Chair after review by the Genetics Admissions Committee. Students are admitted either to participate in research rotations with several faculty or by direct admission into a specific lab and department. First year students participating in rotations with Genetics faculty will take Genet 697 (graduate research rotation). All Ph.D. candidates take a core curriculum comprising one course each from the following four categories and attend seminars and workshops as described: Transmission Genetics (GDCB 510), Molecular Genetics (GDCB 511 or BBMB 502), Quantitative, Population, and Evolutionary Genetics (An S/Agron 561 or EEOB 562 or EEOB 563 or EEOB 566 or EEOB 567), Biochemistry (BBMB 404 or BBMB 501). Students will give three research presentations (Genet 690), attend two genetics faculty seminar series (Genet 691), and participate in three Workshops in Genetics (Genet 591) during their training period. First-year graduate students will also take Genet 692 (Seminar in the Conceptual Foundations of Genetics).

Students may elect a computational molecular biology speciality within the genetics major. This requires that the research project be in the field of computational molecular biology. IG majors will be expected to complete all of the courses required for the major, except that one semester of Student Seminar in Bioinformatics and Computational Biology (BCB 690). Students will be expected to take additional courses in the area of specialization.

M.S. students will take the above core courses and seminars with the following changes: participate in two of the Workshops in Genetics (Genet 591) and present their research once (Genet 690). Additional coursework may be selected to satisfy individual interests or departmental requirements.

The course designator Genet applies to graduate courses taught by the interdepartmental major in Genetics.

Students wishing to minor in genetics must submit a complete application to the graduate program. Requirements for the successful completion of a minor at the Ph.D. or M.S. levels are: completion of three of the four categories of the common-core required lecture courses listed above. One semester of seminar in Genetics (Genet 690 or 691 or 692) is recommended. One member of the POS committee must be a Genetics faculty member.

Student Outcomes: Most students awarded doctoral degrees continue their training as postdoctoral associates at major research institutions in the U.S. or abroad in preparation for research and/or teaching positions in academia, industry, or government. A few go directly to permanent research positions in industry. Many students awarded master's degrees continue their training as doctoral students; however, some choose research support positions in academia, industry, or government. A more thorough list of outcomes is available at our Web site.

Courses for graduate students

Genet 590. Special Topics. Cr. arr. Repeatable. F.S.SS. Contact individual faculty for special projects or topics. Graded.

Genet 591. Workshop in Genetics. (1-0) Cr. 1. Repeatable. S. *Prereq: Permission of instructor.* Current topics in genetics research. Lectures by off-campus experts. Students read background literature, attend preparatory seminars, attend all lectures, meet with lecturers.

Genet 690. Seminar in Genetics. (1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor.* Research presentations by students to improve their ability to: orally present scientific work in a clear and meaningful way, critically evaluate oral presentations, and give and receive constructive criticism.

Genet 691. Seminar in Genetics. (1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor.* Faculty research seminars that introduce students to the variety of genetics research projects on campus and provide an opportunity for students to become engaged in the scientific presentation to the point where they can think critically and ask meaningful questions.

Genet 692. Conceptual Foundations of Genetics. (1-0) Cr. 1. F. *Prereq: Permission of instructor.* Landmark papers in the development of genetics concepts. Papers are presented and discussions led by students, guided and mentored by the instructors. Instructors provide a broad overview and history of the development of fundamental concepts in genetics.

Genet 697. Graduate Research Rotation. Cr. arr. Repeatable. F.S.SS. Graduate research projects performed under the supervision of selected faculty members in the graduate Genetics major.

Genet 699. Research. Cr. arr. Repeatable. F.S.SS.

Genetics - Undergraduate

Jack R. Girton, Chair, Genetics Major Committee

http://www.iastate.edu/~ugradgen/

Genetics is the scientific study of heredity. Understanding the basis of heredity is fundamental to all aspects of the life sciences, from the most basic molecular study to applied studies of agricultural species. At Iowa State University the study of the life sciences is interdepartmental, involving faculty in the basic, agricultural, and veterinary sciences. Faculty in 20 different departments are involved in genetics research. This large group of faculty presents a broad range of possibilities for students to learn from faculty who are at the forefront of research in many areas of genetics.

Undergraduate Study

Undergraduate study in genetics is jointly administered by three departments: Biochemistry, Biophysics, and Molecular Biology; the Department of Genetics, Development, and Cell Biology; and the Department of Ecology, Evolution, and Organismal Biology. Undergraduate degrees are offered through both the College of Agriculture and the College of Liberal Arts and Science. Programs of study for genetics majors leading to a B.A. or a B.S. degree are available. A minor in genetics is also offered for students majoring in several areas of the life sciences.

Training in genetics may lead to employment in teaching, research, or a variety of health-related professions. Although some students find employment directly after their baccalaureate training, many students continue their education in graduate or professional programs. Students with the B.S. or B.A. degree may find employment in the biotechnology, health, or food industries. Recent graduates have also developed careers in conservation biology, technical writing, science journalism, technical sales, business, and genetic counseling.

The required course work and associated electives provide students with the foundation in basic life sciences, mathematics, chemistry, and physics that is essential for professions involving modern biological/biomedical sciences. As part of these courses students develop skills in problem solving, critical thinking, writing, research-related activities in the biological sciences.

The respective communications and communication proficiency requirements of both colleges are met by an average of C or better in Engl 150, 250 or 250H, and an additional English writing course. The lowest grade acceptable in any of these courses is C-. Students in the College of Agriculture must also achieve a C or better in an oral communications course.

A grade of C– or better is required in all biological science courses within the major and a cumulative GPA of at least 2.0 is required for graduation.

Specific entrance requirements for medical and health-related professions are established by the professional schools. Students interested in fulfilling pre-professional requirements for such professions as dentistry, human medicine, nursing, optometry, pharmacy, physical therapy, physicians assistant, and veterinary medicine can major in genetics while fulfilling the pre-professional requirements. (See *Preprofessional Study.*)

Graduate Study

Graduate study in genetics leading to the Master of Science and doctor of philosophy degrees is offered at ISU. Graduate study is organized as a separate interdepartmental graduate major from the undergraduate program. For more information on graduate study in genetics see: *Genetics - Interdisciplinary.*

Curriculum in Genetics

In addition to basic degree requirements listed in the Curricula in Agriculture or in Liberal Arts and Sciences, genetics majors must satisfy the following requirements:

1. Biol 211, 211L, 212, 212L, 313, 313L, 314, 314L, 315, and Micro 302.
2. Gen 110, 409, 410, 491, and either 462 or EEOB 563.
3. Eleven credits of calculus and Statistics including at least one course in each.
4. Three years of chemistry and biochemistry.

. Eight credits of general college physics.

6. Additional credits of biological science support electives chosen from an approved list. For degrees in the College of Agriculture nine credits are required, for degrees in the College of Liberal Arts and Sciences six credits are required.
7. Majors in the College of Liberal Arts and Sciences must take one course that involves both humanities and biology such as history of science, or bioethics. This course may also count toward a college group requirement. A list of acceptable courses is available from the program office.
8. Majors in the College of Agriculture must include Biol 312 in their program.

The minor in genetics may be earned by completing Gen 313, 313L, 314, 314L, Gen 409, 410 and 491. A Genetics major may not double major or minor in Biology.

Courses primarily for undergraduate students

Gen 110. Genetics Orientation. (1-0) Cr. 1. F. Orientation to the area of genetics. For students considering a major in genetics. Specializations and career opportunities. Satisfactory-fail only.

Gen 260. Human Heredity and Society. (3-0) Cr. 3. F. *Prereq: One semester of college biology or Anthr 202.* A survey course in genetics for non-biology majors interested in heredity and its importance, and implications to self and Society. Not recommended for those intending to take advanced courses in genetics. Credit for graduation will not be allowed for more than one of the following: Gen 260, 313, 320, Biol 313 and 313L and Agron 320.

Gen 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Gen 308. Biotechnology in Agriculture, Food, and Human Health. (3-0) Cr. 3. F.S.SS. *Prereq: Biol 211 and 212.* Scientific principles and techniques in biotechnology. Products and applications in agriculture, food, and human health. Ethical, legal, and social implications of biotechnology.

Gen 313. Principles of Genetics. (Cross-listed with Biol). (3-0) Cr. 3. F.S. *Prereq: Biol 211, 211L, 212, and 212L.* Introduction to the principles of transmission and molecular genetics of plants, animals, and bacteria. Recombination, structure and replication of DNA, gene expression, cloning, quantitative and population genetics. Credit for graduation will not be allowed for more than one of the following: Gen 260, Gen 313 and 313L, Gen 320, Biol 313 and 313L, and Agron 320.

Gen 313L. Genetics Laboratory. (Cross-listed with Biol). (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 313.* Laboratory to accompany 313. Students may receive graduation credit for no more than one of the following: Biol 313 and 313L, Gen 260, Gen 313, Gen 320, and Agron 320.

Gen 320. Genetics, Agriculture and Biotechnology. (Cross-listed with Agron). (3-0) Cr. 3. F.S. *Prereq: Biol 212.* Transmission genetics with an emphasis on applications in agriculture, the structure and expression of the gene, how genes behave in populations and how recombinant DNA technology can be used to improve agriculture. Credit for graduation will not be allowed for more than one of the following: Gen 260, 313, 320, Biol 313 and 313L and Agron 320.

Gen 340. Human Genetics. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Biol 313 or Gen 313.* Fundamental concepts and current issues of human genetics. Human chromosome analysis, pedigree analysis, gene mapping, the human genome project, sex determination, genetics of the immune system, genetics of cancer, gene therapy, the genetic basis of human diversity, eugenics.

Gen 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Gen 409. Molecular Genetics. (3-0) Cr. 3. F. *Prereq: Biol 314.* The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes. Nonmajor graduate credit.

Gen 410. Analytical Genetics. (3-0) Cr. 3. S. *Prereq: 313 or Biol 313.* The principles and practice of genetic analysis. Mendelian genetic analysis, mutational analysis of gene function, linkage and gene mapping, chromosomal aberrations, aneuploidy and polyploidy, extrachromosomal inheritance, analysis of genetic pathways, genetics of quantitative traits. Nonmajor graduate credit.

Gen 444. Introduction to Bioinformatics. (Cross-listed with BCB, Biol, Com S, Cpr E). (4-0) Cr. 4. F. *Prereq: Math 165 or Stat 401 or equivalent.* Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics. Nonmajor graduate credit.

Gen 462. Evolutionary Genetics. (Cross-listed with Biol). (3-0) Cr. 3. S. *Prereq: Biol 315.* The genetic basis of evolutionary processes in higher organisms. The role of genetic variation in adaptation, natural selection, adaptive processes, and the influence of random processes on evolutionary change. Nonmajor graduate credit.

Gen 490. Independent Study. Cr. arr. Repeatable. *Prereq: 313, junior or senior classification, permission of instructor.* Students in the College of Agriculture may use no more than 6 credits of Gen 490 toward the total of 128 credits required for graduation; students in the College of Liberal Arts and Sciences may use no more than 9 credits of Gen 490 toward graduation.
R. Genetics research. Cr. 1 to 5 each time taken.
S. Attendance and critique of genetics seminars. cr. 1. Offered on a satisfactory-fail grading basis only.
U. Laboratory teaching experience. For students registering to be undergraduate laboratory assistants. Cr. 1 to 2. Offered on a satisfactory-fail grading basis only.

Gen 491. Undergraduate Seminar. (1-0) Cr. 1. F. *Prereq: Junior classification.* The investigation of current issues in genetics. Graduate school and employment opportunities discussed. Practice in resume writing and interview techniques. Required for majors in genetics.

Gen 495. Molecular Biology for Computational Scientists. (Cross-listed with BCB). (3-0) Cr. 3. F. Survey of molecular cell biology and molecular genetics for nonbiologists, especially those interested in bioinformatics/computational biology. Basic cell structure and function; principles of molecular genetics; biosynthesis, structure, and function of DNA, RNA, and proteins; regulation of gene expression; selected topics. Provides biological background for BCB 594. Credit for graduation will not be allowed for more than one of Gen 411 and Gen/BCB 495. Nonmajor graduate credit.

Gen 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Geological and Atmospheric Sciences

www.ge-at.iastate.edu/

Carl E. Jacobson, Chair of Department

Distinguished Professor (Emeritus): Vondra

Professors: Arritt, Beresnev, Burras, Chen, Gallus, Gutowski, Iverson, Jacobson, Sandor, Simpkins, Spry, Takle, Thompson

Professors (Emeritus): Seifert, Yarger

Professors (Collaborators): Kato, Koch

Associate Professors: Cervato, Windom, Wu

Associate Professor (Emeritus): Cody

Associate Professors (Collaborators): Brake, Burkart, Hasiotis, Tomer

Assistant Professors: Franz, Harding, Hornbuckle

Assistant Professors (Collaborators): Burke, Jones

Senior Lecturer: Dawson

Lecturers: Flory, Noggle

Undergraduate Study

The department offers courses in Geology and Meteorology. Majors can be earned in earth science (B.A., B.S.), geology (B.S.), and meteorology (B.S.). Candidates for all degrees must satisfy the requirements established by the College of Liberal Arts and Sciences (see *Liberal Arts and Sciences, Curriculum*). In addition, the department has requirements for each major.

The bachelor of science in Geology prepares the student for a professional career and/or graduate study in the geological sciences. Students selecting geology as a major will elect an option in traditional geology or environmental geology/hydrogeology. The traditional option prepares a student for employment in state and U.S. geological surveys, mineral and petroleum exploration, and graduate study in most aspects of geology. Required courses in this option include Geol 100, 100L, 102, 102L, 302, 311, 356, 365, 368, 479 and at least 9 credits of geology electives. The environmental geology/hydrogeology option prepares a student for employment in environmental consulting, state and U.S. geological surveys, regulatory agencies, and graduate study in the environmental aspects of geology. Required courses in this option include Geol 100, 100L, 102, 102L, 302, 311, 356, 368, 411, 419 or 426 or 434, 479, and at least 6 credits of geology electives. Required supporting courses include Chem 177, 177L, 178, 178L; Phys 111, 112; Math 165, 166 or Math 181, 182; at least 6 additional credits from an approved departmental list of courses in the science, engineering, or mathematical disciplines outside of geology. No more than 9 credits in 490 may be counted toward a degree in Geology.

A minor in Geology may be earned by taking 15 credits of geology coursework, including Geol 100 and 100L (or 201), 102, and 102L. The remainder should be at the 300 level or above.

Graduates work to understand natural processes on Earth and other planets. They are able to apply their knowledge of forces and factors that shape the Earth to reconstruct the past and anticipate the future. Graduates provide essential information for solving problems for resource management, environmental protection, and public health, safety, and welfare. They work as consultants on engineering and environmental problems, explorers for new minerals and hydrocarbon resources, researchers, teachers, writers, editors, and museum curators. Graduates are able to integrate field and laboratory data and to prepare reports. They are able to make presentations that include maps and diagrams that illustrate the results of their studies.

The study of Meteorology involves the description of the earth's atmosphere and the processes responsible for its behavior. Students majoring in Meteorology earn the bachelor of science. Successful preparation for professional or graduate work in Meteorology requires that the student develop and integrate a diverse range of skills and knowledge bases. These include weather observing, the physics and dynamics of the global atmosphere, application of new weather technologies, advanced mathematical tools, computer programming and modeling, and effective oral and written communication. The faculty view the senior thesis (Meteorology 499), in particular, as a capstone experience in which students demonstrate they have achieved this integration. Also, contemporary meteorology is an earth-system science with ties to a variety of human experiences. The electives and general education requirements of the college are further experiences that the meteorology student must integrate with their core meteorology knowledge in order to function effectively in a global-oriented profession. The program requires the following courses: Mteor 111, 201, 206, 227, 301, 311, 341, 342, 411, 417, 432, 443, 454, and 499. An additional 9 credits must be chosen from Mteor 402, 404, 406, 407, 452, 490, and Geol 415 or C E 372 (some experimental Mteor courses can also be used). Supporting work is required in areas at least equivalent to Chem 163, 163L; Phys 221, 222; Math 165, 166, 265, 266; Stat 105; Sp Cm 212. A grade of C or better (not C-) is required in each of the following courses to meet minimum graduation requirements for a bachelor of science degree in Meteorology: 206, 301, 311, 341, 342, and 443.

Several co-op programs are available for upper division undergraduates. Although a range of opportunities exists for men and women who terminate their studies with a bachelor of science, students who meet the necessary academic standards are encouraged to continue their studies in a graduate program. For these students, minor work is recommended in a mathematical or physical science. Other students can choose a wide range of supporting courses that will contribute to their particular area of interest in meteorology.

The department offers a minor in Meteorology which may be earned by completing 15 credits including Mteor 111 (only 1 credit may count toward the minor), Mteor 206 and Mteor 301. Further information concerning programs of study, including sample degree programs, is available from the department.

The Earth Science major is a broad program that typically emphasizes an interdisciplinary field. Programs leading to the bachelor of science may be individually designed but will include required courses in Geology and Meteorology, and required supporting work in chemistry, physics, and mathematics. Specific programs have been designed for students interested in a geology, meteorology, or an environmental earth science emphasis. Programs leading to the bachelor of arts for earth science teaching are available. The latter program must satisfy the requirements of the Teacher Education Program (see *Index, Teacher Education*).

Communication Proficiency requirement: The department requires a grade of C or better in each of English 150 and 250 (or 250H), and a C or better in English 314 or 302 or JI MC 347.

Graduate Study

The department offers programs leading to the master of science and doctor of philosophy with majors in Earth Science, Geology, and Meteorology. Program options are available for the M.S. and Ph.D. degrees in earth science leading to careers in teaching. The department also cooperates in the interdepartmental major in Water Resources (see *Index*). Students desiring a major in the above fields normally will have a strong undergraduate background in the physical and mathematical sciences. Individuals desiring to enter a graduate program are evaluated by considering their undergraduate background and performance and their expressed goals.

Programs of study are designed on an individual basis in accordance with requirements of the Graduate College and established requirements for each departmental major. Minor work is normally taken in aerospace engineering, Agronomy (soil science), chemistry, civil and construction engineering, computer engineering, computer science, engineering mechanics, materials engineering, mathematics, mechanical engineering, microbiology, physics, or Statistics. Departmental requirements provide a strong, broad background in the major and allow considerable flexibility in the program of each individual.

A dissertation is required of all Ph.D. candidates. M.S. students in Geology are required to complete a thesis. The M.S. in Earth Science is available to students electing the non-thesis (Creative Component) option in Geology or Meteorology. A non-thesis option is also offered for the M.S. degree in Meteorology.

Graduates in Geology specialize in a subdiscipline, but they comprehend and can communicate the basic principles of geology and supporting sciences. They possess the capacity for critical and independent thinking. They are able to write a fundable research proposal, evaluate current relevant literature, carry out the proposed research, and communicate the results of their research to peers at national meetings and to the general public. They work as consultants on engineering and environmental problems, explorers for new minerals and hydrocarbon resources, researchers, teachers, writers, editors, and museum curators.

All candidates for an advanced degree in Meteorology are expected to complete Mteor 542, 543, and 552. In addition, students without prior synoptic course-work must complete Mteor 511; other students must complete Mteor 507 or Agron 507. Students must also complete Mteor 504 (or Agron 504) or Mteor 605 or Agron 505.

Graduates in Meteorology have a good comprehension of basic principles, a capacity for critical and independent thought and an ability to communicate effectively with scientific colleagues. They have an appropriate breadth in their understanding of meteorology with a suitable specialization. Graduates are able to undertake thorough research and explain the results in a scientifically reasonable fashion.

Geology (Geol)

Courses primarily for undergraduate students

Geol 100. The Earth. (3-0) Cr. 3. F.S.SS. How does the earth work, what is it made of, and how does it change through time? Plate tectonics, Earth materials, land forms, structures, climate, and natural resources. Emphasis on the observations and hypotheses used to interpret earth system processes. Students may also enroll in Geol 100L.

Geol 100L. The Earth: Laboratory. (0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in 100.* Characterization of rocks and minerals; interpretation of structures and landforms.

Geol 101. Environmental Geology: Earth in Crisis. (Cross-listed with Env S). (3-0) Cr. 3. F.S. An introduction to geologic processes and the consequences of human activity from local to global scales. Discussion of human population growth, resource depletion, pollution and waste disposal, global warming and ozone depletion, desertification, and geologic hazards such as earthquakes, landslides, flooding, and volcanism.

Geol 102. History of the Earth. (3-0) Cr. 3. S. *Prereq: 100 or 201.* The Earth's physical and biological evolution; concepts of global tectonics. Methods used to decipher earth history. Students majoring in geology must also enroll in Geol 102L.

Geol 102L. History of the Earth: Laboratory. (0-2) Cr. 1. S. *Prereq: Credit or enrollment in 102.* Introduction to the use of sedimentary rocks and fossils in reconstructing the Earth's history.

Geol 108. Introduction to Oceanography. (Cross-listed with Env S). (3-0) Cr. 3. F. Introduction to study of the oceans. Ocean exploration. Waves and currents. Shape, structure, and origin of the ocean basins. Sedimentary record of oceanic life. Composition of seawater and its significance for life. Ocean circulation and its influence on climate. Life of the oceans, including coral reefs. Use and misuse of ocean resources. Anthropogenic impacts on the oceanic environment.

Geol 160. Water Resources of the World. (Cross-listed with Mteor, Env S, Agron). (3-0) Cr. 3. S. Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in society and the environment.

Geol 201. Geology for Engineers and Environmental Scientists. (2-2) Cr. 3. F. Introduction to Earth materials and processes with emphasis on engineering and environmental applications.

Geol 290. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

Geol 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: 100 or 201, 100L, 102, 102L, and permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing the work period.

Geol 302. Summer Field Studies. Cr. 6. SS. *Prereq: 102, 356, 368.* Geologic mapping; structural, stratigraphic, sedimentologic, and geomorphic analyses. Study areas include world-class dinosaur localities. A 6-week summer field course required of all geology majors. Nonmajor graduate credit.

Geol 306. Geology Field Trip. Cr. arr. Repeatable. F.S. *Prereq: 100 or 201, permission of instructor.* Geology of selected regions studied by correlated readings followed by a field trip to points of geologic interest. Ten-day field trip required.

Geol 311. Mineralogy and Earth Materials. (3-6) Cr. 5. F. *Prereq: 100 or 201, Chem 163. Introduction to mineral classification, elementary crystal chemistry, crystal morphology, mineral stability, and associations.* Laboratory problems in mineral identification methods, including hand-specimen identification, optical microscopy, and x-ray diffraction. Nonmajor graduate credit.

Geol 324. Energy and the Environment. (Cross-listed with Env S, Mteor). (3-0) Cr. 3. S. Renewable and non-renewable energy resources. Origin, occurrence, and extraction of fossil fuels. Nuclear, wind, and solar energy. Energy efficiency. Environmental effects of energy production and use, including air pollution, acid precipitation, groundwater contamination, nuclear waste disposal, and global climate change. Geol 324 does not count toward credits required in the Geology major.

Geol 356. Structural Geology. (3-6) Cr. 5. S. *Prereq: 100 or 201; Phys 111, Math 165 or 181.* Principles of stress and strain. Brittle and ductile behavior of rocks. Description and classification of joints, faults, folds, fractures, foliation, and lineation. Plate tectonics and regional geology. Laboratory includes application of geometrical techniques to solve structural problems; emphasizes map interpretation and use of stereonet and computer methods. Nonmajor graduate credit.

Geol 365. Igneous and Metamorphic Petrology. (2-3) Cr. 3. S. *Prereq: 311.* Nature and origin of igneous and metamorphic rocks. Emphasis on important rock-forming environments and processes and their influence on rock characteristics. Laboratory includes thin section study of rock textures and mineralogy and the interpretation of these features. Field trips. Nonmajor graduate credit.

Geol 368. Stratigraphy and Sedimentation. (3-2) Cr. 4. F. *Prereq: 311.* Origin of sedimentary rocks and the characteristics of major depositional systems, geologic time, stratigraphic nomenclature, methods of correlation, facies and facies analysis, sequence stratigraphy, sedimentary tectonics and basin analysis. Required field and laboratory-based problem with a comprehensive written report. Nonmajor graduate credit.

Geol 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 100 or 201, 100L, 102, 102L, and permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Geol 402. Watershed Hydrology. (Dual-listed with 502). (Cross-listed with Agron, EnSci, Mteor, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

Geol 409. Field Methods in Hydrogeology. (Dual-listed with 509). (Cross-listed with EnSci). (0-4) Cr. 2. Alt. SS., offered 2010. *Prereq: 402 or 411 or C E 473.* Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, electronic instrumentation for data collection, and geophysics. Field trips to investigate water resource, water quality, and remediation projects.

Geol 411. Hydrogeology. (Dual-listed with 511). (Cross-listed with EnSci). (3-2) Cr. 4. F. *Prereq: Geol 100 or 201; Math 165 or 181; Phys 111 or 221.* Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations. Nonmajor graduate credit.

Geol 414. Applied Groundwater Flow Modeling. (Dual-listed with 514). (Cross-listed with EnSci). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 411 or C E 473; Math 165 or 181.* Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course. Nonmajor graduate credit.

Geol 415. Paleoclimatology. (Dual-listed with 515). (Cross-listed with EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Four courses in biological or physical science.* Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods; utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~1 million years). Nonmajor graduate credit.

Geol 419. Environmental Geochemistry. (Dual-listed with 519). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: 402 or 411 or equivalent.* Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling. Nonmajor graduate credit.

Geol 426. Stable Isotopes in the Environment. (Dual-listed with 526). (Cross-listed with EnSci). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Four courses in biological or physical science.* Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance. Nonmajor graduate credit.

Geol 434. Contaminant Hydrogeology. (Dual-listed with 534). (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: Geol 411 or equivalent.* Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface Microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies. Nonmajor graduate credit.

Geol 451. Applied and Environmental Geophysics. (Dual-listed with 551). (Cross-listed with EnSci). (2-2) Cr. 3. S. *Prereq: 100 or 201, Math 181 or equivalent experience.* Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic - and resistivity-imaging systems and radar. Nonmajor graduate credit.

Geol 452. GIS for Geoscientists. (Dual-listed with 552). (Cross-listed with Agron, EnSci). (2-2) Cr. 3. F. *Prereq: 100, 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses. Nonmajor graduate credit.

Geol 457. Exploration Seismology. (Dual-listed with 557). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: 100 or 201, Math 181 or equivalent experience.* Physics of elastic-wave propagation. Seismic surveys in environmental imaging, engineering, and petroleum exploration. Reflection and refraction techniques. Data collection, processing, and geological interpretation. Field work with state-of-the-art equipment. Nonmajor graduate credit.

Geol 474. Glacial and Quaternary Geology. (Dual-listed with 574). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 100 or 201 or equivalent experience.* The study of the depositional and erosional processes of glaciers using modern glacier analogs and landforms. Discussion of glaciology, glacier hydrology, Quaternary history and stratigraphy, paleoclimatology, and causes of glaciation. Laboratory emphasizes aerial photo and topographic map interpretation and the Quaternary stratigraphy of Iowa. Two required field trips. Nonmajor graduate credit.

Geol 479. Surficial Processes. (Dual-listed with 579). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: 100 or 201 or equivalent experience.* Study of surficial processes in modern and ancient geological environments. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory emphasizes aerial photo and topographic map interpretation. Nonmajor graduate credit.

Geol 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in geology and permission of instructor.* No more than 9 credits of Geol 490 may be counted toward graduation.

Geol 495. Undergraduate Seminar. Cr. 1. F.S. *Prereq: Junior or senior classification.* Weekly seminar on topics of current research interest.

Geol 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Geol 100 or 201, 100L, 102, 102L, and permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

Geol 502. Watershed Hydrology. (Dual-listed with 402). (Cross-listed with EnSci, Mteor). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

Geol 506. Geology Field Trip. Cr. arr. Repeatable. F.S. *Prereq: Graduate classification.* Geology of selected regions studied by correlated readings, followed by a field trip to points of geologic interest. Ten-day field trip.

Geol 507. Midwestern Geology Field Trip. Cr. 1. Repeatable. F. *Prereq: Geol 365.* On-site inspection of various ore deposits, mining operations, and terrains dominated by igneous or metamorphic rocks. Satisfactory-fail only.

Geol 509. Field Methods in Hydrogeology. (Dual-listed with 409). (Cross-listed with EnSci). (0-4) Cr. 2. Alt. SS., offered 2010. *Prereq: 402 or 411 or C E 473.* Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, electronic instrumentation for data collection, and geophysics. Field trips to investigate water resource, water quality, and remediation projects.

Geol 511. Hydrogeology. (Dual-listed with 411). (Cross-listed with EnSci). (3-2) Cr. 4. F. *Prereq: Geol 100 or 201; Math 165 or 181; Phys 111 or 221.*

Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations.

Geol 514. Applied Groundwater Flow Modeling. (Dual-listed with 414). (Cross-listed with EnSci). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 411 or C E 473; Math 165 or 181.* Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course.

Geol 515. Paleoclimatology. (Dual-listed with 415). (Cross-listed with EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Four courses in biological or physical science.* Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods; utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~ 1 million years).

Geol 519. Environmental Geochemistry. (Dual-listed with 419). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: 511 or equivalent.* Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling.

Geol 526. Stable Isotopes in the Environment. (Dual-listed with 426). (Cross-listed with EnSci). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Four courses in biological or physical science.* Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance.

Geol 534. Contaminant Hydrogeology. (Dual-listed with 434). (Cross-listed with EnSci). (3-0) Cr. 3. S. *Prereq: Geol 511 or equivalent.* Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface Microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies.

Geol 542. Optical Mineralogy. (1-2) Cr. 2. F. *Prereq: 311.* Introduction to using the microscope for mineral identification. Optical properties of minerals in immersion oils and in thin section. Research project required.

Geol 551. Applied and Environmental Geophysics. (Dual-listed with 451). (Cross-listed with EnSci). (2-2) Cr. 3. S. *Prereq: 100 or 201, Math 181 or equivalent experience.* Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic- and resistivity-imaging systems and radar.

Geol 552. GIS for Geoscientists. (Dual-listed with 452). (Cross-listed with Agron, EnSci). (2-2) Cr. 3. F. *Prereq: Geol 100, 201 or equivalent.* Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

Geol 555. Soil Clay Mineralogy. (Cross-listed with Agron). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Agron 473, Chem 178. Recommend: Geol 311.* Structure and behavior of clay minerals in soil environments, with emphasis on layer silicates and on Fe, Mn, and Al oxides.

Geol 555L. Soil Clay Mineralogy Laboratory. (Cross-listed with Agron). (0-3) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in 555.* Thompson. Application of X-ray diffraction, thermal analysis, infrared spectroscopy, and chemical analyses to identification and behavior of clay minerals in soils.

Geol 557. Exploration Seismology. (Dual-listed with 457). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: 100 or 201, Math 181 or equivalent experience.* Physics of elastic-wave propagation. Seismic surveys in environmental imaging, engineering, and petroleum exploration. Reflection and refraction techniques. Data collection, processing, and geological interpretation. Field work with state-of-the-art equipment.

Geol 558. Introduction to the 3D Visualization of Scientific Data. (Cross-listed with HCI, Com S). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate-student standing in the Mathematical or natural sciences.* Introduction to visualizing scientific information with 3D computer graphics and their foundation in human perception. Overview of different visualization techniques and examples of 3D visualization projects from different disciplines (natural sciences, medicine, engineering). Class project in interactive 3D visualization using the OpenDX, VTK or a similar system.

Geol 574. Glacial and Quaternary Geology. (Dual-listed with 474). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 100 or 201.* The study of the depositional and erosional processes of glaciers using modern glacier analogs and landforms. Discussion of glaciology, glacier hydrology, Quaternary history and stratigraphy, paleoclimatology, and causes of glaciation. Laboratory emphasizes aerial photo and topographic map interpretation and the Quaternary stratigraphy of Iowa. Two required field trips.

Geol 579. Surficial Processes. (Dual-listed with 479). (Cross-listed with EnSci). (2-2) Cr. 3. F. *Prereq: Geol 100 or 201 or equivalent experience.* Study of surficial processes in modern and ancient geological environments. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory emphasizes aerial photo and topographic map interpretation.

Geol 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
A. Surficial Processes
B. Stratigraphy
C. Sedimentation
D. Paleontology
E. Petrology
F. Structural Geology
G. Geochemistry
H. Hydrogeology
I. Earth Science
J. Mineral Resources
K. Geophysics
L. Mineralogy
M. Tectonics
N. Paleoecology and Paleoclimatology
O. Isotope Geochemistry
P. Computational Methods and GIS
R. Surface Hydrology

Geol 595. Graduate Seminar. Cr. 1. Repeatable. F.S. *Prereq: Senior or graduate classification.* Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester. Satisfactory-fail only.
A. Cr. 1. Presentation required.
B. Cr. R. Attendance only.

Geol 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

Geol 610. Advanced Seminar. Cr. arr. Repeatable. F.S. *Prereq: Graduate standing and permission of instructor.*
A. Earth Materials
B. Economic Geology
C. Environmental Geochemistry
D. Geophysics
E. Geotectonics
F. Hydrogeology
G. Surficial Processes
H. Sedimentation and Stratigraphy
I. Paleoecology and Paleoclimatology
J. Isotope Geochemistry
K. Computational Methods and GIS

Geol 699. Research. Cr. arr. Repeatable.
A. Surficial Processes
B. Stratigraphy
C. Sedimentation
D. Paleontology
E. Petrology
F. Structural Geology
G. Geochemistry
H. Hydrogeology
I. Earth Science
J. Mineral Resources
K. Geophysics
L. Mineralogy
M. Tectonics
N. Paleoecology and Paleoclimatology
O. Isotope Geochemistry
P. Computational Methods and GIS
R. Surface Hydrology

Meteorology (Mteor)

Courses primarily for undergraduate students

Mteor 111. Synoptic Applications. (1-0) Cr. 1. Repeatable. F. *Prereq: Credit or enrollment in Math 165.* Current weather discussions and introduction to synoptic-scale interpretation of meteorology. Application and use of calculus in meteorology. Course restricted to majors. Others with permission of instructor.

Mteor 160. Water Resources of the World. (Cross-listed with Geol, Env S, Agron). (3-0) Cr. 3. S. Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in Society and the environment.

Mteor 201. Introductory Seminar. (1-0) Cr. R. F. An overview of the atmospheric sciences, the meteorology program at Iowa State, and the major research journals used in the discipline.

Mteor 206. Introduction to Meteorology. (Cross-listed with Agron). (3-0) Cr. 3. F.S. Basic concepts in meteorology, including atmospheric measurements, radiation, stability, precipitation, winds, fronts, forecasting, and severe weather. Applied topics include global warming, ozone depletion, world climates and weather safety. Self-study laboratory assignments utilize interactive computerized exercises, worksheets and computerized real-time forecasting. Self-study section may be available to distant education students.

Mteor 227. Computational Meteorology I. (3-1) Cr. 3. F. *Prereq: Credit or concurrent enrollment in Mteor 206, credit or concurrent enrollment in Phys 221.* An introduction to computer programming using FORTRAN with focus on meteorological applications. Emphasis on basics of good programming techniques and style through extensive practice in top-down design, writing, running, and debugging small programs. Topics include operations and functions, selective execution, repetitive execution, arrays, input/output, file processing, and subprograms. This course is designed for majors.

Mteor 265. Scientific Balloon Engineering and Operations. (Cross-listed with Aer E). (0-2) Cr. 1. F. Engineering aspects of scientific balloon flights. Integration of science mission objectives with engineering requirements. Operations team certification. FAA and FCC regulations, communications, and command systems. Flight path prediction and control.

Mteor 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing the work period.

Mteor 301. General Meteorology. (4-0) Cr. 4. S. *Prereq: Math 166, credit or enrollment in Phys 222.* Global distribution of temperature, wind, and atmospheric constituents; atmospheric thermodynamics, radiative transfer, global energy balance, storms and clouds, introductory dynamics. Nonmajor graduate credit.

Mteor 311. Introduction to Synoptic Meteorology. (1-2) Cr. 2. F. *Prereq: 301.* Concepts of weather map plotting and analysis. Introduction to forecasting and to the use of real-time UNIDATA computer products. Nonmajor graduate credit.

Mteor 321. Meteorology Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: 311; junior or senior standing; permission of co-op program coordinator; acceptance by sponsoring agency.* Supervised practical experience in a professional meteorological agency. Experiences may include providing weather information for radio, TV, utilities, government agencies, construction, or agribusiness.

Mteor 324. Energy and the Environment. (Cross-listed with Env S, Geol). (3-0) Cr. 3. S. Renewable and non-renewable energy resources. Origin, occurrence, and extraction of fossil fuels. Nuclear, wind, and solar energy. Energy efficiency. Environmental effects of energy production and use, including air pollution, acid precipitation, groundwater contamination, nuclear waste disposal, and global climate change. Mteor 324 does not count toward credits required in the meteorology major.

Mteor 341. Atmospheric Physics I. (3-0) Cr. 3. F. *Prereq: Phys 222, credit or enrollment in Math 266.* Basic laws of thermodynamics, thermodynamics of water vapor, mixtures of gases, stability, hydrostatics, cloud physics. Nonmajor graduate credit.

Mteor 342. Atmospheric Physics II. (3-0) Cr. 3. S. *Prereq: 341.* Precipitation physics, radar, atmospheric radiation, atmospheric optics, atmospheric electricity. Nonmajor graduate credit.

Mteor 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing the work period.

Mteor 402. Watershed Hydrology. (Dual-listed with 502). (Cross-listed with Agron, EnSci, Geol, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

Mteor 404. Global Change. (Dual-listed with 504). (Cross-listed with Agron, EnSci, Env S). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Nonmajor graduate credit.

Mteor 405. Environmental Biophysics. (Dual-listed with 505). (Cross-listed with Agron, EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities.

Mteor 406. World Climates. (Cross-listed with Agron, EnSci). (3-0) Cr. 3. F. *Prereq: Agron/Mteor 206.* Arritt. Distribution and causes of different climates around the world. Effects of climate and climate variations on human activities including Society, economy and agriculture. Current issues such as climate change and international efforts to assess and mitigate the consequences of a changing climate. Semester project and in-class presentation required. Nonmajor graduate credit.

Mteor 407. Mesoscale Meteorology. (Dual-listed with 507). (Cross-listed with Agron). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 166 and Mteor 454.* Gallus. Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

Mteor 411. Synoptic Meteorology. (Dual-listed with 511). (1-4) Cr. 3. F. *Prereq: Credit or enrollment in 454.* Current weather forecasting and discussion. Applications of atmospheric physics and dynamics in real-time weather situations. Use of UNIDATA computer products. Nonmajor graduate credit.

Mteor 417. Mesoscale Forecasting Laboratory. (Dual-listed with 517). (1-5) Cr. 3. S. *Prereq: Credit or enrollment in 411.* Real-time computer analysis of current weather, with emphasis on small-scale features. Studies of severe weather, lake-effect snow, CSI, cold-air damming. Nonmajor graduate credit.

Mteor 432. Instrumentation and Measurements. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in Stat 105, Math 266, Phys 222.* Measurement of meteorological variables and instruments used, including surface, upper air, and remote sensors; measurement errors, signal processing, recording and archiving; quality assurance. Nonmajor graduate credit.

Mteor 443. Dynamic Meteorology I. (3-0) Cr. 3. S. *Prereq: 341.* Conservation laws, governing equations, circulation and vorticity. Development of quasi-geostrophic theory. Nonmajor graduate credit.

Mteor 452. Physics of Climate. (Dual-listed with 552). (3-0) Cr. 3. F. *Prereq: Mteor 301.* Exploration of the fundamental physical principles that govern the climate systems of the Earth and other planets. Emphasis on coupled, nonlinear-system interactions of physical processes such as circulation dynamics, radiative transfer, and cloud/precipitation physics, starting with fairly simple 0- and 1-dimensional analytical and numerical models based on energy, mass, and momentum conservation. Observational study of seasonally evolving weather patterns that form climates around the world. Nonmajor graduate credit.

Mteor 454. Dynamic Meteorology II. (3-0) Cr. 3. F. *Prereq: 443.* Planetary boundary layer, linear perturbation theory, atmospheric wave motions, baroclinic and convective instability, mesoscale circulations. Nonmajor graduate credit.

Mteor 471. History of Modern Meteorology. (Dual-listed with 571). (1-0) Cr. 1. Alt. S., offered 2010. *Prereq: Mteor 341, 342, 411, 443, 452* Development of meteorological theories and numerical weather prediction, discoveries of important meteorological phenomena, and impact of weather and climate on important historical events.

Mteor 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in meteorology, permission of instructor.* No more than 9 credits in Mteor 490 may be counted toward graduation.
A. Synoptic Meteorology.
B. Dynamic Meteorology.
C. Physical Meteorology.
D. Instrumentation.
E. Hydrology.

Mteor 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Mteor 499. Senior Research. (2-0) Cr. 2. F. Required of all senior meteorology majors. Research projects in collaboration with faculty. Written and oral presentations of results at the end of the semester.

Courses primarily for graduate students, open to qualified undergraduate students

Mteor 502. Watershed Hydrology. (Dual-listed with 402). (Cross-listed with EnSci, Geol). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

Mteor 504. Global Change. (Dual-listed with 404). (Cross-listed with Agron, EnSci). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior, senior, or graduate standing.* Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change.

Mteor 505. Environmental Biophysics. (Dual-listed with 405). (Cross-listed with Agron, EnSci). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Math 166 or equivalent.* Hornbuckle. The physical microenvironment in which organisms live, with an emphasis on the processes of energy and mass (water and carbon) exchange between organisms and their environment and the quantitative models that are used to represent these processes. Temperature, water, and wind. Heat, mass, and radiative transport. Applications to animals, plants, and plant communities. Semester project required.

Mteor 507. Mesoscale Meteorology. (Dual-listed with 407). (Cross-listed with Agron). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 166 and Mteor 454.* Gallus. The physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure. Semester project and in-class presentation required.

Mteor 511. Synoptic Meteorology. (Dual-listed with 411). (1-4) Cr. 3. F. *Prereq: Credit or enrollment in 454.* Current weather forecasting and discussion. Applications of atmospheric physics and dynamics in real-time weather situations. Use of UNIDATA computer products.

Mteor 517. Mesoscale Forecasting Laboratory. (Dual-listed with 417). (1-5) Cr. 3. S. *Prereq: Credit or enrollment in 411.* Real-time computer analysis of current weather, with emphasis on small-scale features. Studies of severe weather, lake-effect snow, CSI, cold-air damming.

Mteor 518. Microwave Remote Sensing. (Cross-listed with Agron, E E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 265 or equivalent or permission of instructor.* Hornbuckle. Microwave remote sensing of Earth's surface and atmosphere. Overview of relevant electromagnetic theory and antenna theory. Planck emission and the radiative transfer equation. The electrical properties of natural materials at microwave frequencies. Specific examples include remote sensing of atmospheric temperature and water vapor, precipitation, and soil and vegetation water content.

Mteor 542. Physical Meteorology. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 342, Math 266, Phys 222.* Planetary atmospheres, radiative equilibrium models, radiative transfer, the upper atmosphere, remote sounding from satellites.

Mteor 543. Advanced Dynamic Meteorology I. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 455.* The first half of a two semester sequence. Governing equations, scale analysis, simple types of wave motion in the atmosphere, instability theory.

Mteor 544. Advanced Dynamic Meteorology II. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 543.* Continuation of 543. General circulation and dynamics of zonally symmetric circulations, atmospheric energetics, nonlinear dynamics of planetary waves.

Mteor 552. Physics of Climate. (Dual-listed with 452). (3-0) Cr. 3. F. *Prereq: Mteor 301.* Exploration of the fundamental physical principles that govern the climate systems of the Earth and other planets. Emphasis on coupled, nonlinear-system interactions of physical processes such as circulation dynamics, radiative transfer, and cloud/precipitation physics, starting with fairly simple 0- and 1-dimensional analytical and numerical models based on energy, mass, and momentum conservation. Observational study of seasonally evolving weather patterns that form climates around the world.

Mteor 561. Geophysical Fluid Dynamics. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 455 or E M 378 or M E 335 or Phys 361.* Basic concept of rotating fluid dynamics, governing equations and boundary conditions, dynamics of vorticity, potential vorticity and geostrophic motion, wave motion in a rotating system, dynamics of Ekman and Stewartson layers, ocean circulation.

Mteor 571. History of Modern Meteorology. (Dual-listed with 471). (1-0) Cr. 1. Alt. S., offered 2010. *Prereq: Mteor 341, 342, 411, 443, 452.* Development of meteorological theories and numerical weather prediction, discoveries of important meteorological phenomena, and impact of weather and climate on important historical events.

Mteor 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics of current interest.
A. Boundary-layer Meteorology
B. Tropical Meteorology
C. Mesoscale Meteorology
D. Global Climate Systems
E. Climate Modeling
F. Numerical Weather Prediction
G. Satellite Observations
H. Statistical Methods in Meteorology
I. Field Observations
J. Low Frequency Modes
K. Cloud Physics
L. Atmospheric Radiation
M. Hydrology

Courses for graduate students

Mteor 605. Micrometeorology. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 443.* Atmospheric boundary layer, structure and dynamics. Turbulence, soil influences, measurements and empirical relations for wind and temperature profiles near the ground. Simulation of boundary layer structure and dynamics.

Mteor 699. Research. Cr. arr. Repeatable.

Gerontology

www.iastate.edu/~gerontology

(Interdepartmental Minor and Interinstitutional Program)

Advisory Committee: P. Martin, Director; L. Alekel, W. Franke, J. Lempers, Fred Lorenz, Jennifer Margrett, Mack Shelley, A. Smiley-Oyen, R. West

The gerontology program is designed for students desiring careers in aging-related fields and for students interested in improving their understanding of aging persons in American Society. Students are expected to take courses to develop the necessary interdisciplinary breadth which, in combination with other disciplinary training, can prepare them to work with older adults.

Graduates understand the ways in which individual and Societal aging influence, and are impacted by, developments in their major field of study. They have an appreciation and understanding of the cross-disciplinary aspects of human aging.

Gerontology courses are offered in the interdepartmental gerontology program in the following participating departments and programs: Architecture; Biochemistry, Biophysics, and Molecular Biology; Economics; Apparel, Educational Studies, and Hospitality Management, Food Science and Human Nutrition; Health and Human Performance; Human Development and Family Studies; Political Science; Psychology; and Sociology.

Undergraduate Study

Christine Cook, Coordinator

Undergraduate study in this program provides the student with an opportunity to develop a minor in gerontology. A balanced grouping of courses assists the student in developing both a sensitivity to the issues and the ability to synthesize ideas from the variety of disciplines important to the study of the aging process.

Undergraduate students may minor in gerontology by taking 16 semester hours of gerontology related courses. Nine of these credits must come from the following courses: Geron 373, 377, 378, 463. Students will participate in a prepracticum seminar, Geron 466, and will complete a supervised field practicum after all gerontology coursework is completed (Geron 467). A minimum of 3 semester credits must be selected from a list of supportive gerontology related courses. Supportive courses include units or topics related to aging and can be used to complement the student's major interests. The student's minor program must be approved by the undergraduate gerontology coordinator.

Graduate Study

Karen Bermann, Coordinator

A declared graduate minor in gerontology consists of a minimum of 12 credits taken from a list of acceptable courses, and from at least two departments. Nine of the 12 credits must be in courses that are focused specifically on aging. One 590 course (3 credits maximum) can be taken as part of the 12 credits. Geron 510 is required for all minor students. At least one member of the gerontology faculty will be on a student's advisory committee; this person must be a member of the Graduate Faculty. Contact the coordinator to determine whether courses other than those listed below are available.

Interinstitutional Program

Contact: Peter Martin

Participating Faculty:

Iowa State University
Gerontology Program
Peter Martin, pxmartin@iastate.edu
Christine Cook, cccook@iastate.edu
Jennifer Margrett, margrett@iastate.edu

Kansas State University
College of Arts and Sciences
Gayle Doll, gdoll@ksu.edu
Lyn Norris-Baker, lyn@ksu.edu

College of Human Ecology
Janice Dinkel, dinkel@ksu.edu

North Dakota State University
College of Human Development and Education
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Texas Tech University
College of Human Sciences
JeAn Scott, jean.scott@ttu.edu

University of Missouri
Terasa Cooney. cooneyT@missouri.edu
Marilyn Coleman, ColemanMA@missouri.edu
Timothy Killian, TKillian@uark.edu

Gerontology is an interinstitutional distance education program offered through the Web. The student selects the home institution, which grants the degree. After admission at the home institution, the student takes courses from each of the six institutions: Iowa State University, Kansas State University, North Dakota State University, Oklahoma State University, Texas Tech University, and the University of Missouri.

At Iowa State University, gerontology is an area of specialization in the Master of Family and Consumer Sciences degree program of 36 semester hours, 24 of these hours are from the following courses: Geron 530, 534, 540, 545, 563, 577, 584, 594. The remaining 12 credits will include electives and specific courses needed to meet the requirements of the institution awarding the degree. Neither a thesis nor a creative component is required. A computer with a CD-ROM drive, the capacity to access and download materials from the Internet, and a browser equivalent to Netscape/Explorer 4.0 or newer are required for completing the program. An e-mail address is essential as well, plus access to a VCR and a FAX.

Gerontology Graduate Certificate Program

The 21-credit Graduate Certificate Program in Gerontology includes five courses from the list of core courses: Geron 530, 534, 540, 585, 594. The additional six credits required for the certificate can be chosen from the remaining core courses or from other approved elective courses. A maximum of three credits of practicum also can be included in the elective credits.

Admission Procedures: Admission to the Gerontology Certificate Program requires exactly the same procedures as admission to the Graduate College. See *Graduate College* section of the catalog.

Registration: Students choosing to receive their degree from Iowa State University complete all the admissions, registration, and fee payment processes through ISU.

Courses primarily for undergraduate students

Geron 373. Death as a Part of Living. (Cross-listed with HD FS). (3-0) Cr. 3. F.S.Alt. SS., offered 2010. *Prereq: HD FS 102.* Consideration of death in the life span of the individual and the family with opportunity for exploration of personal and Societal attitudes.

Geron 377. Aging and the Family. (Cross-listed with HD FS). (3-0) Cr. 3. *Prereq: HD FS 102.* Interchanges of the aged and their families. Emphasis on role changes, social interaction, and independence as influenced by health, finances, life styles, and community development.

Geron 378. Economics of Aging. (Cross-listed with Econ, HD FS). (3-0) Cr. 3. S. *Prereq: 3 credits in principles of economics and 3 credits in human development and family studies.* Economic Status of the aging, retirement planning and the retirement decision, role of Social Security, public transfer programs for the elderly, intrafamily transfers to/from the elderly, private pensions, financing medical care and housing for the elderly, prospects and issues for the future.

Geron 463. Environments for the Aging. (Dual-listed with 563). (Cross-listed with HD FS, ArtID). (3-0) Cr. 3. S. *Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies.* Emphasis on independent living within residential settings including specialized shelter, supportive services, and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities.

Geron 466. Gerontology Prepracticum Seminar. (1-0) Cr. 1. F.S.SS. *Prereq: 9 credits in core courses for the gerontology minor and approval of the gerontology undergraduate coordinator.* Prepracticum training for students planning a gerontology practicum. Exploration of possible agencies for the practicum, in-depth study of a selected agency, and development of goals and objectives for the practicum.

Geron 467. Gerontology Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: 466, advance reservation.* Supervised field experience related to aging. Satisfactory-fail only.

Geron 490. Independent Study. Cr. arr. Consult program coordinator for procedure.

Courses primarily for graduate students, open to qualified undergraduate students

Geron 501. Seminar. Cr. arr. Repeatable. F.S.SS.

Geron 510. Survey of Gerontology. Cr. arr. Repeatable. S. Provides an overview of important gerontological issues.

Geron 530. Perspectives in Gerontology. (Cross-listed with HD FS). (3-0) Cr. 3. F. WWW only. Overview of current aging issues including theory and research, critical social and political issues in aging, the interdisciplinary focus of gerontology, career opportunities, and aging in the future.

Geron 534. Adult Development. (Cross-listed with HD FS). (3-0) Cr. 3. F: on campus. S: WWW only. Exploration of the biological, psychological, and social factors associated with aging. Although the focus is on the later years, information is presented from a life-span developmental framework. Empirical studies are reviewed and their strengths, limitations and implications for normative and optimal functioning are discussed.

Geron 540. Nutrition and Physical Activity in Aging. (Cross-listed with Diet). (3-0) Cr. 3. Alt. F., offered 2010. WWW only. Basic physiologic changes during aging and their impacts in health and disease. The focus will be on successful aging with special emphasis on physical activity and nutrition. Practical application to community settings is addressed.

Geron 545. Economics, Public Policy, and Aging. (Cross-listed with HD FS). (3-0) Cr. 3. Alt. F., offered 2010. WWW only. Policy development in the context of the economic Status of the older adult population. Retirement planning and the retirement decisions; social security and public transfer programs; intra-family transfers to/from the aged; private pensions; financing medical care; prospects and issues for the future.

Geron 563. Environments for the Aging. (Dual-listed with 463). (Cross-listed with HD FS). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies.* Emphasis on independent living within residential settings including specialized shelter, supportive services and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities.

Geron 571. Design for All People. (Cross-listed with Arch, Dsn S). (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Principles and procedures of universal design in response to the varying ability level of users. Assessment and analysis of existing buildings and sites with respect to standards and details of accessibility for all people, including visually impaired, mentally impaired, and mobility restricted users. Design is neither a prerequisite nor a required part of the course. Enrollment open to students majoring in related disciplines. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Geron 577. Aging in the Family Setting. (Cross-listed with HD FS). (3-0) Cr. 3. *Prereq: 9 credits in social sciences.* Alt. S., offered 2008: on campus. Alt. S. offered 2009: WWW only. Theories and research related to personal and family adjustments in later life affecting older persons and their intergenerational relationships. Related issues including demographics also are examined through the use of current literature.

Geron 584. Program Evaluation and Research Methods in Gerontology. (Cross-listed with HD FS). (3-0) Cr. 3. Alt. SS., offered 2010. WWW only. Overview of program evaluation, research methods, and grant writing in gerontology. Includes application of quantitative and qualitative methods in professional settings.

Geron 590. Special Topics. Cr. arr. Repeatable. Consult program coordinator for procedure.

Geron 594. Professional Seminar in Gerontology. (Cross-listed with HD FS). (3-0) Cr. 3. Alt. SS., offered 2011. WWW only. An integrative experience for gerontology students designed to be taken near the end of the degree program. By applying knowledge gained in earlier coursework, students will strengthen skills in ethical decision-making behavior, applying these skills in gerontology-related areas such as advocacy, professionalism, family and workplace issues. Students from a variety of professions will bring their unique perspectives to bear on topics of common interest.

Global Resource Systems

www.globe.iastate.edu

Gail R. Nonnecke, Faculty Coordinator

Supervisory Committee: David Acker, Richard Hall, Arne Hallam, Jeffery Iles, Kendall Lamkey, Ruth MacDonald, and Robert Martin

Global Resource Systems is a cutting-edge, interdisciplinary, college-wide major that prepares students to make a difference in the world. This major is offered by the College of Agriculture and Life Sciences. The major emphasizes global and cross-cultural engagement while equipping students with a strong technical competency in a resource area of their choice. The interdisciplinary program is designed to prepare students to work on complex global resource issues through leadership positions in global businesses, governmental agencies engaged in international trade and development, non-governmental organizations and globally engaged foundations, educational institutions, and volunteer organizations. It aims to produce systemic thinkers and problem solvers with a global perspective who are trained in resource issues and able to lead teams representing high levels of cultural diversity. Students interested in this major are encouraged to contact the Faculty Coordinator at globe@iastate.edu.

Undergraduate Study

The Global Resource Systems undergraduate major employs a truly interdisciplinary and systemic approach to understanding complex global resource issues. The major allows students to develop a core set of technical competencies in a resource area selected from among the 23 minors and certificates offered by the College of Agriculture and Life Sciences. Students choose a world region in which to specialize, develop competency in a relevant world language, participate in a significant cross-cultural living and working immersion experience in their chosen world region, and carry out a senior project related to their resource specialization within the context of the world region.

Multidisciplinary themes will be developed in the context of the physical, biological and sociological factors affecting global resource systems. In this context, resource systems will include agricultural (including crops, livestock and aquaculture), food, fuel, natural, environmental, biological, financial, governmental, institutional, human, knowledge, and other resources. Graduates of this program will have developed transnational leadership skills and will be successful integrators of various specializations on a team. They will be skilled in developing a systemic perspective and accomplished at solving complex global resource systems problems.

Courses for undergraduate students

Globe 110. Orientation.. (1-0) Cr. 1. F. An introduction to Global Resource Systems (GRS) program, development of student and professional skills, participation in GRS Learning Community and service learning project.

Globe 201. Global Resource Systems. (3-0) Cr. 3. F.S. A comparative analysis of global resources and the various natural and human Systems affecting those resources.

Globe 211. Issues in Global Resource Systems. (1-0) Cr. 1. Repeatable. F.S. *Prereq: credit or enrollment in 201.* Discussion of topics of current importance in global resource systems. A maximum of 3 credits of 211 may be used towards degree requirements.

Globe 221. Apprenticeship. Cr. R. Repeatable. F.S.SS. *Prereq: Approval by the Global Resource Systems Faculty Coordinator.* Practical work experience in approved domestic or international settings such as with a company, research laboratory, governmental agency or non-governmental organization. Satisfactory-fail only.

Globe 290. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator.* Independent study on topics of special interest to the student. Comprehensive report required. Intended primarily for freshmen and sophomores. H. Honors

Globe 301. Resource Systems of Industrialized Nations. (2-2) Cr. 3. F. *Prereq: 201, Econ 101 or 102.* In-depth analysis of the opportunities, constraints and consequences of the resource systems common in industrialized nations. Topics integrate natural resources with land tenure, societal structure, food security, agriculture, shelter, energy and wealth dynamics.

Globe 302. Resource Systems of Developing Nations. (2-2) Cr. 3. S. *Prereq: 201, Econ 101 or 102.* In depth appraisal of resource systems common throughout the developing world. Topics integrate natural resources with land tenure, societal structure, food security, agriculture, shelter, energy and wealth dynamics.

Globe 321. Internship - Global. Cr. arr. Repeatable. *Prereq: Junior or Senior and enrollment in Global Resource Systems major; permission of the instructor and approval by the Global Resource Systems Faculty Coordinator.* A supervised learning experience including an analysis of an international location's resource system via immersion in a foreign culture lasting at least five weeks. The experience should focus on the region consistent with the student's degree track. A maximum of 12 credits of 321 and 322 may be used for degree requirements.

Globe 322. Internship - United States. Cr. arr. Repeatable. *Prereq: Junior or Senior and enrollment in Global Resource Systems major; permission of the instructor and approval by the Global Resource Systems Faculty Coordinator.* A supervised learning experience including an analysis of a domestic location's resource system via immersion in a different culture within the United States lasting at least five weeks. Designed for international students and for students who are not in a position to leave the United States. A maximum of 12 credits of 321 and 322 may be used for degree requirements.

Globe 401. Senior Project. Cr. 3. F.S. *Prereq: Senior classification in Global Resource Systems.* Research project in collaboration with faculty that complements and furthers a student's experiences from Globe 321 and 322 while simultaneously bringing into focus entire four-year experience. Student will write a research report and make either an oral or poster presentation
H. Honors

Globe 402. Responses to Global Resource System Challenges. (1-4) Cr. 3. S. Capstone analysis of critical challenges facing global resources and, especially, identification of alternative solutions.

Globe 446. International Issues and Challenges in Sustainable Development. (Cross-listed with Agron, IntSt). Cr. 4. S. *Prereq: 3-credit biology course, Sophomore or higher classification, permission of Instructor.* Mullen. Interdisciplinary study and analysis of agricultural, biophysical, environmental, sociological, economical, political, and historical factors affecting sustainable development of communities and countries from art and science perspectives. International field experience with foreign language training required. A program fee is charged to students for international study abroad.

Globe 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator.* Independent study on topics of special interest to the student. Comprehensive report required. Intended primarily for juniors and seniors. A maximum of 4 credits may be used for degree requirements.
E. Entrepreneurship
H. Honors
Z. Service Learning

Globe 495. Global Resource Systems Study Abroad Course Preparation. Cr. R. Repeatable. F.S. *Prereq: Permission of instructor.* Global resource systems topics will include the agricultural industries, climate, crops, culture, economics, food, geography, government, history, livestock, marketing, natural resources, public policies, soils, and preparation for travel to locations to be visited. Students enrolled in this course intend to register for Globe 496 or 497 the following term.

Globe 496. Global Resource Systems Study Abroad. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Extended field trips abroad to study global resource systems. Location and duration of trips will vary. Pre-trip sessions arranged through Globe 495. Trip expenses paid by students.

Globe 497. Deans Global Ag and Food Leadership Program. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* An integrated agricultural and food production and policy program that allows students to assess, analyze and evaluate complex, country-specific situations and to develop their skills, knowledge and abilities via team-oriented projects that involve complex issues such as development of effective foreign food aid and agricultural and food production systems, drivers of world hunger, sustainable resource management and efficacy of policy, and the role of the USA and the United Nations and other development agencies in these systems. International location and duration of program will vary. Pre-trip sessions arranged through Globe 495. Trip expenses paid by students.

Globe 499. Undergraduate Research. Cr. arr. F.S. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator.* Research projects in collaboration with faculty.

Graduate Studies

No major is granted in Graduate Studies. At the recommendation of the major professor and/or the department chair, graduate students may enroll in the following graduate courses to fulfill certain enrollment requirements.

Courses for graduate students

Gr St 585. Preparing Future Faculty Introductory Seminar. Cr. 1. *Prereq: One year of graduate course work; admission into PFF program.* Introduction to faculty life issues such as hiring, tenure, teaching, and service at a variety of higher education institutions. Includes presentations from faculty at other institutions.

Gr St 586. Preparing Future Faculty Intermediate Seminar. Cr. 1-3. *Prereq: Admission into PFF program; completion of 585 or permission of instructor.* Consideration of a wide range of faculty life issues. Includes topics such as higher education trends, diversity issues, learning styles, assessment, grant and proposal writing, and legal and ethical issues. Written components include job and teaching portfolios.

Gr St 587. Preparing Future Faculty Teaching Practicum. Cr. 1. *Prereq: Permission of instructor, 585, credit for or concurrent enrollment in 586.* Students complete a stand-alone teaching assignment at Iowa State or another higher education institution. Written components include pedagogical documents.

Gr St 588. Preparing Future Faculty Special Topics. Cr. 1-3. *Prereq: Permission of instructor, 585, credit for or concurrent enrollment in 586.* In-depth study of topic providing academic professional development.

Gr St 600. Examination Only. Cr. R. Reserved for graduate students the term they take the final oral examination. Students must have completed all required coursework and not be registered for another course.

Gr St 601. Required Enrollment. Cr. R. Reserved for graduate students who must be registered for a particular term, but are not required to take additional coursework.

Gr St 680. Doctoral Post Prelim (Continuous) Registration. Cr. R. Repeatable. Reserved for Ph.D. candidates only. See the Graduate College Handbook for specific requirements.

Gr St 697. Curricular Practical Training. Cr. R. Repeatable. F.S.SS. Professional work period.

History

www.history.iastate.edu/

Charles Dobbs, Chair of Department

University Professors (Emeritus): Schwieder

Professors: Adeleke, Cravens, Dobbs, Goedeken, Liu, Riney-Kehrberg, Wilson

Professors (Emeritus): Bennett, Dobson, Geiger, Keller, Kottman, Lowitt, Marcus, McJimsey, Plakans, Rawson, Schofield

Associate Professors: Andrews, Bix, Griffiths, Hollander, Monroe

Associate Professors (Emeritus): Avraamides, Pope, Whitaker

Assistant Professors: Bailey, Byars, Delcastillo, Hilliard, Houghtby, Sadosky

Assistant Professors (Emeritus): Madison, Osborn, Zaring

Assistant Professor (Adjunct): Schneider

Lecturer: Hill

The History department offers curricula leading to the B.A. and B.S. degrees in history, the M.A. degree in history, the M.A. and Ph.D. degrees in the history of technology and science, and the Ph.D. degree in agricultural history and rural studies.

The department offers a variety of survey courses (200 series) designed to serve primarily first- and second-year students as either general education courses or as introductions to advanced courses in history or other subject areas. In addition to 200-level survey courses, it offers advanced undergraduate courses in the history of Europe, Asia, Latin America, the United States, technology and science, agriculture, and other selected topics.

Undergraduate Study

The History major. For a description of the undergraduate curriculum with a major in History see *Liberal Arts and Sciences, Curriculum*. History majors may earn either a bachelor of arts or bachelor of science degree. The minimum required for a major in history is 36 credits, of which at least 24 must be in courses numbered 300 or above. Students may take a maximum of 12 credits at the 200-level, a maximum of 15 credits at the 300-level, and must take a minimum of 12 credits at the 400-level or above. A minimum of 15 credits numbered 300 or above must be taken in residence at Iowa State. Candidates for the B.A. must complete two years of university-level study in one foreign language or the equivalent.

Objectives for History Majors

1. Display the appropriate level of cognitive knowledge of historical themes and events based upon the student's course of study.
2. Display an understanding of past cultures and social organizations, based on the course of study.
3. Develop the fundamental methodological skills of the historical craft:
- The ability to contextualize and analyze primary source evidence.
- Familiarity with the concepts of historical argument and interpretation, and the ability to formulate effective argumentation in written and oral forms.
- Awareness of the basic historiography in selected research area.
- The ability to conduct research and to write a historical essay based upon primary and secondary source research.

4. Display a sophisticated understanding of the relationship between past events and the present.

For purposes of outcomes assessment, all History majors must complete three credits of History 495 or, if qualified and willing, one graduate level writing/research seminar.

Communication Proficiency requirement: History majors must receive a grade of C or better in each of Engl 150 and 250 (or 250H), and Hist 495 or any graduate seminar.

For a description of the major in History as preparation for professional programs, see *Preprofessional Study*. Students majoring in History may also earn a second major in International Studies; see *International Studies*.

Majors must distribute their courses across geographic and chronological areas such that they take at least 3 credits at the 300-level or above in five of the following six areas:

• U.S. history, European history, African/Asian/Latin American history

• Ancient history (pre-500), medieval and early-modern history (ca. 500-1750), and modern history (post-1750)

It is expected that individual courses will fulfill both a geographic and a chronological area. For example, a course on nineteenth century France would count as both European history and modern history. No single course, however, may be used to fulfill more than one geographic and one chronological area. If a course stretches significantly across two or more areas, students will select which geographic and/or which chronological area they want the course to fulfill. The History Department undergraduate adviser should be consulted as to which courses fulfill what areas. History 495 may not be used to fulfill any area.

The department offers a minor in History, which may be earned with 15 credits in History courses, of which at least 9 must be in courses numbered 300 or above, excluding Hist 490. A minimum of 9 credits numbered 300 or above must be taken at Iowa State. The College of Liberal Arts and Sciences requires students to earn a C or higher in at least 6 of the required 300-level credits. The History minor is most frequently chosen by students majoring in Political Science, English, Journalism, Computer Science, and Business.

Graduate Study

Graduate students may take any 400-level history course except 490 and 495 for graduate credit. No more than 12 credits of 400-level courses, however, may be used toward the minimum credits required for a graduate degree in history. Additional work is required for graduate credit in 400-level courses.

Most history graduate courses are either proseminars or seminars. Proseminars acquaint students with the historical literature of a field and prepare them for careers in teaching and research. Seminars require students to conduct original historical research and to write extensive research papers reporting the results.

The M.A. in history. For the M.A. in history, students may elect a thesis or a nonthesis program. See the departmental website on the M.A. in History for a full discussion of the options and requirements. An M.A. in History serves as the basis for continued study in history, as well as preparation for careers in law, education, business, and government service. For international students, a TOEFL score of 600 is required at the time of admission.

The M.A. and Ph.D. in history of technology and science. The graduate program in the history of technology and science examines the role of technology and science in the formation of modern Societies and their attitudes toward people and the world. The program is structured in a sequence of courses leading to the M.A. and Ph.D. degrees. Since these courses approach their subject in the context of social and cultural change, they are also open to and appropriate for students in engineering, the sciences, science education, and science journalism. For a thorough description of the program requirements, see the department's website on the history of technology and science program.

The Ph.D. in agricultural history and rural studies. The program is designed as a Ph.D. program, but students without an M.A. in history will be expected to qualify for the departmental M.A. in history while progressing toward the doctorate. In some cases, the M.A. may be recommended as the terminal degree. Thirty semester hours of graduate credit are required for the M.A. and 72 for the Ph.D. Students who continue beyond the M.A. are expected to pass preliminary examinations in four areas of specialization, complete a dissertation, and defend it orally in the Ph.D. final examination. See the departmental website on the program for a full description of requirements.

Courses primarily for undergraduate students

Hist 201. Introduction to Western Civilization I. (3-0) Cr. 3. F. Western civilization from ancient Mediterranean world to 1500. Social and cultural developments; economic and political ideas and institutions; problems of historical change and continuity.

Hist 202. Introduction to Western Civilization II. (3-0) Cr. 3. S. Western civilization from 1500 to present. Social and cultural developments; economic and political ideas and institutions; problems of historical change and continuity.

Hist 207. Chinese Civilization. (3-0) Cr. 3. Origins, development, decline and transformation of China from earliest times to present.

Hist 221. Survey of United States History I. (3-0) Cr. 3. F. Colonial foundations: revolution, confederation, and constitution; nationalism and democracy; sectional disunity, Civil War, and reunion.

Hist 222. Survey of United States History II. (3-0) Cr. 3. S. Industrialization; emergence as a great power; boom and depression; war, internationalism and Cold War; modern industrial Society.

Hist 245. Introduction to Latin American History. (3-0) Cr. 3. Latin America from pre-conquest times to the present. Economic, social, political, and cultural developments; problems of historical change and continuity.

Hist 280. Introduction to History of Science I. (3-0) Cr. 3. F. Ideas of nature from ancient Greece to the seventeenth-century scientific revolution.

Hist 281. Introduction to History of Science II. (3-0) Cr. 3. S. Science from seventeenth-century scientific revolution to Darwin and Einstein.

Hist 284. Wonders of the World, Ancient to Early Modern. (3-0) Cr. 3. F. Starting from the classical "Seven Wonders of the World," examines machines, structures, buildings, innovations, and technologies from Sumer, Egypt, Greece, and Rome, through China, Latin America, and the Islamic world, up to Europe's Industrial Revolution. Topics include developments in warfare and weaponry, architecture, agriculture, printing, religious ceremony, entertainment, and major engineering achievements.

Hist 285. Modern Wonders of the World. (3-0) Cr. 3. S. Examines machines, structures, buildings, innovations, and technologies from the Industrial Revolution to the twenty-first century, including the US, Europe, Asia, and Middle East. Topics include developments in manufacturing, communication, electrification, automobiles, airplanes, warfare, computers, the atom bomb, and major engineering achievements.

Hist 304. Cultural Heritage of the Ancient World. (Cross-listed with Cl St). (3-0) Cr. 3. *Prereq: Sophomore classification.* Historical examination of art, literature, thought, and religious beliefs of major civilizations of the ancient Mediterranean countries until the end of the 8th century.

Hist 305. Cultural Heritage of the Modern World. (3-0) Cr. 3. *Prereq: Sophomore classification.* Examination of parallel formal and structural elements in scientific and social thinking, technological design, and composition in literature and the arts from the late medieval period to the 20th century.

Hist 307. American Popular Culture. (3-0) Cr. 3. *Prereq: Sophomore classification.* Social practices, beliefs and material traits of everyday life in America from the mid-19th century to the present. Includes literature, music, theater and other entertainments. Dime novels, vaudeville, rock and roll music, Hollywood and establishment of professional athletic leagues are among the cultural artifacts and phenomena considered.

Hist 316. History of Medieval Europe, 300-1500. (3-0) Cr. 3. *Prereq: Sophomore classification.* Survey of political, social, and cultural developments in western Europe for the entire medieval period, 300-1500.

Hist 323. Science and Religion. (Cross-listed with Relig). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of changing interplay of science and religion in our understanding nature, from the trial of Galileo to the reception of Darwin.

Hist 325. Society and Politics in England, 1525-1700. (3-0) Cr. 3. *Prereq: Sophomore classification.* Social, cultural, demographic, and economic experiences. Religious Reformation. Growth of the State (and Empire) and political institutions.

Hist 336. History of Modern China I. (3-0) Cr. 3. *Prereq: Sophomore classification.* China from 1644 to 1912; internal and external stimuli on traditional structure leading to reform and revolution.

Hist 337. History of Modern China II. (3-0) Cr. 3. *Prereq: Sophomore classification.* China from 1912 to present; search for a new order and continuing Chinese revolution.

Hist 338. Modern Japanese History. (3-0) Cr. 3. *Prereq: Sophomore classification.* Japan 1600 to the present; emphasis on transformation of feudal Japan into a post-industrial Society.

Hist 339. US-Asian Relations. (3-0) Cr. 3. *Prereq: Sophomore classification.* A survey of US-East Asian (Japan, China, Korea) relations from the late 18th century to the end of the Cold War.

Hist 340. History of Latin America I. (3-0) Cr. 3. *Prereq: Sophomore classification.* Colonial Latin America from European discovery and colonization to wars for independence.

Hist 341. History of Latin America II. (3-0) Cr. 3. *Prereq: Sophomore classification.* Modern Latin America national origins from 1800 to present.

Hist 351. Social and Cultural History of American People I. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of ordinary Americans since 1800; development of Society; dissemination of popular ideas; living conditions, work, and play; the arts, music, architectural styles, material culture; rural and urban lifestyles; majority-minority and gender relations; religion, mass culture, corporations, and technology in modern times from 1800.

Hist 352. Social and Cultural History of American People II. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of ordinary Americans since 1900; development of Society; dissemination of popular ideas; living conditions, work, and play; the arts, music, architectural styles, material culture; rural and urban lifestyles; majority-minority and gender relations; religion, mass culture, corporations, and technology in modern times.

Hist 353. History of African Americans I. (Cross-listed with Af Am). (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines African roots of black culture and the African American experience in the United States from the colonial period through the Civil War. Topics include Atlantic Slave Trade, slavery and American identity, abolition, the emergence of Black Nationalism, and black participation in the Civil War.

Hist 354. History of African Americans II. (Cross-listed with Af Am). (3-0) Cr. 3. *Prereq: Sophomore classification.* Explores African American political thought and political action from Reconstruction to the present. Topics include rise of Jim Crow segregation, urban migration, Garvey movement, Harlem Renaissance, Depression and world wars, Pan-Africanism, civil rights, Black Power, and black feminism.

Hist 355. Slavery and the Crisis of Union. (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines causes and primary events of the sectional crisis over slavery leading up to the Civil War. Missouri Crisis through Presidential Election of 1860.

Hist 356. The U.S. Civil War and Reconstruction. (3-0) Cr. 3. *Prereq: Sophomore classification.* Political, military, and social aspects of the Civil War and Southern Reconstruction. Secession crisis through Reunion.

Hist 360. U.S. 1900 to 1945. (3-0) Cr. 3. *Prereq: Sophomore classification.* America in transition and crisis: Progressivism, World War I, the twenties, the Great Depression, and World War II.

Hist 361. U.S. 1945 to the Present. (3-0) Cr. 3. *Prereq: Sophomore classification.* From the Cold War to the Baby Boom to the liberal swing of the 1960s, back to the conservative counter-swing thereafter.

Hist 365. History of American Agriculture I. (3-0) Cr. 3. *Prereq: Sophomore classification.* American agricultural development from colonial times: European background, colonial period to 1865.

Hist 366. History of American Agriculture II. (3-0) Cr. 3. *Prereq: Sophomore classification.* American agricultural development from 1865 to present.

Hist 367. Topics in American Agriculture. (3-0) Cr. 3. *Prereq: Sophomore classification.* Thematic approach to the development of the American agricultural system. Topics vary; examples include food and agriculture, animals in agriculture, and systems of production.

Hist 370. History of Iowa. (3-0) Cr. 3. *Prereq: Sophomore classification.* Survey of major social, cultural, and economic developments in Iowa from the late 1700s. Emphasis on minority groups, pioneer life, early economic development, industrial development, educational and religious development, and outstanding personalities.

Hist 374. Women in the Ancient Mediterranean World. (Cross-listed with Cl St, W S). (3-0) Cr. 3. Repeatable. S. *Prereq: Any one course in Cl St, W S, Latin, or Greek.* Chronological and topical survey of the Status of women in the Ancient Mediterranean world; study of constructs of the female and the feminine. Readings from ancient and modern sources. Emphasis on either the Greek world and Hellenistic Egypt, or Hellenistic Egypt and Rome.
A. Hellenic World and Hellenistic Egypt
B. Roman World including Roman Egypt

Hist 376. Classical Archeology. (Cross-listed with Cl St, Relig). (3-0) Cr. 3. Repeatable. Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.
A. Bronze Age (Minoan and Mycenaean palatial cultures) and Early Iron Age Greece. (ca 3000-700 BC).
B. Archaic through Hellenistic Greece (ca 700-30 BC).

Hist 380. History of Women in Science, Technology, and Medicine. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of women's relationship to the fields of science, technology, and medicine, as students and professionals, consumers, subjects and patients, family members, workers and citizens. Concentrates especially on 19th and 20th century United States, concluding with an examination of current issues of special interest to women in science, technology, and medicine.

Hist 383. Technology, Public Science, and European Culture, 1715-Present. (3-0) Cr. 3. *Prereq: Sophomore classification.* A survey from the Age of Enlightenment to the end of the twentieth century of the relationship between science, technology, and public or popular culture in a comparative European context (including Russia and the former Soviet Union).

Hist 386. History of Women in America. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification.* A survey of social, economic, and political aspects of women's role from colonial era to present; emphasis on employment, education, concepts of sexuality, and changing nature of the home.

Hist 388. History of Modern Astronomy. (3-0) Cr. 3. *Prereq: Sophomore classification.* Changing conception of the universe from Galileo to Edwin Hubble and beyond.

Hist 389. American Military History. (3-0) Cr. 3. *Prereq: Sophomore classification.* American military history from the colonial wars to the present, including Revolutionary War, Mexican War, Civil War, First and Second World Wars, Korean War, Vietnam War, and Gulf Wars.

Hist 390. World Military History. (3-0) Cr. 3. *Prereq: Sophomore classification.* Covers military history from the Napoleonic era through the mid- and late-19th century wars, the First and Second World Wars, and wars of national liberation and regional conflicts since 1945.

Hist 391. American Diplomatic History. (3-0) Cr. 3. *Prereq: Sophomore classification.* A study of US foreign relations during the twentieth century, including the rise to global power, the First World War, diplomacy during prosperity and depression, the Second World War, the Cold War, relations with Latin America, East and South Asia, and Africa, the search for markets, and the perceptions of American foreign policy held by the US, its allies and adversaries, and others.

Hist 402. Greek Civilization. (Cross-listed with Cl St). (3-0) Cr. 3. *Prereq: Sophomore classification.* Ancient Greece from the Bronze Age to the Hellenistic period; evolution of the Greek polis and its cultural contributions, with a particular emphasis on the writings of Herodotus and Thucydides. Nonmajor graduate credit.

Hist 403. Roman Civilization. (Cross-listed with Cl St). (3-0) Cr. 3. *Prereq: Sophomore classification.* Ancient Rome from the Regal Period to the fall of the Western Empire; evolution of Roman institutions and Rome's cultural contributions studied through original sources. Nonmajor graduate credit.

Hist 404. Roman Social History. (Cross-listed with Cl St). (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines major topics in Roman social history during the late Republic and early Empire, such as class, family, slavery, religion, and the economy. Nonmajor graduate credit.

Hist 405. History of the Early Middle Ages. (3-0) Cr. 3. *Prereq: Sophomore classification.* General coverage of political, economic, social, and cultural developments in early medieval Europe, 300-1000; in depth coverage of particular issues and topics. Nonmajor graduate credit.

Hist 406. History of the High Middle Ages. (3-0) Cr. 3. *Prereq: Sophomore classification.* General coverage of political, economic, social, and cultural developments in high medieval Europe, 1000-1300; in-depth coverage of particular issues and topics. Nonmajor graduate credit.

Hist 408. Europe, 1500-1648. (3-0) Cr. 3. *Prereq: Sophomore classification.* Northern Renaissance; Church and Luther; Protestant reform and Roman-Catholic counter-reform; social, cultural, and economic changes; Spain in triumph and decline; religious wars and emergence of France. Nonmajor graduate credit.

Hist 414. European Cultural and Intellectual History. (3-0) Cr. 3. *Prereq: Sophomore classification.* A study of the development of key themes in European thought: nature, man, God, society, history, and creativity from Rousseau to Post-Modernism. Nonmajor graduate credit.

Hist 419. History of Modern France. (3-0) Cr. 3. *Prereq: Sophomore classification.* From absolutism to revolution and the rise of modern democracy. Nonmajor graduate credit.

Hist 420. France's Revolutionary Century, 1715-1815. (3-0) Cr. 3. *Prereq: Sophomore classification.* An in-depth investigation of the French Revolution, its causes and consequences, beginning in the Ancien Regime and ending with the fall of Napoleon. Nonmajor graduate credit.

Hist 421. History of Russia I. (3-0) Cr. 3. *Prereq: Sophomore classification.* Russia to 1850. Origins of Russian people; Byzantine influences; Mongol invasion; rise of Moscow; Westernization. Nonmajor graduate credit.

Hist 422. History of Russia II. (3-0) Cr. 3. *Prereq: Sophomore classification.* Russia since 1850. Reform and revolution; transformation of Society; USSR as a world power; recent changes. Nonmajor graduate credit.

Hist 424. History of Modern Germany. (3-0) Cr. 3. *Prereq: Sophomore classification.* Political, social, and cultural history of Germany from the 19th century to the present. Nonmajor graduate credit.

Hist 427. Crime and Policing in England 1550-1850. (3-0) Cr. 3. *Prereq: Sophomore classification.* Course examines different forms and ideas of criminality and the nature and development of law enforcement in England between 1550 and 1856. Significant issues will include the nature of criminal records and Statistics, the legal system, the politics of the law and its links with social relations, policing, female crime, juvenile delinquency, organized crime, riots, "social crime," and the treatment of crime in creative literary texts. Nonmajor graduate credit.

Hist 428. Punishment, Mentalities, and Society in England, 1550-1868. (3-0) Cr. 3. *Prereq: Sophomore classification.* Explores the history of punishing criminals in England and shows how interdisciplinary perspectives, ideas, and practices of punishment are related to mentalities, and Socio-economic change. Issues of significance examined: violence, civility, manners, madness, public punishment, execution, imprisonment, transportation, mercy, the rise of asylums, and penal reform. Nonmajor graduate credit.

Hist 429. "Monstrous London": London's Histories 1500-1800. (3-1) Cr. 4. *Prereq: Sophomore classification.* Study of London's social, economic, cultural, political, and environmental history 1500-1800, using both quantitative and qualitative methods to examine contemporary and secondary sources. Course combines standard lecture and discussion format with one week of intensive study abroad for 4th hour of course credit. Nonmajor graduate credit.

Hist 431. Modern England. (3-0) Cr. 3. *Prereq: Sophomore classification.* England since 1850. Parliamentary and constitutional development; social reform and economic change; imperial Britain; welfare state. Nonmajor graduate credit.

Hist 443. Science, Technology, and Medicine in Latin America. (3-0) Cr. 3. *Prereq: Sophomore classification.* Development of science, technology, and medicine in Latin America from pre-colonial times to the present. Themes include: intersection of science, medicine, and technology with colonization, impact of human populations on environments, formation of nation-states, spread of disease, and how perceptions of accepted scientific knowledge change over time. Nonmajor graduate credit.

Hist 450. Colonial America. (3-0) Cr. 3. *Prereq: Sophomore classification.* Exploration, colonization, and development of political, economic, religious, and cultural institutions of North American colonies before 1754. Topics also include social history, emergence of African-American Slavery, relations with American Indians. Nonmajor graduate credit.

Hist 451. American Revolutionary Era. (3-0) Cr. 3. *Prereq: Sophomore classification.* Participants, ideas, and events leading to independence and the foundation of the United States, 1754 to 1789. Topics include political, military, social, cultural history, also issues of gender and race relations. Nonmajor graduate credit.

Hist 456. American Family History. (3-0) Cr. 3. *Prereq: Sophomore classification.* The impact on American families from colonial times onward of agricultural change, industrialization, urbanization, and wars and depressions. Nonmajor graduate credit.

Hist 461. The Rural South. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of the American South from colonial period to present. Emphasis on economic, social, and political change in this rural region. Nonmajor graduate credit.

Hist 462. History of American Thought I. (3-0) Cr. 3. *Prereq: Sophomore classification.* American religious, social, and political thought; development of democracy and nationalism and of the arts and sciences from colonial times to late nineteenth century. Nonmajor graduate credit.

Hist 463. History of American Thought II. (3-0) Cr. 3. *Prereq: Sophomore classification.* Religious, social, and political thought; development of democracy and nationalism, the arts and sciences from late nineteenth century to modern and post-modern times. Nonmajor graduate credit.

Hist 464. Nineteenth Century America. (3-0) Cr. 3. *Prereq: Sophomore classification.* Development of the modern American Nation. Examines social, political, and institutional transformation wrought by modern industrial Society. Nonmajor graduate credit.

Hist 465. The American West. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of trans-Mississippi West from 1800 to present, concentrating on settlement and regional identity. Emphasis on the state, the environment, urbanization, agriculture, Native Americans, and minority communities. Nonmajor graduate credit.

Hist 466. Empires in North American. (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines imperial contests to claim and settle interior of North American continent from 15th to 19th century. Focuses on growth of Spanish empire, experiences of various Plains Indian nations, expansion of United States. Nonmajor graduate credit.

Hist 468. History of Rural America. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of rural America from the colonial period to the present. Emphasizes immigration, ethnicity, religion, social and cultural change, and agriculture in relation to rural settlement, institution building, demographic change, gender, class, and political and economic development. Nonmajor graduate credit.

Hist 472. U. S. Environmental History. (Cross-listed with Env S). (3-0) Cr. 3. *Prereq: Sophomore classification.* Survey of the interactions of human communities with the North American environment. Focus on the period from presettlement to the present, with a particular concentration on natural resources, disease, settlement patterns, land use, and conservation policies. Nonmajor graduate credit.

Hist 473. Civil Rights and Black Power. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of the civil rights and Black Power movements in the U.S. from World War II to the present. Topics include institutional foundations, leadership, gender dynamics, and the intersection of local grassroots organizing and national and international politics. Nonmajor graduate credit.

Hist 474. Tradition and Transformation of China's Foreign Affairs. (3-0) Cr. 3. *Prereq: Sophomore classification.* Evolution of China's external relations from the antiquities to our own times; conceptions, practices, and relationships that characterized the inter-state relations of the so-called "Chinese world order," interactions between "Eastern" and "Western," and "revolutionary" and "conventional" modes of international behaviors. Nonmajor graduate credit.

Hist 479. China and the Cold War. (3-0) Cr. 3. *Prereq: Sophomore classification.* Important events in China's Cold War involvement, connections between domestic and foreign affairs, factors and rationales in China's foreign policy making the relationship between China's Cold War experience and recent developments. Nonmajor graduate credit.

Hist 482. Birth, Death, Medicine, and Disease. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of medicine, sickness, and public health from ancient times to the twenty-first century in the US, Europe, and around the world. Topics include changing ideas of health and illness, development of doctors and hospitals, social and ethical issues in health care, and epidemics from cholera to AIDS. Nonmajor graduate credit.

Hist 483. Modern Science and Human Nature. (3-0) Cr. 3. *Prereq: Sophomore classification.* History of the sciences of humankind since the 18th century: evolutionary natural and social science, the modern social sciences; anthropology, psychology, economics, law, psychiatry, human growth and development, political science, city planning, public administration, business administration, among others, and the uses of the human Sciences in education, politics, advertising, corporate functioning, warfare, psychotherapy, childrearing, and other pursuits in modern times, as well as the impact of postmodernism on the human Sciences. Nonmajor graduate credit.

Hist 486. History of Medicine, Gender, and the Body. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of medicine, history of science, and women's history combine for an intensive examination of topics related to health, the body, and medical care over the centuries. Topics include gender and sexuality, reproduction, historical interpretations of gender differences, and the politics of women's health. Nonmajor graduate credit.

Hist 488. American Stuff, Colonial Times to the Present. (3-0) Cr. 3. *Prereq: Sophomore classification.* Examines inventions, machines, innovations, artifacts, and material culture in the US, from homespun cloth and the Colt revolver through the transcontinental railroad and Model T, to the Big Mac and iPod. Nonmajor graduate credit.

Hist 489. History of American Science. (3-0) Cr. 3. *Prereq: Sophomore classification.* Science as a cultural and social activity in America from the eighteenth century to present. Scientific discovery; interaction of scientific and social ideas; science and war; science and health, environment; role of science as expertise in a nationalistic democracy. Nonmajor graduate credit.

Hist 490. Independent Study. (3-0) Cr. arr. Repeatable. *Prereq: 9 credits in history; permission of department chair.* Reading and reports on problems selected in conference with each student. No more than 6 credits of Hist 490 may be counted toward graduation with a major in History. No credits of Hist 490 may count toward a minor in History.

Hist 495. Historiography and Research Writing. (3-0) Cr. 3. F.S. *Prereq: Senior history majors with at least 12 credits of 300+ level history courses.* Variable topics seminar that focuses on historiographical and research skills and writing. Required of majors.

Courses primarily for graduate students, open to qualified undergraduate students

Hist 510. Proseminar in East Asian History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Readings in East Asian history. Topics vary each time offered.

Hist 511. Proseminar in American History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Readings in American history. Topics vary each time offered.
A. Colonial Period
B. Nineteenth Century
C. Twentieth Century
D. Environment
E. Social and Cultural

Hist 512. Proseminar in European History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Readings in European history.
A. Ancient (Same as Cl St 512A)
B. Medieval
C. Modern

Hist 513. Proseminar in Latin American History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Readings in Latin American history. Topics vary each time offered.

Hist 530. Proseminar in Modern Russian/Soviet History. (3-0) Cr. 3. Repeatable. *Prereq: Hist 422.* Readings in modern Russian history. Topics vary each time offered.

Hist 550. Proseminar in European Rural and Agricultural History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.*
A. Modern European Rural Life
B. Twentieth Century Europe

Hist 552. Proseminar in American Rural and Agricultural History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.*
A. American Agriculture
B. Agrarian Reform Movements
C. Midwestern Rural Society
D. Women in Rural Life

Hist 570. Seminar in General History of Science I. (3-0) Cr. 3. *Prereq: Permission of instructor.* The history of science from pre-classical civilizations to the Age of Isaac Newton with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research.

Hist 571. Seminar in General History of Science II. (3-0) Cr. 3. *Prereq: Permission of instructor.* The history of science from Isaac Newton to modern times, with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research.

Hist 575. Seminar in General History of Technology. (3-0) Cr. 3. *Prereq: Permission of instructor.* The history of technology from the 11th century to the present, with emphasis on the historical literature, differing interpretations of major problems, and problems identified for college-level teaching and for further scholarly research.

Hist 576. Colloquium in Historiography of Technology and Science. Cr. R. F. Topical lectures, reports, and discussion of methodology and research in history of technology and science. Required of all graduate students in history of technology and science program.

Hist 580. Museum or Archive Internship. (3-0) Cr. arr. *Prereq: 15 graduate credits in history and permission of instructor.* Introduction to work and research in either a museum or archive setting.

Hist 583. Historical Methods. (3-0) Cr. 3. Study of evidence, theory, and methods.
A. Historical Narrative
B. Statistical Evidence and Analysis

Hist 585. Teaching Methods. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics vary each time offered.

Hist 586. Proseminar in Women's History and Feminist Theory. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Permission of instructor.* Feminist theory from the 1960s to the present as it relates to the writing of women's history. Analysis of interpretations of U.S. women's history from patriarchal to postmodernist perspectives.

Hist 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

Hist 592. Seminar in East Asian History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Topics vary each time offered.

Hist 593. Seminar in American History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Topics vary each time offered.
A. Colonial Period
B. Nineteenth Century
C. Twentieth Century
D. Environmental

Hist 594. Seminar in European History. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Topics vary each time offered.
A. Ancient (Same as Cl St 594A)
B. Medieval
C. Modern

Courses for graduate students

Hist 602. Seminar on History of Science and Technology. (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor.* Emphasis varies each time offered.

Hist 610. Seminar on American Rural Life. (3-0) Cr. 3. *Prereq: Permission of instructor.* Emphasis varies each time offered.

Hist 699. Research. Cr. arr. Repeatable. Graduate student thesis research.

Honors Program

http://www.honors.iastate.edu/

Susan Yager, Chair, University Honors Committee

The Honors Program provides a vehicle for highly motivated and able students to pursue an innovative and challenging undergraduate education. Oversight of students' progress toward this goal is primarily the responsibility of the undergraduate colleges, each of which operates its own Honors Program. The college Honors Program committees admit students into the Program, approve programs of study, and are responsible for the administration of their college Honors Program. The University Honors Program Committee, which includes the chairs of the college Programs, is responsible for the general coordination of the college Honors Programs and the First-year Honors Program.

Students in the Honors Program are offered a variety of academic opportunities designed to help them derive the fullest benefit from their undergraduate education. To enhance their individualized programs of study, students are offered numerous Honors courses, seminars, and independent research opportunities.

Honors courses and Honors sections of regular courses are offered by several departments and programs. These courses, open only to Honors Program members, have limited enrollment and are taught by specially selected instructors. Most of these courses are listed by department or program. (See *Economics, Engineering, English, Mathematics, Physics, Psychology, and Speech Communication*.)

In addition to established Honors courses, Honors students may designate any course as an Honors course by making appropriate arrangements with the course instructor and obtaining approval of the Honors Program Director. Most departments offer opportunities for independent study and research under 290 and 490; when designated by an H, these courses also carry Honors credit.

Research grants are available to support Honors research.

Listed below are those courses that are offered directly by the University Honors Program. Specific information about the full range of Honors courses and seminars for the current academic year, including the Honors courses offered by individual departments and programs, may be obtained from the Honors Program Office in Jischke Honors Building.

Courses primarily for undergraduate students

Hon 121. First-Year Honors Seminar. (0-2) Cr. 1. F. *Prereq: Membership in the First-year Honors Program.* Orientation to Iowa State University and to the University Honors Program. Satisfactory-fail only.

Hon 290. Special Problems. Cr. arr. *Prereq: Membership in and permission of the University Honors Program.* Independent study on topics of an interdisciplinary nature. Intended primarily for freshmen and sophomores. Satisfactory-fail only.
H. Honors.
U. Undergraduate Research

Hon 302. Honors Leadership Seminar. (1-2) Cr. 2. F. *Prereq: Selection as a leader of a First-year Honors Seminar. For students* serving as leaders of First-year Honors Seminars, under faculty supervision. Development of teaching and leadership skills within the context of an Honors education experience. Satisfactory-fail only.

Hon 321. University Honors Seminars. Cr. arr. F.S.SS. *Prereq: Membership in the University Honors Program.* Interdisciplinary seminars on topics to be announced in advance. Satisfactory-fail only.

Hon 322. University Honors Seminars. Cr. arr. F.S.SS. *Prereq: Membership in the University Honors Program.* Interdisciplinary seminars on topics to be announced in advance. Satisfactory-fail only.

Hon 323. University Honors Seminars. Cr. arr. F.S.SS. *Prereq: Membership in the University Honors Program.* Interdisciplinary seminars on topics to be announced in advance. Satisfactory-fail only.

Hon 324. University Honors Seminars. Cr. arr. F.S.SS. *Prereq: Membership in the University Honors Program.* Interdisciplinary seminars on topics to be announced in advance. Satisfactory-fail only.

Hon 490. Independent Study. Cr. arr. Repeatable. *Prereq: Membership in and permission of the University Honors Program.* Independent study on topics of an interdisciplinary nature. Intended primarily for juniors and seniors.

Horticulture

www.hort.iastate.edu

Jeffery Iles, Chair of Department

University Professors: Christians, Nonnecke

Professors: Arora, Domoto, Gleason, Graves, Hannapel, Iles, Minner, Taber

Professors (Emeritus): Chaplin, Hall, Hodges

Professor (Collaborator): Yadav

Associate Professors: Delate, Fei, Gladon, Haynes, Stephens, VanDerZanden

Associate Professors (Collaborators): Beeson, Krebs

Assistant Professor: Reinert

Assistant Professors (Collaborators): Sharma, Widrlechner

Senior Lecturers: Osborn, Rollenhagen

Lecturer: Nilles

Undergraduate Study

For undergraduate curriculum in Horticulture leading to the Bachelor of Science degree, see *Horticulture, Curriculum*.

To meet the educational needs of a student population with interests ranging from landscape design/installation to fruit and vegetable production to golf course construction and management, considerable flexibility is built into the Horticulture curriculum. And the diversity of interests and need for flexibility is reflected in our impressive array of Horticulture courses.

The Department of Horticulture offers nine options within the Horticulture major; (1) Environmental Horticulture, (2) Greenhouse Production and Management, (3) Fruit & Vegetable Production and Management, (4) Horticultural Communications and Public Education, (5) Nursery Crops Production and Garden Center Management, (6) Landscape Design, Installation and Management, (7) Public Garden Management and Administration, (8) Science, and (9) Turfgrass Management. Students considering graduate degrees should participate in the Science option.

Graduates possess the technical knowledge and skills to become professional Horticulturists. They understand plant growth and development and are familiar with cultural and management principles for a wide assortment of Horticultural crops. They are able to work and communicate effectively with fellow Horticultural professionals and with ordinary citizens who share an interest in Horticulture. Graduates also understand the ethical and environmental dimensions of problems and issues facing Horticultural professionals.

A degree in Horticulture opens the door to employment opportunities with production nurseries, seed companies, interior landscaping firms, greenhouses, garden centers, conservatories, landscape design/installation firms, public gardens and arboreta, orchards and vineyards, food processing companies, vegetable farms, golf courses, sports fields, sod production companies and lawn care businesses. Several industries closely related to Horticulture provide employment opportunities in the areas of sales, management, and communication. Opportunities also exist for careers in research, teaching, and business after obtaining advanced training in graduate school.

Undergraduate students have the option of selecting a secondary major in one of several interdepartmental programs including, seed science, agricultural education, environmental studies, or international agriculture (see *Index*).

The Department of Horticulture offers work for a minor in Horticulture that is earned by taking Hort 221 plus 12 additional credits with a maximum of 3 credits at the 200-level and a minimum of 9 credits at the 300-level or above.

Visit our departmental website at www.hort.iastate.edu

Graduate Study

The graduate major in Horticulture leads to the M.S. (thesis required) and Ph.D. A nonthesis master's degree is offered through the master of agriculture program. Some faculty members of the department serve as major professors for students in interdepartmental graduate majors in plant biology; genetics; molecular, cellular, and developmental biology; ecology and evolutionary biology; sustainable agriculture; and environmental science.

Graduate students majoring in Horticulture usually take minor course work in Agronomy, botany (cytology, morphology, or physiology), biochemistry, chemistry, entomology, food science and human nutrition, genetics, plant pathology, or Statistics. There is no uniform foreign language requirement for the Master of Science or Doctor of Philosophy degree.

Graduates possess a broad understanding of horticulture and the allied plant sciences. They are able to communicate effectively with members of the scientific community, industry groups, and other interested citizens. They are experienced in conducting research and communicating the results from that research. They are capable of addressing and solving complex problems that confront the many Horticultural, agricultural and plant science professions. They also understand the ethical, legal, social, and environmental issues associated with modern agricultural/horticultural practices.

Courses primarily for undergraduate students

Hort 110. Orientation in Horticulture. (1-0) Cr. 1. F. Introduction to the field of Horticulture.

Hort 112. Orientation to Learning and Productive Team Membership. (Cross-listed with Aer E, FS HN, TSM, NREM). (2-0) Cr. 2. F. Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

Hort 114. Developing Responsible Learners and Effective Leaders. (Cross-listed with NREM, FS HN, TSM). (2-0) Cr. 2. S. Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

Hort 121. Home Horticulture. (2-0) Cr. 2. F.S. Growing plants in and around the home including requirements for growing house plants; plant propagation; designing and maintaining flower, fruit, and vegetable gardens; lawn, tree, and shrub maintenance.

Hort 122. Hands-On Home Horticulture. (1-0) Cr. 1. F.S. Demonstration and activities that illustrate principles of growing plants for the home garden. Topics include plant identification, propagation, selection, and management for indoor and outdoor gardens.

Hort 193. Topics in Horticulture. Cr. arr. Repeatable. F.S.SS. Off Campus. Offered as demand warrants. Includes practical courses in the field of Horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.
A. Greenhouse Crops
B. Nursery Crops
C. Turfgrass
D. Fruit Crops
E. Vegetable Crops
F. Cross-Commodity
G. Landscape Horticulture

Hort 221. Principles of Horticulture. (2-2) Cr. 3. F.S. *Prereq: Biol 211.* Biological principles of growing Horticultural crops including anatomy, reproduction, light, temperature, water, nutrition, and growth and development. Laboratory exercises emphasize environmental factors and permit detailed observation of plant growth.

Hort 233. Foliage Plants for Interiorscapes. (2-2) Cr. 3. F. *Prereq: 221.* Identification, nomenclature, selection and culture of foliage plants for interior landscapes. Planning, cost-estimating, installation, and maintenance of foliage plants and flowering potted plants in homes, offices, and public buildings.

Hort 240. Trees, Shrubs, and Woody Vines for Landscaping. (3-0) Cr. 3. F. Students will learn to identify trees, shrubs, and woody vines. Factors influencing the horticultural use of woody plants also will be taught.

Hort 280. Landscape Graphics. (3-0) Cr. 3. S. Introduction to computer and hand rendering techniques of landscape graphics. Students will gain proficiency in plan view, section and elevation graphics. Intensive studio and computer based instruction.

Hort 282. Educating Youth Through Horticulture. (2-3) Cr. 3. Alt. S., offered 2010. Planning, developing, and implementing science-based educational programs in a public garden setting. Through hands-on experiences students will learn about Horticulture, learning theory, and the application of science principles as they pertain to educating youth.

Hort 283. Pesticide Application Certification. (Cross-listed with Ent, for, Agron). (2-0) Cr. 2. S. Holscher. Core background and specialty topics in agricultural, and Horticultural pesticide applicator certification. Students can Select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

Hort 321. Horticulture Physiology. (3-0) Cr. 3. F. *Prereq: 221 or Biol 211.* Principles of plant physiology relating to growth and development of Horticultural plants including plant water relations, membrane transport, photosynthesis, photomorphogenesis, respiration, and phytohormones. Emphasis on plant's responses to environmental factors (temperature, water, and light) including cellular and whole-plant physiology under stressful environments.

Hort 322. Plant Propagation. (2-2) Cr. 3. S. *Prereq: 221 or Biol 212.* Fundamental principles underlying sexual and asexual propagation of plants; practice in reproducing plants by use of seeds, leaves, stems, and roots.

Hort 330. Herbaceous Ornamental Plants. (2-2) Cr. 3. F. *Prereq: 221 or by permission of instructor.* Identification, botanical characteristics, origins, propagation, uses and general culture of herbaceous annual and perennial plants for Midwestern gardens and landscapes.

Hort 332. Greenhouse Operation and Management. (3-3) Cr. 4. S. *Prereq: 221.* Principles of greenhouse and other controlled environment operation and management. Methods of monitoring and manipulating environmental factors such as light, temperature, fertility, production media, etc., to maximize production rate and quality and minimize production costs and time. Field trip(s) outside scheduled class time required. Nonmajor graduate credit.

Hort 338. Seed Science and Technology. (Cross-listed with Agron). (2-3) Cr. 3. F. *Prereq: Agron 114 or Hort 221, Biol 211.* Goggi. Seed production, maturation, dormancy, vigor, deterioration, and related aspects of enhancement, conditioning, storage, and quality evaluation. Aspects of the seed industry and regulation of seed marketing.

Hort 341. Woody Plant Cultivars: Shade Trees. (1-0) Cr. 1. S. *Prereq: 240 or L A 221 or L A 222.* Students will learn how to identify and care for the most Horticulturally important shade tree taxa suitable for the Midwest. Cultivars of the most prevalent species also will be taught.

Hort 342. Landscape Installation and Establishment. (2-3) Cr. 3. F. *Prereq: 240 or L A 221 or L A 222.* Principles and practices involved with establishment of managed landscapes. Laboratory work involves site evaluation, installation techniques, postplant care, and maintenance of established landscape plants.

Hort 351. Turfgrass Establishment and Management. (Cross-listed with Agron). (3-0) Cr. 3. F. *Prereq: 221 or Agron 114 or Biol 211.* Principles and practices of turfgrass propagation, establishment, and management. Specialized practices relative to professional lawn care, golf courses, athletic fields, highway roadsides, and seed and sod production. The biology and control of turfgrass pests. Nonmajor graduate credit.

Hort 351L. Turfgrass Establishment and Management Laboratory. (Cross-listed with Agron). (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 351.* Those enrolled in the Horticulture curriculum are required to take 351L in conjunction with 351 except by permission of the instructor. Nonmajor graduate credit.

Hort 354. Soils and Plant Growth. (Cross-listed with Agron). (3-0) Cr. 3. F.S. *Prereq: Biol 101 or 211.* Killorn or Loynachan. Effects of chemical, physical, and biological properties of soils on plant growth, with emphasis on nutritive elements, pH, organic matter maintenance, and rooting development. Nonmajor graduate credit.

Hort 354L. Soils and Plant Growth Laboratory. (Cross-listed with Agron). (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 354.* Henning. Laboratory exercises in soil testing that assess a soil's ability to support nutritive requirements for plant growth.

Hort 380. Principles of Garden Composition. (2-0) Cr. 2. S. *Prereq: 240.* Not available as credit for L A majors. Functional and aesthetic aspects of landscape planning as a basis for design decisions; emphasis on plant selection. Includes site analysis, development process, and design principles.

Hort 381. Beginning Garden Composition Studio. (0-4) Cr. 2. S. *Prereq: 240, 330.* To be taken concurrently with 380. Not available as credit for L A majors. Development of landscape graphic techniques. Studio-based projects implementing principles of landscape design.

Hort 391. Horticultural Management Experience. Cr. 1. Repeatable. F.S.SS. *Prereq: 221, permission of instructor.* A structured work experience for the student to gain insight into management operations associated with production and management of Horticultural crops. A report of 10 or more pages describing the student's experience is required. One credit is given for each term the student is enrolled in the course. A maximum of two credits may be used toward the Horticultural sciences course requirements, and two additional credits may be used toward the 128 credits required for graduation.

Hort 398. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of department resource and career center coordinator.* Students must register for this course before commencing each work period.

Hort 421. Introduction to Plant Breeding. (Cross-listed with Agron). (3-0) Cr. 3. F. *Prereq: Gen 320 or Biol 313.* Breeding methods used in the genetic improvement of self-pollinated, cross-pollinated, and asexually reproduced Agronomic and Horticultural crops. Applications of biotechnology techniques in the development of improved cultivars. Nonmajor graduate credit.

Hort 422. Postharvest Technology. (3-3) Cr. 4. Alt. F., offered 2009. *Prereq: 221, junior or senior classification.* Principles, methods, and techniques related to postharvest maintenance of quality of Horticultural commodities. Emphasis on the effects of handling, storage facilities and techniques, and quality evaluation. Field trips outside scheduled class time required. Weekend/overnight field trips may be required. Nonmajor graduate credit.

Hort 423. Plant Tissue, Cell, and Protoplast Culture. (Dual-listed with 523). (2-0) Cr. 2. Alt. F., offered 2009. *Prereq: Biol 313 and Hort 321 or Biol 330.* Theory and techniques of plant tissue culture, including organogenesis, somatic embryogenesis, micropropagation, anther and embryo culture, protoplast isolation and culture, and transformation. Applications to agriculture.

Hort 424. Sustainable and Environmental Horticulture Systems. (Dual-listed with 524). (Cross-listed with Env S). (2-0) Cr. 2. F. Inquiry into ethical issues and environmental consequences of Horticultural cropping systems and production practices. Emphasis on production systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

Hort 434. Greenhouse Crop Production I. (3-3) Cr. 4. Alt. F., offered 2009. *Prereq: 330 and 332.* Principles and practices of greenhouse floricultural crop production. Emphasis is placed on production of common bulbous, cut flower, foliage, and containerized flowering species produced in greenhouses and other controlled environments. Field trips outside scheduled class time required. Weekend/overnight field trips may be required. Nonmajor graduate credit.

Hort 435. Greenhouse Crop Production II. (2-3) Cr. 3. Alt. S., offered 2010. *Prereq: 330 and 332.* Principles and practices of greenhouse floricultural crop production. Emphasis is placed on production of flowering annual and perennial crops, vegetative annuals, and species in hanging baskets. Field trips outside scheduled class time required. Weekend/overnight field trips may be required. Nonmajor graduate credit.

Hort 442. Nursery Production and Management. (2-0) Cr. 2. Alt. F., offered 2009. *Prereq: 221.* Theory, nursery layout and design, and cultural practices important for growing and shipping field and container-grown nursery crops. Overview of garden center design and retailing and marketing strategies. Field trip(s) outside scheduled class time may be required. Nonmajor graduate credit.

Hort 444. Landscape Construction. (2-3) Cr. 3. F. *Prereq: 240, junior or senior classification.* Principles and practices of residential landscape construction. Encompasses process from initial client contact, materials procurement, job sequencing, and installation of plant material and hardscapes. Laboratory work involves site evaluation and measurement and landscape installation using various landscape materials and techniques.

Hort 445. Horticulture Management and Administration. (2-0) Cr. 2. F. *Prereq: 221, junior or senior classification.* In-depth presentation and discussion of skills and strategies needed to manage a Horticultural enterprise. Topics include motivating employees, managing meetings, conducting performance appraisals, dealing with conflict, and managing an increasingly diverse work force.

Hort 446. Landscape Contracting and Estimating. (2-0) Cr. 2. F. *Prereq: 240 and credit or enrollment in 342; junior or senior classification.* Overview and implementation of landscape estimating and contracting. Includes estimating procedures (material, labor, equipment) and landscape business issues (contracts, insurance, personnel).

Hort 451. Professional Turfgrass Management. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 351.* Turfgrass science including the study of (1) specific information on soil chemistry and soil modification as they relate to the development and maintenance of turfgrass areas, (2) specialized management practices used in athletic field care, professional lawn care, and golf course industries, and (3) construction methods for golf courses and sports fields. Nonmajor graduate credit.

Hort 452. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 552). (Cross-listed with Pl P, Ent). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Hort 453. Sports Turf Management. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 351.* Management techniques for today's specialized athletic fields. The Horticultural and budgetary aspects of football, soccer, baseball, and softball fields will be presented. Field trips and laboratory exercises will develop a practical understanding of actual principles in field development, construction, and management. Nonmajor graduate credit.

Hort 454. Turf & Landscape Irrigation. (3-0) Cr. 3. Alt. F., offered 2009. Irrigation systems and principles for turf and landscape environments. Topics include design, installation, equipment, management, and trouble shooting of irrigation systems for golf, athletic fields, residential lawns and landscapes. Participation in practical exercises and local field trips to irrigation sites are required.

Hort 461. Fruit and Nut Crop Production and Management. (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 221.* Principles and practices of small fruit, tree fruit, and nut culture and production. Morphology, physiology of growth and development, plant establishment, pest management, pruning, training, harvesting, storage, and marketing. Emphasis on sustainable practices. Participation in practical exercises and local field trips is required. Nonmajor graduate credit.

Hort 471. Vegetable Production and Management. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 221 or Agron 114 and Agron 154 or 155.* Principles of vegetable production with emphasis on sustainable practices, market outlets, business aspects, and risk management. Organic techniques will be discussed. Major crop climatic conditions, physiological growth and development, harvesting, storage, and marketing. Nonmajor graduate credit.

Hort 471L. Vegetable Production and Management Laboratory. (0-2) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in Hort 471 is required, except by permission of the instructor.* Sequence planting techniques, seed and seedling identification, seed germination quality and requirements, earliness techniques, irrigation management, fertilizer and compost application, postharvest handling, high tunnel production, and pesticide application will be covered. Field trip required. Some laboratory projects will require time outside the regular scheduled class period. Nonmajor graduate credit.

Hort 475. Urban Forestry. (Cross-listed with For). (2-3) Cr. 3. F. *Prereq: Junior or senior classification, 3 credits in biology.* Discussion of establishment and management of woody perennials in community-owned urban greenspaces, consideration of urban Site and soil characteristics, plant physiology, plant culture, urban forest valuation, inventory methods, species selection, and urban forest maintenance (health care and pest management). Nonmajor graduate credit.

Hort 480. Contemporary Issues in the Green Industry. (3-0) Cr. 3. S. *Prereq: junior or senior classification.* Analysis and evaluation of contemporary issues facing the green industry including environmental regulations, labor, market share, landscape contracting business management and professionalism. Discussion format and interaction with green industry professionals.

Hort 481. Advanced Garden Composition. (0-5) Cr. 3. F. *Prereq: 240, 330, 380, 381.* Limited to Planting Design/Installation option students. Development of residential landscapes using design principles and the design process. Projects encompass site analysis, concept development, preliminary design, final design, and graphic presentation techniques. Techniques will include hand and computer rendering.

Hort 484. Organic Agricultural Theory and Practice. (Dual-listed with 584). (Cross-listed with Agron). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 9 cr in biological or physical sciences.* Delate & DeWitt. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and Socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

Hort 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or Senior classification in Horticulture, permission of instructor.* Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.
A. Greenhouse Crops
B. Nursery Crops
C. Turfgrass
D. Fruit Crops
E. Vegetable Crops
F. Cross-Commodity
G. Landscape Horticulture
H. Honors
I. International Study
J. Entrepreneurship
Z. Service Learning

Hort 491. Seed Science Internship Experience. (Cross-listed with Agron, TSM). Cr. arr. Repeatable. F.S.SS. *Prereq: Agron 338, advanced approval and participation of employer and instructor.* A professional work experience and creative project for seed science secondary majors. The project requires prior approval and participation of the employer and instructor. The student must submit a written report.

Hort 493. Workshop in Horticulture. Cr. arr. Repeatable. Off campus. Offered as demand warrants. Workshops in Horticulture. Nonmajor graduate credit.

Hort 495. Horticulture Travel Course Preparation. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Limited enrollment. Students enrolled in this course also intend to register for Hort 496 the following term. Topics include preparation for safe international travel, the Horticultural/agricultural industries, climate, crops, economics, geography, history, marketing, soils, culture, traditions, and Horticultural/agricultural development of the country to be visited. Students enroll in this course the term immediately before travel to the foreign country.

Hort 496. Horticulture Travel Course. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Limited enrollment. Study and tour of production methods in major Horticultural regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, cultures, and history of Horticultural crops. Location and duration of tours will vary. Tour expenses paid by students.

Hort 497. Professional Development Seminar. (1-0) Cr. 1. S. *Prereq: Junior or senior classification.* Weekly series of lectures and workshops will help students better prepare for their professional career in Horticulture by developing the professional skills necessary to be successful in today's competitive workplace.

Courses primarily for graduate students, open to qualified undergraduate students

Hort 511. Integrated Management of Tropical Crops. (Cross-listed with Pl P, Ent). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Pl P 408 or 416 or Ent 370 or 376 or Hort 221.* Gleason, Lewis, Nonnecke. Applications of Integrated Crop Management principles (including plant pathology, entomology, and Horticulture) to tropical cropping systems. Familiarization with a variety of tropical agroecosystems and Costa Rican culture is followed by 10-day tour of Costa Rican agriculture during spring break, then writeup of individual projects. Tour expenses paid by students.

Hort 523. Plant Tissue, Cell, and Protoplast Culture. (Dual-listed with 423). (2-0) Cr. 2. Alt. F., offered 2009. *Prereq: Biol 313 and Hort 321 or Biol 330.* Theory and techniques of plant tissue culture, including organogenesis, somatic embryogenesis, micropropagation, anther and embryo culture, protoplast isolation and culture, and transformation. Applications to agriculture.

Hort 524. Sustainable and Environmental Horticulture Systems. (Dual-listed with 424). (2-0) Cr. 2. F. Inquiry into ethical issues and environmental consequences of Horticultural cropping systems and production practices. Emphasis on production systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

Hort 529. Publishing in Biological Sciences Journals. (Cross-listed with Agron, NREM). (2-0) Cr. 2. S. *Prereq: Permission of instructor; evidence of a publishable unit of the student's research data.* Process of preparing a manuscript for submission to a refereed journal in the biological sciences. Emphasis on publishing self-generated data from thesis or dissertation research.

Hort 530. Research Orientation. (1-3) Cr. 2. F. Instruction in scientific methods and communication skills.

Hort 537. Plant Stress Biology. (Cross-listed with Agron, EEOB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 330A or equivalent and BBMB 404-405.* Physiology and molecular biology of plant responses to environmental stress. Emphasis on the role of hormones and hormone interactions in governing stress responses. Lectures are prepared from journal papers that elucidate key mechanisms controlling responses to drought, flooding, salt, nutrient deficiencies, freezing, pathogens and herbivores. Plants studied include genetic model systems and crops of Horticultural and Agronomic value.

Hort 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BCB, FS HN, NutrS, VDPAM, BBMB, B M S, EEOB, NREM, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

Hort 543. Seed Physiology. (Cross-listed with STB). (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Brief introduction to plant physiology. Physiological aspects of seed development, maturation, longevity, dormancy and germination. Links between physiology and seed quality.

Hort 546. Organizational Strategies for Diversified Farming Systems. (Cross-listed with Agron, Soc, SusAg). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: SusAg 509.* Examination of the organization and operation of complex, diversified farming systems using tools and perspectives drawn from ecology, Agronomy, and Sociology. The course contains a significant field component focused on an Iowa farm.

Hort 551. Growth and Development of Perennial Grasses. (Cross-listed with Agron). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Junior or senior or graduate classification or permission of instructor.* The grass plant. Selected topics on anatomy, morphology, and physiology relative to growth and development of perennial grasses. Emphasis on growth and development characteristics peculiar to grasses and variations of such characteristics under natural and managed conditions.

Hort 552. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 452). (Cross-listed with Ent, Pl P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Hort 565. Professional Practice in the Life Sciences. (Cross-listed with Pl P, An S, V MPM, Agron, BCB, Micro). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.

A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.

B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

Hort 584. Organic Agricultural Theory and Practice. (Dual-listed with 484). (Cross-listed with Agron, SusAg). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 9 cr in biological or physical sciences.* Delate & DeWitt. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and Socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

Hort 590. Special Topics. Cr. arr. Repeatable. *Prereq: a major or minor in Horticulture.*

Hort 593. Workshop in Horticulture. Cr. arr. Repeatable. Workshops in Horticulture, with emphasis on off-campus instruction.
A. Greenhouse Crops
B. Nursery Crops
C. Turfgrass
D. Fruit Crops
E. Vegetable Crops
F. Cross-Commodity
G. Landscape Horticulture

Hort 599. Creative Component. Cr. arr. Repeatable.

Courses for graduate students

Hort 610. Graduate Seminar. Cr. 1. Repeatable. F.S. Satisfactory-fail only.

Hort 690. Advanced Topics. Cr. arr. Repeatable.

Hort 696. Research Seminar. (Cross-listed with GDCB, Agron, BBMB, PlBio, for). Cr. 1. Repeatable. Research seminars by faculty and graduate students. Satisfactory-fail only.

Hort 698. Horticulture Teaching Practicum. (1-0) Cr. 1. S. *Prereq: Graduate student classification.* Discussions are intended to foster the development of graduate students as teaching assistants and future Horticulture/plant science teachers. Topics include establishing a classroom presence, improving lectures, motivating students, dealing with difficult or disruptive students, and developing a teaching Philosophy. Satisfactory-fail only.

Hort 699. Thesis and Dissertation Research. Cr. arr. Repeatable.
A. Greenhouse Crops
B. Nursery Crops
C. Turfgrass
D. Fruit Crops
E. Vegetable Crops
F. Cross-Commodity
G. Landscape Horticulture
I. Biotechnology

Hotel, Restaurant, and Institution Management

(Administered by the Department of Apparel, Educational Studies, and Hospitality Management)

Robert Bosselman, Chair of Department

Distinguished Professors (Emeritus): Fanslow, Moyer, Winakor

University Professors (Emeritus): Farrell-Beck

Professors: Bosselman, Damhorst, Fiore, Kadolph

Professors (Emeritus): Anderson, Beavers, Brun, Burnet, Cowan, Crabtree, Gilmore, Smith, Stone, Williams

Associate Professors: Baltzer, Hausafus, Jeong, Niehm, Oh, Parsons

Associate Professors (Emeritus): Amos, Brackelsberg, Brown, Ebert, Huss, Kundel, Kunz, Walsh

Associate Professor (Adjunct): Strohbehn

Assistant Professors: Barker, Hurst, Karpova, Keino, Y. Lee, Marcketti, Rajagopal, Wohlsdorf-Arendt, Zheng

Assistant Professor (Adjunct): Glock

Instructor (Adjunct): Fratzke

Lecturers: Ackerman, Burger, Christensen, Fiihr, Fitzpatrick, Kramer, M. Lee, Sanger, Trost, Wirth, Wise

The Hotel, Restaurant, and Institution Management (HRIM) program aspires to excellence in professional and leadership development, economic development, and food safety for the hospitality industry through education, research, and outreach with a mission of developing leaders in practice, education, and research for the hospitality industry. Educational experiences are planned to contribute to the graduate's effectiveness as a career professional and as a person, family member, and citizen. Research and extension efforts are conducted with the purpose of improving management effectiveness and quality of services within hospitality organizations. Finally, the program is committed to serving the respective missions of Iowa State University and the College of Human Sciences and to serving the needs of the citizens of Iowa.

Undergraduate Study

The program offers work for the degree bachelor of science in hospitality management. Coursework is planned to provide students with a general education plus professional preparation for supervisory and executive positions in hospitality organizations. Principles of business management are presented, as well as fundamentals of hospitality operations.

Graduates demonstrate leadership characteristics and make decisions based on integrating knowledge of financial, human resources, marketing, and operational principles for managing hospitality operations. They demonstrate best practices in meeting customer expectations and use of technology to achieve operational efficiency.

Learning experiences are provided in the quantity food production and service facility of the HRIM program and other approved establishments. Students are required to have a total of at least 600 hours of relevant work experience prior to graduation. Of the 600 hours, 200 hours are required prior to completing one year in the program.

The HRIM program offers a minor that may be earned by successfully completing at least 15 credits of AESHM/HRIM courses in consultation with the advisor. The program also participates in food safety and entrepreneurship interdisciplinary minors.

Communication Proficiency Requirement: Grade of C or better in either Engl 150 and 250 or equivalent transfer courses

Graduate Study

The HRIM program offers work for the master of science and doctor of philosophy degrees in hospitality management. Graduates of the program are able to interpret trends and adapt operating practices of hospitality organizations to changing economic, social, political, technological, and environmental conditions. They can manage a hospitality enterprise successfully to achieve objectives of the operation or, at the doctoral level, successfully carry out responsibilities of a hospitality educator. Graduates will make positive contributions to the growth and improvement of the hospitality industry using current research in the decision-making process.

A degree in hotel, restaurant, and institution management is the usual background for graduate study; however, applicants with preparation in dietetics, business, or closely related fields are encouraged to apply. Ph.D. applicants must have two (2) years of professional work experience in the field.

The master of science degree requires either a thesis or non-thesis (creative component) project. Students also are required to take one course in three of four core areas (human resources, financial management, marketing, and strategic management).

The program participates in the Master of Family and Consumer Sciences degree by offering a specialization in Hospitality management. The program also participates in the Master of Family and Consumer Sciences degree with specialization in Dietetics, offered in cooperation with the Department of Food Science and Human Nutrition.The Ph.D. program requires 80 credits, up to 30 of which may be applied from the Master's degree. All Ph.D. students take a minimum of 15 research/dissertation credits.

Courses primarily for undergraduate students

HRI 101. Introduction to the Hospitality Industry. (3-0) Cr. 3. F. Introduction to the foodservice, lodging, and tourism components of the hospitality industry. Background information, current issues, and future challenges in various segments of the industry.

HRI 189. Introduction to University Dining Services Management. (1-0) Cr. 1. S. Overview of management concepts and distinct features of university dining services.

HRI 193. Hospitality Work Experience I. Cr. R. F.S.SS. Approved work experience in foodservice, lodging, or related operations. A minimum of 200 hours required prior to completing one year in the program. Satisfactory-fail only.

HRI 233. Hospitality Sanitation and Safety. (3-0) Cr. 3. F.S. Sanitation and safety principles in foodservice and lodging operations. Issues impacting consumers and operators. Application of HACCP. Preparation for national foodservice sanitation certification examination. Characteristics of food, supplies, and equipment as related to quality, sanitation and safety.

HRI 260. Global Tourism Management. (3-0) Cr. 3. S. Overview of the global tourism industry: hospitality and related services, destination/ attractions, and transportation. Introduction to travel behavior, tourism planning and research, and economic and social impacts of tourism development.

HRI 289. Private Club Operations. (2-0) Cr. 2. F.S. *Prereq: 101.* Organization and management of private clubs including city, country, and other recreational and social clubs. Field trip required.

HRI 315. Hospitality Law. (3-0) Cr. 3. S. *Prereq: 101.* Laws relating to ownership and operation of hospitality organizations. The duties and rights of both hospitality business operators and customers. Legal implications of various managerial decisions. Nonmajor graduate credit.

HRI 333. Hospitality Operations Cost Controls. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 380, 380L; Math 104 or 150; Com S 103.* Introduction to revenue and cost systems in foodservice and lodging operations. Application of principles related to procurement, production, and inventory controls.

HRI 352. Lodging Operations Management I. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 101.* Introduction to functional department activities and current issues of lodging organizations with emphasis on front office and housekeeping. Reservation activities and night audit exercises. Case studies.

HRI 380. Quantity Food Production Management. (3-0) Cr. 3. F.S. *Prereq: 233 or 2 cr Micro; FS HN 111 or 214; at least junior classification; enrollment in 380L.* Principles of and procedures used in quantity food production management including quality control, food costing, work methods, menu planning, food production systems, and service.

HRI 380L. Quantity Food Production and Service Management Experience. (0-6) Cr. 2. F.S. *Prereq: 233 or 2 cr Micro; FS HN 111 or 214; at least junior classification; enrollment in 380; reservation with program required.* Application of quantity food production and service management principles and procedures in the program's foodservice operation.

HRI 381. International Study in Hospitality. Cr. arr. Repeatable. SS. *Prereq: Permission by application.* Limited enrollment. Supervised study abroad of tourism and its impact on hospitality operations. Experiences include hospitality-related tourist attractions and opportunities related to different cultures. Required pre-study sessions arranged. Expenses paid by student.

HRI 382. Field Study. Cr. arr. F.S.SS. *Prereq: Permission by application.* Supervised study opportunity for students to observe and apply classroom theory to actual hospitality operations across the US. Hospitality operations may include hotels, restaurants, resorts, wineries, theme parks, clubs, hospitals, and tourism operations. Required pre-study sessions may be arranged. Expenses paid by student.

HRI 383. Introduction to Wines, Beers, and Spirits. (2-0) Cr. 2. F.S. *Prereq: Must be at least 21 years old.* Introduction to history and methods of production for a variety of wines, beers, spirits, and other beverages. Product knowledge, sales, and service techniques related to the hospitality industry.

HRI 391. Foodservice Systems Management I. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 380, 380L.* Principles and techniques related to basic management, leadership, and human resource management of foodservices in health care and other institutional settings. Food safety and sanitation for institutions. Credit for either HRI 391 or 287 and 438 may count toward graduation. Not accepted for credit toward a major in HRIM.

HRI 392. Foodservice Systems Management II. (3-0) Cr. 3. S. *Prereq: 391.* Introduction to cost control in foodservice departments: procedures for controlling food, labor, and other variable costs. Application of principles related to food product selection, specification, purchase, and storage in health care and other institutions. Credit for either HRI 392 or 233 and 333 may count toward graduation. Not accepted for credit toward a major in HRIM.

HRI 393. Hospitality Work Experience II. Cr. 2. F.S.SS. *Prereq: 101, 193, 233, 287; adviser approval.* Approved 400-hour work experience in foodservice, lodging, or related operations for HRIM majors. Open to minors. Satisfactory-fail only.

HRI 433. Hospitality Financial Management. (3-0) Cr. 3. S. *Prereq: 333; Acct 284; Econ 101; credit or enrollment in Stat 101.* Use of common financial statements, accounting ratios, and financial techniques to impact management decisions.

HRI 437. Hospitality Information Technology. (3-0) Cr. 3. F. *Prereq: 352.* Introduction to hospitality information technology. Property management and point-of-sales system interfaces: customer relationship management, selecting and purchasing computer systems, electronic distribution systems, internet and its related application systems, managing internal and external communication networks. Case studies. Nonmajor graduate credit.

HRI 439. Advanced Hospitality Human Resource Management. (3-0) Cr. 3. F. *Prereq: 438.* Emphasis on development of management personnel in hospitality organizations. Case studies.

HRI 452. Lodging Operations Management II. (3-0) Cr. 3. S. *Prereq: 352; Com S 103.* Development of business plan and evaluation of business performance in a simulated environment. Operational decision making practices by applying concepts of management, operations, marketing, and finance for a computer-mediated environment. Nonmajor graduate credit.

HRI 455. Introduction to Strategic Management in Foodservice and Lodging. (3-0) Cr. 3. S. *Prereq: 340; credit or enrollment in 433; 438.* Introduction to strategic management principles and practices with an application of human resources, operations, marketing, and financial management concepts. Case studies.

HRI 487. Fine Dining Management. (Dual-listed with 587). (2-3) Cr. 3. F. *Prereq: 380, 380L; credit or enrollment in 333.* Creative experiences with U.S. regional and international foods appropriate for fine dining. Application of management principles in food preparation and service in fine dining operations. Exploration of the historical and cultural development of the world food table.

HRI 489. Issues in Food Safety. (Cross-listed with An S, FS HN, VDPAM). (1-0) Cr. 1. S. *Prereq: Credit or enrollment in FS HN 101 or 272 or HRI 233; FS HN 419 or 420; FS HN 403.* Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

HRI 490. Independent Study. Cr. arr. *Prereq: Sections B-E: Program approval; Section H: Full membership in Honors Program.*
B. Hospitality Management
D. Lodging Operations
E. Foodservice Operations
H. Honors

HRI 491. Internship. Cr. 2. Repeatable. F.S.SS. *Prereq: 193, 287, 352 or 380, 380L; adviser approval.* Approved 400-hour experience in hospitality operations and supervisory responsibilities. Satisfactory-fail only.
A. Foodservice Operations
B. Lodging Operations
C. Hospitality Management

HRI 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of undergraduate coordinator.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

HRI 504. Seminar. (0-1) Cr. 1. F. (A), S.(B). 504B may be taken more than once for credit.
A. Hospitality Research
B. Current Issues

HRI 511. Research Methods in Foodservice & Lodging Management. (3-0) Cr. 3. *Prereq: Graduate standing in the Department.* Overview of research methods. Methods for collecting and analyzing quantitative and qualitative data. Development of research plan.

HRI 533. Financial Decision Making in Foodservice and Lodging Organizations. (3-0) Cr. 3. S. *Prereq: 433.* Concepts of financial management applied to strategic decision making.

HRI 538. Human Resources Development in Foodservice and Lodging Organizations. (3-0) Cr. 3. *Prereq: 438.* Theories of human resources management. Practices and principles related to development of management personnel.

HRI 540. Marketing Strategy. (3-0) Cr. 3. S. *Prereq: 340.* Application of marketing principles in developing effective marketing strategies for hospitality, apparel, and retail organizations. Development of marketing plan.

HRI 555. Strategic Management in Foodservice and Lodging Organizations. (3-0) Cr. 3. *Prereq: Courses in Mkt. and Fin. Management.* Strategic management process as a planning and decision-making framework; integration of human resources, operations, marketing, and financial management concepts.

HRI 575. Professional Experience in Foodservice and Lodging Organizations. Cr. 2. F.S.SS. *Prereq: Accepted in HRIM graduate program.* Analysis and interpretation of professional functions or data, or design and implementation of a management project.

HRI 587. Fine Dining Management. (Dual-listed with 487). (2-3) Cr. 3. F. *Prereq: 380, 380L.* Creative experiences with U.S. regional and international foods. Application of management principles in food preparation and service. Exploration of the historical and cultural development of the world food table. Individual special problems.

HRI 590. Special Topics. Cr. arr. Repeatable. *Prereq: 9 credits in HRI at 400 level or above; permission of instructor.*
B. Hospitality Management
D. Lodging Operations
E. Foodservice Operations
F. Child Nutrition Program Management

HRI 599. Creative Component. Cr. arr.

Courses primarily for graduate students

HRI 604. Professional Writing. (2-0) Cr. 2. Development of professional written communication with emphasis on abstracts, proposals, manuscripts, and technical reports.

HRI 608. Administrative Problems. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Advanced administrative problems; case studies in foodservice and lodging organizations.

HRI 633. Advanced Hospitality Financial Management. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 533.* Theories and research in financial management with emphasis on financial performance and financing decisions.

HRI 638. Advanced Human Resources Management in Foodservice and Lodging Organizations. (3-0) Cr. 3. F. *Prereq: 538.* Research in human resources management with an emphasis on organization or unit administration.

HRI 640. Seminar on Marketing Thoughts. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 540; Stat 401.* Conceptual and theoretical development of marketing strategies. Analytical and critical review of marketing research and industry practices.

HRI 652. Advanced Lodging Operations. (3-0) Cr. 3. *Prereq: Enrollment in PhD program.* Analysis and applications of concepts and theories of operations research for lodging operations.

HRI 675. HRIM Teaching Experience. Cr. 1. F.S.SS. *Prereq: Accepted in PhD program.* Development of objectives, teaching methods and materials, and test items for selected topics. Implementation in an HRIM course.

HRI 680. Analysis of Research in Foodservice Operations. (3-0) Cr. 3. *Prereq: Enrollment in PhD program.* Analysis and application of theories, research, and research methods in foodservice.

HRI 690. Advanced Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in doctoral program.* Advanced study of current topics in foodservice and lodging management.
A. Leadership in Hospitality
B. Hospitality Management
C. Entrepreneurship
D. Lodging Operations
E. Foodservice Operations
F. Child Nutrition in Program Management

HRI 699. Research. Cr. arr. Repeatable.

Human Computer Interaction

www.hci.iastate.edu

(Interdepartmental Graduate Program)

Supervisory Committee: James Oliver, Chair; Chui Shui Chan; Julie Dickerson, Steven Hernstadt, Doug Gentile, Stephen Gilbert, Brian Mennecke

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in Human Computer Interaction (HCI). A Graduate Certificate in Human Computer Interaction is also offered, targeted especially for the benefit of students working in business and industry wanting education in this field. The graduate program in Human Computer Interaction (HCI) welcomes applicants from a diverse collection of technical and creative fields whose unifying characteristic is the desire to develop new ways to bridge the gap between human and machine. The students must demonstrate skill in software development and proficiency in high-level, object-oriented programming. To accommodate students who lack exposure to programming, the HCI interdepartmental graduate major will offer an introductory course to provide a base of technical skills.

At the Masters level, entrance requirements will include an undergraduate degree and demonstrable software skills. The degree calls for 30 credits of course work including appropriate credit for the master's thesis. MS students must take one core course of their choice from each of the categories of Implementation, Design, Evaluation and Phenomena. MS Students must also take two semesters of HCI 591 Seminar in HCI.

All programs of study for the Ph.D. must include 1) one core course of their choice from each of the categories of Implementation, Design, Evaluation and Phenomena, if not completed as part of the student's masters program; 2) two more courses of their choice from a list of recommended electives; and 3) four semesters of HCI 591 Seminar in HCI.

Information on applications procedures and specific requirements of the major can be obtained from the following Internet address: www.hci.iastate.edu.

Courses for graduate students

HCI 407. Principles of 3D Character Animation. (Dual-listed with 507). (Cross-listed with ArtIS). (0-6) Cr. 3. Repeatable. F.S. *Prereq: 308.* Animation techniques using the computer and available software. Principles of character animation. Prior knowledge of modeling, lighting, texturing and rendering with available software is assumed. Nonmajor graduate credit.

HCI 409. Computer/Video Game Design and Development. (Dual-listed with 509). (Cross-listed with ArtIS). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Permission of instructor. Programming emphasis: Com S 227, 228, 229 or equivalent in Engineering; art or graphics emphasis: Art 230 and ArtIS 308; writing emphasis: an English course in creative writing or writing screen plays; business or marketing students: junior classification.* Independent project based creation and development of "frivolous and non-frivolous" computer games in a cross disciplinary team. Projects require cross-disciplinary teams. Aspects of Indie development and computer/video game history will be discussed. Nonmajor graduate credit.

HCI 504. Managing and Evaluating Instructional Technology Interventions. (Cross-listed with C I). (3-0) Cr. 3. S. *Prereq: CI 501.* Principles and procedures for analysis, review, and assessment of instructional technology interventions in education and corporate settings. Methods for planning, organizing, and conducting evaluative studies are applied.

HCI 509. Computer/Video Game Design and Development. (Dual-listed with 409). (Cross-listed with ArtIS). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Permission of instructor. Programming emphasis: Com S 227, 228, 229 or equivalent in Engineering; art or graphics emphasis: Art 230 and ArtIS 308; writing emphasis: an English course in creative writing or writing screen plays; business or marketing students: junior classification.* Independent project based creation and development of "frivolous and non-frivolous" computer games in a cross-disciplinary team. Projects require cross-disciplinary teams. Aspects of Indie development and computer/video game history will be discussed.

HCI 515. Statistical Natural Language Processing. (Cross-listed with Engl, Ling). (3-0) Cr. 3. F. *Prereq: Stat 330 or equivalent, recommended Ling 219 or Ling 511.* Introduction to computational techniques involving human language and speech in applications such as information retrieval and extraction, automatic text categorization, word prediction, intelligent Web searching, spelling and grammar checking, speech recognition and synthesis, statistical machine translation, n-grams, POS-tagging, word-sense disambiguation, on-line lexicons and thesauri, markup languages, corpus analysis, and Python programming language.

HCI 520. Computational Analysis of English. (Cross-listed with Engl, Ling). (3-0) Cr. 3. F. *Prereq: Engl 510 or 511.* Concepts and practices for analysis of English by computer with emphasis on the applications of computational analysis to problems in applied linguistics such as corpus analysis and recognition of learner language in computer-assisted learning and language assessment.

HCI 521. Cognitive Psychology of Human Computer Interaction. (Cross-listed with Psych). (3-0) Cr. 3. *Prereq: Graduate classification or instructor approval.* Biological, behavioral, perceptual, cognitive and social issues relevant to human computer interactions.

HCI 522. Scientific Methods in Human Computer Interaction. (Cross-listed with Psych). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Psych 521 and Stat 101 or equivalent.* Basics of hypothesis testing, experimental design, analysis and interpretation of data, and the ethical principles of human research as they apply to research in human computer interaction.

HCI 525. Optimization Methods for Complex Designs. (Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: Engr 160, Math 265.* Optimization techniques including unconstrained and constrained minimization, linear programming, and particle swarm optimization. Both the theory and methods and the application to complex designs will be presented.

HCI 558. Introduction to the 3D Visualization of Scientific Data. (Cross-listed with Geol, Com S). (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate-student standing in the Mathematical or natural sciences.* Introduction to visualizing scientific information with 3D computer graphics and their foundation in human perception. Overview of different visualization techniques and examples of 3D visualization projects from different disciplines (natural sciences, medicine, engineering). Class project in interactive 3D visualization using the OpenDX, VTK or a similar system.

HCI 575. Computational Perception. (Cross-listed with Com S, Cpr E). (3-0) Cr. 3. S. *Prereq: Graduate standing or permission of instructor.* This class covers Statistical and algorithmic methods for sensing, recognizing, and interpreting the activities of people by a computer. This semester we will focus on machine perception techniques that facilitate and augment human-computer interaction. The main goal of the class is to introduce computational perception on both theoretical and practical levels. You will work in small groups to design, implement, and evaluate a prototype of a human-computer interaction system that uses one or more of the techniques covered in the lectures.

HCI 590. Special Topics. Cr. arr. Repeatable. Investigation of problems of special interest in human computer interaction.

HCI 591. Seminar in Human Computer Interaction. Cr. arr. Repeatable.

HCI 592. Entrepreneurship Workshop. (1-0) Cr. 1. F. Students will be taken step-by-step through activities that must be undertaken when attempting to commercialize a technology or start their own company. Speakers will be brought in to introduce relevant topics, provide resources, answer questions, and provide working examples.

HCI 603. Advanced Learning Environments Design. (Cross-listed with C I). (3-0) Cr. 3. S. *Prereq: CI 503.* Exploration of advanced aspects of the instructional design process. Application of analysis, design, development and production, evaluation, implementation, and project management principles. Focus on the production and use of instructional technology with an emphasis on the instructional design consulting process. Theory and research in instructional technology provides the foundation for design decisions.

HCI 655. Organizational and Social Implications of Human Computer Interaction. (Cross-listed with MIS). (3-0) Cr. 3. *Prereq: Graduate Classification.* Examine opportunities and implications of information technologies and human computer interaction on social and organizational systems. Explore ethical and social issues appurtenant to human computer interaction, both from a proscriptive and prescriptive perspective. Develop informed perspective on human computer interaction. Implications on research and development programs.

HCI 697. HCI Internship. Cr. R. Repeatable. *Prereq: Permission of Director of Graduate Education, graduate classification.*

HCI 699. Research. Cr. arr. Repeatable.

Human Development and Family Studies

Corlice Brooke, Interim Chair of Department

Distinguished Professors (Emeritus): Bivens, Meixner

Professors: Brooke, Brotherson, Crase, Draper, Fletcher, Garasky, Hira, Lempers, Macdonald, Martin, Peterson, Russell, Wickrama, Yearns

Professors (Emeritus): Coulson, Deacon, Engel, Joanning, Mercier, Pickett, Winter

Associate Professors: Cook, Greder, Hegland, Luze, Maude, Murphy, Torrie

Associate Professors (Emeritus): Crull, Dail, Herwig, K. Miller, N. Miller, Strong, Volker

Associate Professor (Adjunct): Melby

Assistant Professors: Hughes, Lohman, Margrett

Assistant Professors (Emeritus): Glass, Graham

Assistant Professors (Adjunct): Colbert, Hockaday, Oesterreich, Swanson

Senior Lecturer: Krogh

Lecturers: Borkowski, Enloe, Hensley, Kostelecky, Mahan, Mcclain, Popillion, Schrag, Shedd, Trudeau, Vanmeter, Walsh, Wetzler

Undergraduate Study

For undergraduate curricula in Human Development and Family Studies, leading to the degree bachelor of science, see *Human Sciences, Curricula.*

The Department of Human Development and Family Studies offers courses that focus on the interactions among individuals, families, their resources, and their environments throughout the life span. The department offers work for the Bachelor of Science degree in three curricula: Child, Adult, and Family Services; Early Childhood Education; and Family Finance, Housing and Policy.

The Child, Adult and Family Services curriculum leads to work in the helping professions with employment opportunities in public and private agencies, including Head Start. Opportunities exist to observe and work with infants, preschoolers, school-age children, adolescents, adults, and families. Graduates of the program are prepared for employment in agencies and organizations serving children, youth, families, and adults as program development specialists, coordinators, directors, teachers, direct care staff, and administrators. This flexible program provides a broad emphasis in theory, research, and application in child, adult and family services including attention to community issues and public policy.

Students in the Child, Adult and Family Services curriculum are eligible to participate in *Camp Adventure ™ Youth Services.* Administered by the University of Northern Iowa, Camp Adventure ™ offers students an opportunity to plan and implement school-age service and youth development, develop leadership and management skills, enhance one's global awareness and promote cultural sensitivity. Comprehensive school age and youth service programs directed primarily toward U.S. military installations, U.S. embassies, and corporate clubs and associations are offered. Students will earn 12 credits from the University of Northern Iowa, which can be transferred and applied to CAFS requirements. Students in the child program and youth program options may use Camp Adventure as HD FS 491 Internship if prerequisites are met before beginning the internship. See departmental advising coordinator for information and eligibility.

Students graduating in the Child, Adult, and Family Services major will 1) demonstrate competency in human development and family studies and their chosen field of emphasis; 2) demonstrate proficiency in interpersonal communication and in working with diverse groups to solve multidisciplinary problems; 3) effectively practice preparation and delivery of information to human Service and child care professionals as well as to the general public; 4) critically evaluate information and accurately interpret and use research, and 5) understand the complexity of issues facing professionals in the field, including ethical, cultural and environmental elements.

The Family Finance, Housing, and Policy curriculum prepares students for careers as financial counselors and planners, insurance agents, loan officers, mortgage originators, government housing authority administrators, housing advocates, housing planners, real estate agents, non-profit agency administrators, policy analysts and lobbyists, property managers, and consumer credit and financial aid counselors. The program focuses on financial resource management, housing services and administration, and family policy issues pertinent to children, adults and families. In addition, the program is designed to provide students with skills and background necessary to address the financial and housing related needs of vulnerable households including populations who experience discrimination due to poverty, minority Status, age, and/or disability Status. Laboratory and practicum opportunities exist in the ISU Financial Counseling Clinic, a HUD-approved financial and housing counseling service. Laboratory opportunities also exist in the Universal Design Learning Laboratory where students can complete class projects and investigations to better understand requirements of life span design and accessibility issues. A variety of service learning opportunities are available to familiarize students with public and not-for-profit community services and agencies. Well qualified juniors and seniors in Family Finance, Housing and Policy who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both a B.S. in FFHP and an M.S. in HDFS or a B.S. in FFHP and a Graduate Certificate in Family Financial Planning. Under concurrent enrollment, students simultaneously take undergraduate and graduate courses and may be eligible for assistantships. See *Graduate Study* for more information.

Students graduating in the Family Finance, Housing, and Policy major will 1) demonstrate competency in consumer science and policy and their chosen field of emphasis, 2) demonstrate proficiency in interpersonal communication and in working with diverse groups to solve multidisciplinary problems, 3) effectively practice preparation and delivery of information to family finance, housing, and policy professionals as well as to the general public, 4) critically evaluate information and accurately interpret and use research, and 5) understand the complexity of issues facing professionals in the field, including ethical, cultural and environmental elements.

The curriculum in Early Childhood Education is planned for students preparing to teach young children and work with their families. This program leads to careers in working with young children who are typically developing and those with special needs from birth through age eight. Graduates in this curriculum may teach in early childhood (preschool and primary) classrooms or home based programs, with emphasis on inclusive services; graduates may be employed by either public or private agencies or schools. This curriculum has been approved by the Iowa Department of Education and meets requirements for the early childhood education unified teacher license, which permits individuals to teach general and special education for children from birth through age eight. The program is an interdepartmental major administered by the Department of Curriculum and Instruction and the Department of Human Development and Family Studies within the College of Human Sciences.

Students who enroll in Early Childhood Education must make application to and be accepted into the teacher education program prior to enrolling in advanced courses. All early childhood education students, including those seeking a double major, must meet general education requirements for teacher licensure. Iowa State University is in compliance with the Iowa Department of Education's mandate for a performance based system of teacher training. Following this same type of system, the State of Iowa has developed and implemented a competency system to evaluate the performance of all teachers. A detailed list of the eleven Iowa State University Teacher Education Standards and the eight State of Iowa Teaching Standards, along with other information about the University Teacher Education Program, can be found at www.teacher.hs.iastate.edu/, the teacher education website. Information is also available from the student's academic adviser.

Students in early childhood education must meet the performance outcome standards for teacher licensure. Standards are assessed in coursework through designated performance indicators such as assignments, projects, or practicum participation. These standards assessments are based on the early childhood content standards for endorsement 100 in the State of Iowa. These include competencies in (1) child growth, development, and learning; (2) developmentally appropriate learning environment and curriculum implementation; (3) health, safety, and nutrition; (4) family and community collaboration; and (5) professionalism. Pre-student teaching field experiences and student teaching experience in a least two different settings are required. Students will receive both formative and summative evaluations of their progress toward meeting these outcomes throughout their program at ISU.

The department offers minors in Child, Adult, and Family Services, and Family Finance, Housing, and Policy.

The Child, Adult, and Family Services minor may be earned by completing 102; selecting 3 credits from 220, 221, 226, 227, or 377; and selecting 9 credits from 270, 344, 349, 360, 367, 373, 380, 395, 449, 463 or 479.

The Family Finance, Housing, and Policy minor may be earned by completing HD FS 239; 283; 395; and selecting 6 credits from HD FS 341, 360, 378, 463, 483, 488 or 489.

Communication Proficiency requirement: A student must achieve a grade of C or higher in English 150 and 250. A student achieving a grade of C– or lower in 150 and/or 250 must either repeat the course(s), earning a minimum grade of C, or, in consultation with the adviser and the coordinator of freshman English, complete another appropriate English writing course with a minimum grade of C.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with the major in Human Development and Family Studies, and minor work for students taking major work in other departments. Graduates of M.S. and Ph.D. programs in the department will understand and apply relevant theories to educational, research, and/or intervention programs. It is intended that they will produce and disseminate research results and provide leadership in human development and family studies professions.

Within the major of Human Development and Family Studies, both M.S. and Ph.D candidates may choose to work primarily in one of three signature areas: early childhood, care and education; life-span development; or family policy and practice. The Department of Human Development and Family Studies offers coursework and experiences leading to National Council of Family Relations certification as a family life educator

Prerequisite to work in the major is the completion of a related undergraduate program with basic courses in one or more of the following areas: architecture, child/human development, community and regional planning, economics, education, family studies, interior design, psychology, or Sociology. Additional coursework or prerequisites may be required depending on the undergraduate program and program of study.

Core guidelines for graduate programs of study in Human Development and Family Studies have been developed, and the student's program of study committee has the major responsibility for determining additional requirements for an individual program.

The department also participates in the Master of Family and Consumer Sciences degree programs. Students selecting this option may choose Human Development and Family Studies as the focus of their studies. A 42-credit Master of Family and Consumer Sciences-Family Financial Planning program (MFCS-FFP), along with the 18-credit Graduate Certificate Program is designed to prepare individuals to work in the financial planning field. The courses for this program are completely Web-based. Completion of course work in the Master's degree and Graduate Certificate meets the educational requirements to sit for the Certified Financial Planner (CFP) Board of Standards Certification Examination.

The department offers well qualified students in Family Finance, Housing, and Policy concurrent degree programs that allow them to obtain a B.S. in FFHP and an M.S. in HD FS or a B.S. in FFHP and a Graduate Certificate in Family Financial Planning in 5 years. Application for admission to the Graduate College should be made near the end of the junior year. Under concurrent enrollment, students simultaneously take undergraduate and graduate courses and may be eligible for assistantships. Students interested in these programs should contact the department for details.

The department cooperates in the interdepartmental Gerontology program; students may declare a minor in Gerontology. The Master of Family and Consumer Sciences - Gerontology program (MFCS-Geron) and the Graduate Gerontology Certificate program are designed to prepare professionals who work directly with older people or are involved in education and research related to the elderly. Professionals offering direct services often are involved in health promotion programs, directing intergenerational activities, managing senior centers or retirement communities, counseling older people and their families, and helping people plan for retirement. Professionals involved in education and research may evaluate community-based services, teach others about the aging process, develop policies and programs to serve the needs of the elderly, and work with business and industry on issues related to an aging work force.

Courses primarily for undergraduate students

HD FS 102. Individual and Family Life Development. (3-0) Cr. 3. F.S.SS. Development of individuals, families, and their reciprocal relationships as affected by external factors; examined within a framework of life-span developmental tasks.

HD FS 110. Freshman Learning Community Orientation. (2-0) Cr. 2. F. *Prereq: Membership in HD FS Learning Community.* Introduction to the Department of Human Development and Family Studies including academic requirements and opportunities, strategies for transitioning to college, learning and study strategies, reading and reflection, and career awareness.

HD FS 111. Orientation. (1-0) Cr. 1. Orientation to HD FS curricula. Development of a long-term curriculum plan. Satisfactory-fail only.

HD FS 208. Early Childhood Education Orientation. (Cross-listed with C I). Cr. 1. F.S. Overview of early childhood education (birth-grade 3) teacher licensure requirements. Program planning and university procedures. Required of all students majoring in early childhood education. Satisfactory-fail only.

HD FS 218. Professional Orientation and Service Learning. Cr. 2. F.S. *Prereq: 102.* Restricted to CH FS majors. Ethics, professional development, and career exploration in child, adult and family services. Visits to and service learning with programs that serve children, adults and families with diverse needs. Participation in service learning project required. Satisfactory-fail only.

HD FS 220. Development and Guidance: Ages Birth through 2 Years. (2-2) Cr. 3. F.S. Alt. SS., offered 2011. *Prereq: 102.* Typical and atypical development from birth through two years of age. Development and guidance within the contexts of family, program, and Society. Guided observation of physical, motor, cognitive, communication, social, and emotional development; practicum.

HD FS 221. Development and Guidance: Ages 3 through 8 Years. (3-1) Cr. 3. F.S. Alt. SS., offered 2010. *Prereq: 102.* Typical and atypical development from 3 through 8 years of age. Development and guidance within the contexts of family, program, and Society. Guided observation of physical, motor, cognitive, communication, social, and emotional development; practicum

HD FS 223. Development and guidance Ages Birth though 8 Years. (3-0) Cr. 3. S. Typical and atypical development from birth through eight years of age. Development and guidance within the contexts of the family, program, and Society. Guided observation of physical, motor, cognitive, communication, social, and emotional development.

HD FS 226. Development and Guidance in Middle Childhood. (2-2) Cr. 3. F.S. *Prereq: 102 or Psych 230.* Typical and atypical development from 5 to 12 years of age. Development in the contexts of family, school, and Society. Guidance of children in family and group settings; practicum.

HD FS 227. Adolescent Development. (3-0) Cr. 3. F. *Prereq: 102 or Psych 101 or 230.* Physical, cognitive, and socioemotional development of adolescents and young adults in the context of family, relationships, and culture.

HD FS 239. Housing and Consumer Issues. (3-0) Cr. 3. F.S. Introduction to factors affecting housing consumption of individuals and families, including current housing consumer issues related to housing choices, housing context of neighborhoods and communities, housing structure types, and credit and housing finance. Issues such as homelessness, housing discrimination, indoor air quality, accessible design.

HD FS 240. Literature for Children. (3-0) Cr. 3. F.S. *Prereq: 102 or Psych 230.* Evaluation of literature for children. Roles of literature in the total development of children. Literature selection and use.

HD FS 269. Research in Human Development and Family Studies. (3-0) Cr. 3. F.S. *Prereq: 102 or Psych 230.* Understanding and evaluating research. Use of primary and secondary data to identify and study problems related to human development and family issues, including finance and housing. An introduction to Statistical concepts and computer analysis. Research participation.

HD FS 270. Family Relationships. (3-0) Cr. 3. F.S.Alt. SS., offered 2011. *Prereq: 102 or Psych 230.* Introduction to and application of family theories. Family communication and its functions to develop, maintain, enrich and limit family relationships.

HD FS 276. Human Sexuality. (3-0) Cr. 3. F.S.SS. Behavioral, biological, and psychological aspects of human sexuality within the social context of family, culture, and society. Role of sexuality in human development. Critical analysis of media and research. Communication and decision-making skills relating to sexuality issues and relationships.

HD FS 283. Personal and Family Finance. (3-0) Cr. 3. F.S.SS. Introduction to basic principles of personal and family finance. Budgeting, record keeping, checking and savings accounts, consumer credit, insurance, investments, and taxes.

HD FS 317. Field Experiences. Cr. arr. Repeatable. F.S.SS. Consult department office for procedure. Permission of instructor. Supervised field experience in human development and family studies programs. Satisfactory-fail only.
A. Early Childhood Education Programs. Prereq: 343.
B. Family Services Programs. Prereq: 9 credits in HD FS.

C. Early Childhood Special Education Programs. Prereq: 220, 221.
D. School-Age Child Care Programs. Prereq: 226.
E. Infant/Toddler Programs. Prereq: 340.
F. Research. Prereq: 269.
G. Family Finance Programs.
K. Housing Programs.
L. Policy Programs.

HD FS 340. Assessment and Curricula: Ages Birth through 2 Years. (3-3) Cr. 4. F.S. *Prereq: 220.* Assessment strategies for infants and toddlers, including those with special needs. Curricula, learning environments, teaching strategies, health and nutritional practices, and schedules that are developmentally, individually, and culturally appropriate. Using assessment to plan, implement, and evaluate activities to promote physical, motor, cognitive, communication, and social emotional development; practicum.

HD FS 341. Housing Finance and Policy. (3-0) Cr. 3. F. *Prereq: 6 credits in social sciences.* The social, economic, and governmental contexts of housing and financial decision-making at the household level. Financial considerations for residential property management.

HD FS 343. Assessment and Programming: Ages 3 through 6 Years. (3-3) Cr. 4. F.S. *Prereq: 221; 240; 269 or Psych 332 or 333.* Assessment strategies for preschool and kindergarten children, including those with special needs. Learning environments, schedules, activities, nutritional practices, and teaching strategies that are developmentally, individually, and culturally appropriate. Using assessment to plan, implement, and evaluate activities to promote physical motor, cognitive, communication, and social emotional development; practicum.

HD FS 344. Programming for Children in Early Care and Education. (3-3) Cr. 4. F.S. *Prereq: 220 or 221.* Programming in inclusive child care centers and family child care homes, including those with special needs, aged birth through 8 years. Developing, implementing, and evaluating learning environments; activities and materials; behavioral guidance and classroom management practices; health and nutritional practices; and schedules to ensure developmental, individual, and cultural appropriateness. Monitoring children s development and behavior to promote physical, motor, cognitive, communication, and social emotional development. Collaborating effectively with parents and staff.

HD FS 345. Adapting Programming in Inclusive Settings. (3-1) Cr. 3. F.S. *Prereq: Credit or concurrent enrollment in 340 or 343; Sp Ed 250.* Adapting instruction, materials, and equipment to meet developmental needs of young children birth through age 8 with diverse learning needs and multiple disabilities in inclusive settings. Addressing individualized education programs; special health care needs, challenging behavior, and positioning and handling techniques; practicum.

HD FS 349. Parenting and Family Diversity Issues. (3-0) Cr. 3. F.S.Alt. SS., offered 2010. *Prereq: 102 or Psych 230; 270.* Diversity issues as they affect families. Parenting practices and family relationships among diverse human populations. Understanding the family system and the relationship of that system to Societal systems.

HD FS 360. Housing and Services for Families and Children. (3-0) Cr. 3. F. *Prereq: 6 credits in social sciences.* Approaches to and assessment of housing and services that assist those with special needs including those with disabilities, low-income, children at risk, single-parents, and the homeless. Emphasis on community settings; e.g., residential facilities, group housing, shelters and transitional housing.

HD FS 367. Abuse and Illness in Families. (3-0) Cr. 3. F.S.Alt. SS., offered 2010. *Prereq: 102 or Psych 230; 270.* Causes and consequences of family stressors including physical, sexual, and emotional abuse; substance abuse; and mental and physical illness across the life span. Interplay between victims, offenders, and the treatment system.

HD FS 373. Death as a Part of Living. (Cross-listed with Geron). (3-0) Cr. 3. F.S.Alt. SS., offered 2010. *Prereq: 102.* Consideration of death in the life span of the individual and the family with opportunity for exploration of personal and Societal attitudes.

HD FS 377. Aging and the Family. (Cross-listed with Geron). (3-0) Cr. 3. F.Alt. SS., offered 2011. *Prereq: 102.* Interchanges of the aged and their families. Emphasis on role changes, social interaction, and independence as influenced by health, finances, life styles, and community development.

HD FS 378. Economics of Aging. (Cross-listed with Econ, Geron). (3-0) Cr. 3. S. *Prereq: 3 credits in principles of economics and 3 credits in human development and family studies.* Economic Status of the aging, retirement planning and the retirement decision, role of Social Security, public transfer programs for the elderly, intrafamily transfers to/from the elderly, private pensions, financing medical care and housing for the elderly, prospects and issues for the future.

HD FS 380. Family Law. (3-0) Cr. 3. S. *Prereq: Junior classification.* Family relationships, rights, and duties as prescribed by law. Investigation of sources and interpretations of law.

HD FS 395. Children, Families, and Public Policy. (3-0) Cr. 3. F.S.Alt. SS., offered 2011. *Prereq: 6 credits in social sciences.* Public policy and politics as they affect children and families. Examination of how individuals and groups influence policy. Investigation of current issues and programs influencing the well-being and welfare of children and families.

HD FS 416. Human Development and Family Studies Seminar. Cr. arr. Repeatable. F.S.SS. *Prereq: 8 credits in human development and family studies.* Intensive study of a selected topic in human development and family studies.

HD FS 417. Supervised Student Teaching. Cr. 8. Repeatable. Reservation required.
A. Kindergarten Programs. F. S. Prereq: GPA 2.5, full admission to teacher education program, 455. Teaching experience with young children in kindergarten settings.
B. Preschool Programs. F. S. Prereq: GPA 2.5, full admission to teacher education program, 455; 456. Teaching experience with young children from birth to 5 in group settings.

C. Early Childhood Special Education Programs. F. S. Prereq: GPA 2.5, full admission to teacher education program, 455; 456. Teaching experience with preschool children with disabilities.

HD FS 445. Administration of Programs for Children. (3-0) Cr. 3. S. *Prereq: 344.* Management principles and techniques, including an introduction to financial management involved in programs for children with diverse needs and their families. Staff development, supervision, and evaluation in programs for children and families. Government regulations concerning child and family programs; community relations; and advocacy for children and families.

HD FS 449. Linking Families and Communities. (3-0) Cr. 3. F.S. *Prereq: 269 or Psych 332 or 333, senior classification.* Assessing family needs and community resources across the lifespan. Characteristics of successful community-based family intervention and support programs. Strategies and skills needed by community-based professionals, including grant writing skills. Linking families to community resources. Nonmajor graduate credit.

HD FS 455. Curricula for Ages 3 through 6 Years. (3-3) Cr. 4. F.S. *Prereq: 343, 345; Sp Ed 355 and 455.* Program models and methods leading to development and organization of appropriate curricula in preschool and kindergarten programs for young children with diverse learning needs. Government regulations and professional standards for child programming. Teaming with parents, colleagues, and paraprofessionals to plan, implement, and evaluate developmentally and culturally appropriate individualized education plans in inclusive settings; practicum. Nonmajor graduate credit.

HD FS 456. Family-Centered Supports for Young Children and their Families. (3-1) Cr. 3. F.S. *Prereq: 340, 345.* Family systems and the application of family centered principles in early intervention and home-based services. Impact of disability on families with young children and strategies for delivering family-centered interventions and service coordination. Understanding and measuring family outcomes of early intervention. Understanding foundations of theory and policy, establishing effective partnerships, and building family capacity through effective supports and services. Experiences with families. Nonmajor graduate credit.

HD FS 463. Environments for the Aging. (Dual-listed with 563). (Cross-listed with ArtID, Geron). (3-0) Cr. 3. S. *Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies.* Emphasis on independent living within residential settings including specialized shelter, supportive services, and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities.

HD FS 479. Family Interaction Dynamics. (3-0) Cr. 3. F. *Prereq: 102 or equivalent; 269 or equivalent; 9 hours in social sciences and junior or senior Status.* Analysis of research related to family interaction processes across the family life span. Emphasis on relationship dynamics and cultural differences. Nonmajor graduate credit.

HD FS 483. Advanced Personal and Family Finance. (3-0) Cr. 3. S. *Prereq: 283.* Managerial approaches to achievement of short- or long-term financial goals for households. Investigation of different forms of investments and investment risks management in financing current and future consumption. Analyses of tax, estate, and retirement planning needs of the family. Nonmajor graduate credit.

HD FS 486. Administration of Human Service Programs. (3-0) Cr. 3. F. *Prereq: Junior classification; 6 credits in HD FS at 300 level and above.* An examination of purposes, staffing, operation, and clientele of organizations and agencies serving families. Analysis of issues in coordination and delivery of services.

HD FS 488. Families in the Economy. (3-0) Cr. 3. S. *Prereq: Econ 101.* Analysis of the family as an economic unit in Society. Structure and composition of the family. Patterns of resource use and activities pursued by the family. Family economic transitions such as marriage, divorce, and childbirth. Nonmajor graduate credit.

HD FS 489. Financial Counseling. (Dual-listed with 589). (3-0) Cr. 3. F. *Prereq: 283.* Personal, social/psychological, and legal climates affecting family financial decisions. A life-cycle approach to financial decision-making. Development of financial counseling and planning skills to assist families and individuals to become self-sufficient in family financial management. Nonmajor graduate credit.

HD FS 489L. Financial Counseling Laboratory. (Dual-listed with 589L).(0-2) Cr. arr. Repeatable. F.S. *Prereq: Instructor permission.* Practical experience in remedial, preventative, and productive approaches to both financial and housing counseling in one-on-one and/or group settings.

HD FS 490. Independent Study. Cr. arr. *Prereq: 6 credits in human development and family studies.* Consult department office for procedure.
A. Child and Family Studies
B. Housing
C. Family Finance
F. Early Childhood Education
G. Early Childhood Special Education
H. Honors
I. Human Development and Family Studies
L. Policy Programs.

HD FS 491. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: 449; permission of instructor, senior classification.* Reservation required one semester before placement; minimum 2.0 GPA. Supervised work experience related to the student's curriculum. Satisfactory-fail only.

HD FS 493. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: Senior classification.* (Dual-listed with 593).

HD FS 499. Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Consult department office for procedures..* Supervised research experience.

Courses primarily for graduate students, open to qualified undergraduate students

HD FS 501. Graduate Study Orientation. (1-0) Cr. R. F. Orientation to graduate study and current research in the department.

HD FS 503. Quantitative Research Methodology. (3-0) Cr. 3. S. *Prereq: Stat 401 or ResEv 553, concurrent enrollment in HD FS 505.* Concepts, methods, and strategies for research in human development and family studies. Topics include the nature of scientific research, measurement, types of research in human development and family studies, validity of research designs, methods of data gathering, and strategies for and issues in the study of change.

HD FS 504. Qualitative Research Methods I. (3-0) Cr. 3. F. *Prereq: 9 credits of social sciences.* Introduction to qualitative research methodology. Application of fieldwork methods, analysis, interpretation, and writing through individual qualitative research projects.

HD FS 505. Application of Quantitative Research Methodology. (1-2) Cr. 2. S. *Prereq: Stat 401 or ResEv 553.* Coding, entry and manipulation of research data. Practical applications with interactive Statistical software.

HD FS 510. Theories of Human Development. (3-0) Cr. 3. F.SS. *Prereq: 9 credits of social sciences.* Theoretical approaches and current research in child, adolescent, and adult development. Individual life span perspectives. Policy implications.

HD FS 511. Family Theory. (3-0) Cr. 3. F. *Prereq: 9 credits in social sciences.* Theoretical approaches and current research in family development. Review the nature and value of theory to the study of the family and evaluate the use of theory in empirical research. Policy implications.

HD FS 521. Community Context of Individual and Family Well-being. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification; 511 or 6 credits in social sciences.* Impact of community contextual influences on human development and families. Analysis of conceptual frameworks, methodological approaches, and current research. Socio-psychological and economic impact of housing and community on children and families.

HD FS 525. Theories and Research in Early Childhood Education. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 510 or 6 credits in social sciences.* Analysis of contemporary and historical models, including early intervention programs. Examination of relationships among physical environment, programming, teacher effectiveness, and child outcomes.

HD FS 530. Perspectives in Gerontology. (Cross-listed with Geron). (3-0) Cr. 3. F. WWW only. Overview of current aging issues including theory and research, critical social and political issues in aging, the interdisciplinary focus of gerontology, career opportunities, and aging in the future.

HD FS 534. Adult Development. (Cross-listed with Geron). (3-0) Cr. 3. F: on campus. S: WWW only. Exploration of the biological, psychological and social factors associated with aging. Although the focus is on the later years, information is presented from a life-span developmental framework. Empirical studies are reviewed and their strengths, limitations and implications for normative and optimal functioning are discussed.

HD FS 538. Developmental Disabilities in Children. (Cross-listed with Psych). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 9 credits in human development and family studies or psychology.* Theories, research, and current issues regarding development in children with disabilities. Investigation of interventions with children and families.

HD FS 541. Housing and Real Estate in Family Financial Planning. (Cross-listed with FFP). (3-0) Cr. 3. Alt. SS., offered 2010. WWW only. The role of housing and real estate in the family financial planning process, including taxation, mortgages, financial calculations, legal concerns, and ethical issues related to home ownership and real estate investments. Emphasis on emerging issues in the context of housing and real estate.

HD FS 545. Economics, Public Policy, and Aging. (Cross-listed with Geron). (3-0) Cr. 3. Alt. F., offered 2010. WWW only. Policy development in the context of the economic Status of the older adult population. Retirement planning and the retirement decisions, social security and public transfer programs, intra-family transfers to/from the aged, private pensions; financing medical care, prospects and issues for the future.

HD FS 547. Parent-Child Relations. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 510 or 511 or 6 credits in social sciences.* Analysis of theories and research related to parent-child interactions; examination of parenting as a developmental process. Current issues in child rearing.

HD FS 548. Parent Education. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 510 or 511 or 6 credits in social sciences.* Needs assessments, models, delivery systems, and evaluation procedures used in parent education programs for families with diverse needs, including single parents, adolescent parents, and parents of children with developmental disabilities. Developmental aspects of parenting. Effects of values, family structures, family goals, and parenting styles on parent education.

HD FS 555. Current Issues in ECSE. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 9 credits in social sciences.* Examination of research and current issues in early childhood special education with special emphasis on inclusion, activity-based intervention, and developmentally appropriate programming. Emphasis on continuum of strategies to embed learning opportunities that promote physical, language, cognitive, and social development.

HD FS 556. Families and Disability. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 9 credits in social sciences.* Review of research, policy, and practice regarding families of children with a disability. Educational, environmental, economic, and social issues faced by families. Communication and consultation skills to work collaboratively with interdisciplinary professionals and families to implement individualized family and educational programs.

HD FS 563. Environments for the Aging. (Dual-listed with 463). (Cross-listed with Geron). (3-0) Cr. 3. S. *Prereq: 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies.* Emphasis on independent living within residential settings including specialized shelter, supportive services and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities.

HD FS 566. Impact of Public Policy on the Family. (3-0) Cr. 3. S. *Prereq: 9 credits in social sciences.* The effect of public policies on families and children, especially those at risk. Examines poverty in the U.S.; the consequences of poverty; the programs used to alleviate the consequences of poverty; evaluation of the efficacy of these programs.

HD FS 567. Family Stress, Abuse, and Illness. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 9 credits in social sciences.* Contemporary theory and research on the causes and consequences of family stressors including physical, sexual, and emotional abuse; substance abuse; and mental and physical illness across the life span. Interplay between victims, offenders, and the treatment system. Identification of barriers to services and supports and exploration of approaches to assist families in overcoming these barriers.

HD FS 568. Developmental Assessment. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 510.* Techniques assessing cognitive, language, motor, emotional, and social skills of children in school, home and community settings using criterion-referenced, norm-referenced, and curriculum-based tests and screening tools. Techniques for interviewing families and including them in assessment. Opportunities to practice using different assessments.

HD FS 571. Marital Therapy and Assessment. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 9 credits in social sciences.* Theories and techniques of couple therapy across the life cycle.

HD FS 573. Ethics and Professional Studies in Marriage and Family Therapy. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 credits in graduate level social sciences.* Professional ethics and legal responsibilities relevant to family therapy. Professional socialization and the role of professional organizations and state licensure/certification.

HD FS 575. Cross-cultural Perspectives on Families and Children. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 credits in social sciences.* Review of methods and findings on cultural influences on the development of children and youth and on family life. Comparison of child rearing practices, family roles, values, and traditions in different cultures.

HD FS 576. Marriage Across the Life Course. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 511.* A developmental approach to exploring predictors of the formation, maintenance, and dissolution of intimate relationships across the life course. Understanding how intimate relationships develop and change over time, beginning with the development of early adolescent relationships and continuing through later life.

HD FS 577. Aging in the Family Setting. (Cross-listed with Geron). (3-0) Cr. 3. *Prereq: 9 credits in social sciences.* Alt. S., offered 2008: on campus. Alt. S. offered 2009: WWW only. Theories and research related to personal and family adjustments in later life affecting older persons and their intergenerational relationships. Related issues including demographics also are examined through the use of current literature.

HD FS 578. Models of Marriage and Family Therapy. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 9 credits in social sciences.* Major models of marriage, couple, and family therapy. Includes clinical assessment, intervention, and evaluation.

HD FS 579. Family Interaction Dynamics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 9 credits in social sciences.* Current research and theory in family interaction, with emphasis on family dynamics and family change across the life course.

HD FS 581. International Study in Human Development and Family Studies. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission by application.* Limited enrollment. Supervised international study experiences in Human Development and Family Studies. Countries vary.
A. Practicum
B. Exchange
C. Group Study

HD FS 582. Contemporary Issues in Marriage and Family Therapy. (3-0) Cr. 3. Alt. SS., offered 2011. *Prereq: 9 credits in social sciences.* Focus on assessment, intervention, and treatment of issues marriage and family therapists routinely face, including suicidal/depressed clients, eating disorders, alcoholism and substance abuse, self-harm behaviors, and grief issues. Issues examined from a systemic, socio-cultural perspective.

HD FS 583. Investing for the Family's Future. (Cross-listed with FFP). (3-0) Cr. 3. F. *Prereq: 483.* Evaluation of investment markets for the household. Analysis of how families choose where to put their

savings. Emphasis is on using the family's overall financial and economic goals to help inform investment choices.

HD FS 584. Program Evaluation and Research Methods in Gerontology. (Cross-listed with Geron). (3-0) Cr. 3. Alt. SS., offered 2010. WWW only. Overview of program evaluation, research methods, and grant writing in gerontology. Includes application of quantitative and qualitative methods in professional settings.

HD FS 585. Family Policy Analysis and Evaluation. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in graduate level social sciences.* Theoretical and practical issues related to family policy analysis and program evaluation. Assessment of programs' success in meeting goals. Examination of concepts related to family policy development in the United States. Examination of how individuals and groups can influence family policy and evaluation.

HD FS 586. Sex Therapy. (3-0) Cr. 3. Alt. SS., offered 2010. *Prereq: 571 or 578.* Review of gender orientation and sexual functioning as well as assessment and treatment of sexual problems. Research regarding effectiveness of treatment is reviewed.

HD FS 587. Diversity Issues in Marriage and Family Therapy. (Cross-listed with W S). (3-0) Cr. 3. Alt. F., offered 2009. Review treatment implications associated with topics such as gender and power, race/ethnicity, family structure, and Socioeconomic Status. Discuss treatment implications of social oppression and discrimination on families.

HD FS 588. Family Economics and Public Policy. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in Sociology or economics.* Analysis of family income, wealth, and economic well-being. Emphasis on effects of family behavior and public policies on the adequacy and security of income across the family life cycle. Implications of resource allocation within the family for adult and child well-being.

HD FS 589. Financial Counseling. (Dual-listed with 489). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Personal, social/psychological and legal climates affecting family financial decisions. A life cycle approach to financial decision making. Development of financial counseling and planning skills to assist families and individuals to become self-sufficient in family financial management.

HD FS 589L. Financial Counseling Laboratory. (Dual-listed with 489L).(0-2) Cr. arr. Repeatable. F.S. *Prereq: Instructor permission.* Practical experience in remedial, preventive, and productive approaches to both financial and housing counseling in one-on-one and/or group settings.

HD FS 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Consult department office on procedure for filing a written plan of study.
A. Family Studies
B. Housing
C. Family Finance
D. Human Development
E. Child Development
F. Early Childhood Education
G. Early Childhood Special Education
I. Human Development and Family Studies
M. Marriage and Family Therapy
N. Family Policy

HD FS 591. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: 10 graduate credits.* Supervised experience in an area of human development and family studies.
A. Family Studies
B. Housing
C. Family Finance
D. Human Development
E. Child Development
F. Early Childhood Education
G. Early Childhood Special Education
I. Human Development and Family Studies
M. Marriage and Family Therapy
N. Family Policy

HD FS 593. Workshop. Cr. arr. Repeatable. F.S.SS. *Prereq: Senior classification.* (Dual-listed with 493.)

HD FS 594. Professional Seminar in Gerontology. (Cross-listed with Geron). (3-0) Cr. 3. Alt. SS., offered 2011. WWW only. An integrative experience for gerontology students designed to be taken near the end of degree program. By applying knowledge gained in earlier coursework, students will strengthen skills in ethical decision-making behavior, applying these skills in gerontology-related areas such as advocacy, professionalism, and family and workplace issues. Students from a variety of professions will bring their unique perspectives to bear on topics of common interest.

Courses for graduate students

HD FS 603. Advanced Quantitative Methods. (3-0) Cr. 3. S. *Prereq: 503; Stat 402 or 404.* Methodological and analytical issues in research in human development and family studies. Advanced research design and measurement, selection of Statistical techniques, and issues in the interpretation of findings.

HD FS 604. Advanced Qualitative Research. (3-0) Cr. 3. F. *Prereq: 503. Qualitative methods and related theory in human development and family studies.* Research procedures, including phenomenology, grounded theory, ethnography, and case studies. Methods of data collection and analysis.

HD FS 605. Multi-level Modeling for social and Behavioral Sciences. (Cross-listed with Psych). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 404.* Rationale for and interpretation of random coefficient models. Strategies for the analysis of multi-level and panel data including models for random intercepts, random slopes, and growth curves. Applications including HLM, SAS, PROCMIX, and MPLUS.

HD FS 616. Seminar. Cr. arr. May be repeated. F.S.SS.

HD FS 631. Learning and Cognitive Development in Children. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 510.* Theory and research emphasizing constructivist, Vygotskian, and information processing approaches to cognitive development. Concept, memory, and problem-solving development. Sources of individual differences in cognitive functioning of children and adolescents.

HD FS 632. Language and Literacy Development in Children. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 510.* Theory and research related to language and literacy development of children from birth to age 8. Exploration of the relationship between language and literacy development during the early childhood years. Discussion of current issues.

HD FS 633. Social and Emotional Development in Children. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 510.* Theory and research related to social and emotional development of infants, children, and adolescents. Dynamic socialization processes involving children, adolescents, parents, peers, and Society.

HD FS 634. Adolescent Development. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 510 or 511.* Theory and research on physical-motor, intellectual-cognitive, and social-personality development from early to late adolescence. Sources of developmental and individual differences in identity formation and attainment.

HD FS 650. Advanced Family Policy Theory. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 588.* Analysis of theories, research, and current issues related to family and household economics and policy. Emphasis on theory development and empirical analyses of macro and micro family economic problems. Future policy, economic and social trends, and their meaning for the family as an economic institution.

HD FS 690. Advanced Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor and enrollment in Ph.D. program.*
A. Family Studies
B. Housing
C. Family Finance
D. Human Development
E. Child Development
F. Early Childhood Education
G. Early Childhood Special Education
I. Human Development and Family Studies
M. Marriage and Family Therapy
N. Family Policy

HD FS 691. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Supervised practice and experience in the following specified areas: Satisfactory-fail only.
A. College Teaching
B. Research
C. Marriage and Family Therapy
D. Professional Experience

HD FS 699. Research. Cr. arr. Repeatable. Satisfactory-fail only.
A. Family Studies
B. Housing
C. Family Finance
D. Human Development
E. Child Development
F. Early Childhood Education
G. Early Childhood Special Education
I. Human Development and Family Studies
M. Marriage and Family Therapy
N. Family Policy

Human Sciences

David Whaley, Program Coordinator

Human Sciences courses provide integrative study and enriching experiences in areas that cut across the diverse curricula of the College of Human Sciences. These may include such areas as leadership, global understanding, social justice/responsibility, and ethics. Students in any college may take these courses.

Courses primarily for undergraduate students

H Sci 150. Dialogues on Diversity. (1-0) Cr. 1. F.S. An exploration of diversity within the context of the Iowa State University community through understanding human relations issues. Satisfactory-fail only.

H Sci 482. The Dean's International Leadership Seminar. (Dual-listed with 582). (3-0) Cr. 3. S.SS. *Prereq: Permission of the seminar leader.* Leadership strategies and effective use of leadership skills in an international setting. Compare leadership theories and practices in the U.S. and foreign countries. Construct individual leadership strategies to deal with complex issues in a global environment. Use discussion, personal assessment inventories, and simulated experiences to evaluate leadership strategies. Develop and improve skills in meeting the challenges of teamwork. Learn about the culture of a foreign country.

H Sci 490. Independent Study. Cr. arr.
E. Entrepreneurship

H Sci 582. The Dean's International Leadership Seminar. (Dual-listed with 482). (3-0) Cr. 3. S.SS. *Prereq: Permission of the seminar leader.* Leadership strategies and effective use of leadership skills in an international setting. Compare leadership theories and practices in the U.S. and foreign countries. Construct individual leadership strategies to deal with complex issues in a global environment. Use discussion, personal assessment inventories, and simulated experiences to evaluate leadership strategies. Develop and improve skills in meeting the challenges of teamwork. Learn about the culture of a foreign country.

Immunobiology

www.immunobiology.iastate.edu

(Interdepartmental Graduate Program)

Supervisory Committee: Marian Kohut, Chair; Mike Wannemuehler, Louisa Tabatabai, Jesse Hostetter, Bryan Bellaire

The Graduate Faculty: Marian Kohut, Chair; Ackermann, Mark, Andreasen; Claire, Andreotti, Amy; Bartholomay, Lyric; Bellaire, Bryan; Cunnick, Joan; Griffith, Ronald; Harris,DL; Hostetter, Jesse; Jarvinen, Julie; Jones, Doug; Kanthasamy, Anumantha; Lamont, Susan; Lippolis, John; Minion, F. Chris; Nilsen-Hamilton, Marit; Nonnecke, Brian; Nystrom, Evelyn; Opriessnig, Tanja; Palic, Dusan; Petersen, Christine; Platt, Ken; Reynolds, Don; Rosenbusch, Ricardo; Roth, James; Rothschild, Max; Sacco, Randy; Stabel, Judy; Tabatabai, Louisa; Thoen, Charles; Wannemuehler, Mike; Waters Ray; Zhang, Qijing

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in Immunobiology. Faculty are drawn from eight departments: Animal Science; Biochemistry, Biophysics, and Molecular Biology; Biomedical Sciences; Entomology; Kinesiology; Veterinary Diagnostic & Production Animal Medicine; Veterinary Microbiology & Preventative Medicine; and Veterinary Pathology. The diversity of faculty expertise ensures a broad education, while offering flexibility in choice of specialization. Ongoing research projects include areas such as: antibody and cell-mediated immunity, immunochemistry, immunogenetics, immunomodulation, mucosal immunity and nutritional immunology.

Students may enter the Immunobiology major in one of two ways; they may apply to and be directly accepted into the major, or they may be admitted to a participating department followed by formal admission to the major. Students directly admitted into the Interdepartmental Immunobiology Major will take Imbio 697 (graduate research rotation) in their first two semesters, and by the end of the second semester, enter a department by choosing a major professor from the participating faculty. Students first admitted to a department will choose a major professor from the participating faculty in that department.

Students should have a strong background in the biological sciences, including work in immunology, genetics and biochemistry. Prior research experience is highly encouraged. Submission of scores of the GRE General Test is required.

Immunobiology students should include in their program of study a core of courses which will provide a broad coverage of the basic program in immunobiology. Formal courses should include immunology, biochemistry, and Statistics. Additional coursework may be selected to satisfy individual interests or departmental requirements. The foreign language and teaching requirements are determined by the student's department. All students will take a minimum of one seminar course per year.

Graduates have a broad understanding of the interdisciplinary field of immunobiology, and can effectively integrate the principles of immunology with related disciplines. They are able to effectively communicate with scientific colleagues and the general public in both formal and informal settings. Graduates are able to integrate theory and research to address complex problems facing scientific professionals studying animal and human health, taking into account related ethical, social, legal and environmental issues. They are skilled at carrying out research, communicating research results, and writing persuasive grant proposals.

Courses for graduate students

Imbio 602. Current Topics Workshop in Immunology. (1-0) Cr. 1. Repeatable. Lectures provided by off-campus experts. Students are required to participate in discussion sessions with lecturers.

Imbio 604. Seminar in Immunobiology. (1-0) Cr. 1. Repeatable. Student and faculty presentation.

Imbio 690. Special Topics. Cr. arr. Repeatable. Advanced study of specific topics in specialized field of immunobiology.

Imbio 697. Graduate Research Rotation. Cr. arr. Repeatable. Graduate research projects performed under the supervision of selected faculty members in the Interdepartmental Immunobiology major.

Imbio 699. Research. Cr. arr. Repeatable.

Industrial Engineering

(Administered by the Department of Industrial and Manufacturing Systems Engineering)

Gary Mirka, Chair of Department

Distinguished Professors (Emeritus): Cowles

University Professor: Vardeman

University Professor (Emeritus): David

Professors: Heising, Mirka, Morris, Ryan

Professors (Emeritus): Barta, Berger, Even, Mohr, Montag, Moore, Patterson, C. Smith, G. Smith, Tamashunas, Vaughn

Associate Professors: Gemmill, Jackman, Meeks, Min, Olafsson, Peters

Associate Professor (Emeritus): Love

Assistant Professors: Frank, Stone, Wang

Assistant Professor (Collaborator): Guerra-De-Castillo

Senior Lecturer: Potter

Lecturers: Sly

Undergraduate Study

For the undergraduate curriculum in industrial engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission ABET.

Industrial engineers are employed to design, analyze, and improve systems and processes found in manufacturing, consulting, and service industries. Professional responsibilities are typically in design, management, analysis, optimization, and modeling of industrial systems. An industrial engineer is focused on human factors, operations research, engineering management, manufacturing engineering, and quality. Industrial engineers are typically found in organizations responsible for operations management, process engineering, automation, logistics, supply chain management, scheduling, plant engineering, quality control, and technical sales. The overall goal of the industrial engineering undergraduate curriculum is to produce technically qualified industrial engineers who are capable of successful professional practice in the field. To meet this goal, the curriculum includes in-depth instruction to accomplish the integration of systems using appropriate analytical, computational, and engineering practices. The curriculum also provides graduates with the necessary educational foundation to pursue advanced studies in industrial engineering or related fields.

The industrial engineering curriculum has the following objectives. The industrial engineering curriculum is preparing its graduates during their professional careers to:

1. Make decisions on system design or analysis with broad-based analytical tools and information technology.
2. Formulate and analyze problems in specific application areas including manufacturing, production, logistics, ergonomics, service industries, public policies, or information systems.
3. Develop and implement project solutions concerning designs, processes, operations, or systems.
4. Prepare and deliver professional communications in written and oral formats.
5. Achieve team goals in a multidisciplinary team environment and provide leadership in some capacity, based on an understanding of team dynamics and project management.
6. Acquire new skills and training for lifelong learning.

Details on industrial engineering program outcomes that foster the attainment of these objectives are available at appropriate sections of: www.imse.iastate.edu

The industrial engineering undergraduate curriculum provides students with fundamental knowledge in mathematics and science, engineering science, social science, and humanities as well as professional industrial engineering course work. Management electives provide students with an opportunity to become familiar with modern business practices that they will encounter in their career. A senior capstone design course provides students with an opportunity to solve open-ended industrial problems with an industrial partner. The cooperative education program provides students with real world experience in the profession and a good perspective on career choices. Students are encouraged to participate in international experiences through exchange programs and industrial internships. Qualified juniors and seniors interested in graduate studies may apply to the Graduate College to concurrently pursue both B.S. and M.S. degrees in Industrial Engineering or B.S. and M.B.A. degrees.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with a major in industrial engineering. A formal minor is available to graduate students having a major in another department. Graduate study is designed to improve the student's capability to conduct research as well as improve professional expertise in industrial engineering.

The prerequisite to major graduate work is the completion of a curriculum similar to that required of undergraduate students in engineering at this institution.

With the help of a program of study committee, a graduate student develops an educational program in areas within industrial engineering. Typical areas of concentration include ergonomics, engineering management, human computer interfaces, manufacturing systems, operations research and optimization, and information engineering.

Courses primarily for undergraduate students

I E 101. Industrial Engineering Profession. Cr. R. F.S. (1-0) Introduce students to the industrial engineering profession, its scope, industrial engineering tools, and future trends.

I E 148. Information Engineering. (2-2) Cr. 3. F.S. *Prereq: Credit or enrollment in Math 142.* Development of information solutions for engineering problems. Fundamentals of the software development process. Engineering computations and the human/computer interface. Data models and database development. Program connectivity and network applications.

I E 248. Engineering System Design, Manufacturing Processes and Specifications. (2-2) Cr. 3. F. *Prereq: Credit or enrollment in 101 and Mat E 272.* Introduction to metrology, engineering drawings and specifications. Engineering methods for designing and improving systems. Theory, applications, and quality issues related to machining processes.

I E 271. Applied Ergonomics and Work Design. (3-0) Cr. 3. S. *Prereq: Phys 221.* Basic concepts of ergonomics and work design. Their impact on worker and work place productivity, and cost. Investigations of work physiology, biomechanics, anthropometry, work methods, and their measurement as they relate to the design of human-machine systems.

I E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

I E 305. Engineering Economic Analysis. (3-0) Cr. 3. F.S.SS. *Prereq: Math 166.* Economic analysis of engineering decisions under uncertainty. Financial engineering basics including time value of money, cash flow estimation, and asset evaluation. Make versus buy decisions. Comparison of project alternatives accounting for taxation, depreciation, inflation, and risk. Nonmajor graduate credit. Nonmajor graduate credit.

I E 312. Optimization. (3-0) Cr. 3. F. *Prereq: Math 267.* Concepts, optimization and analysis techniques, and applications of operations research. Formulation of Mathematical models for systems, concepts, and methods of improving search, linear programming and sensitivity analysis, network models, and integer programming. Nonmajor graduate credit.

I E 341. Production Systems. (3-0) Cr. 3. F. *Prereq: Stat 231; credit or enrollment in I E 312.* Introduction of key concepts in the design and analysis of production systems. Topics include inventory control, forecasting, material requirement planning, project planning and scheduling, operations scheduling, and other production systems such as Just-In-Time (JIT), warehousing, and global supply chains. Nonmajor graduate credit.

I E 348. Solidification Processes. (2-2) Cr. 3. S. *Prereq: 248.* Theory and applications related to metal casting, welding, polymer processing, powder metallurgy, electronic assembly, and semi-conductor manufacturing. Nonmajor graduate credit.

I E 361. Statistical Quality Assurance. (Cross-listed with Stat). (2-2) Cr. 3. F.S. *Prereq: Stat 231 or 401.* Statistical methods for process improvement. Simple quality assurance principles and tools. Measurement system precision and accuracy assessment. Control charts. Process capability assessment. Experimental design and analysis for process improvement. Significant external project in process improvement. Nonmajor graduate credit.

I E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period.

I E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* Professional work period for a maximum of one semester per academic year. Satisfactory-fail only.

I E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

I E 403. Introduction to Sustainable Production Systems. (Dual-listed with 503). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Credit or enrollment in 341.* Quantitative introduction of sustainability concepts in production planning and inventory control. Review of material recovery (recycling) and product/component recovery (remanufacturing) from productivity perspectives. Sustainability rubrics ranging from design and process to systems. Application to multi-echelon networks subject to forward/backward flow of material and information. Closed-loop supply chains. Comparative study of sustainable vs traditional models for local and global production systems.

I E 408. Interdisciplinary Problem Solving. (Cross-listed with E E, TSM). (3-0) Cr. 3. F.S. *Prereq: Junior or senior classification.* Use of the Theory of Constraints as a way of approaching problem solving, win-win negotiation, project planning and effective delegation in the context of engineering/business systems. Team projects aimed at improving design outcomes. Nonmajor graduate credit.

I E 409. Interdisciplinary Systems Effectiveness. (Cross-listed with E E, TSM). (3-0) Cr. 3. F.SS. *Prereq: Junior or senior classification.* Focus on functions that determine the effectiveness of an entire organization. Generic Theory of Constraints solutions to production, distribution, and project management are compared to traditional solutions. Strategy for improvements discovered using simulations. Nonmajor graduate credit.

I E 413. Stochastic Modeling, Analysis and Simulation. (4-0) Cr. 4. F. *Prereq: Math 267, Stat 231.* Development and analysis of simulation models using a simulation language. Application to various areas of manufacturing and service systems such as assembly, material handling, and customer queues. Utilizing model output to make important business decisions. Fitting of data to Statistical distributions. Introduction to Markov processes and other queuing models. Nonmajor graduate credit.

I E 419. Manufacturing Systems Modeling. (3-0) Cr. 3. S. *Prereq: Stat 231.* Modeling material handling systems, inventory systems, and production systems for performance analysis. Introduction to analysis, simulation, and physical models of manufacturing systems. Simulation languages such as ARENA, AweSim, and ProModel. Not available for degrees in industrial engineering. Nonmajor graduate credit.

I E 441. Industrial Engineering Design. (1-6) Cr. 3. F.S. *Prereq: 248, 271, 361; credit or enrollment in 341, 413, and 448.* A large, open-ended design project related to an enterprise. Application of engineering design principles including problem definition, analysis, synthesis, and evaluation. Nonmajor graduate credit.

I E 446. Geometric Variability in Manufacturing. (Dual-listed with 546). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: I E 348, or Mat E 341, or M E 324.* Assessment, accommodation, and control of geometric variability of manufacturing processes. Use of CMMs, vision and scanning systems, and prolifometers. Techniques to successfully accommodate variation through design of product, tooling or process plan including plastic injection molding, metalcasting, welding, machining, powder metallurgy. Methodologies to control geometric variability. Nonmajor graduate credit.

I E 448. Manufacturing Systems Engineering. (3-0) Cr. 3. S. *Prereq: 248 or similar manufacturing experience, 305.* Fixturing and tooling requirements for manufacturing process planning, geometric dimensioning and tolerancing, computer aided inspection, cellular and flexible manufacturing, and facility layout. The role of these topics in supporting lean manufacturing will be integrated throughout the course. Nonmajor graduate credit. Nonmajor graduate credit.

I E 449. Computer Aided Design and Manufacturing. (Dual-listed with 549). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 248, some experience with theory of matrices.* Representation and interpretation of curves, surfaces and solids. Parametric curves and surfaces and solid modeling. Use of CAD software and CAD/CAM integration. Computer numerical control, CNC programming languages, and process planning.

I E 466. Multidisciplinary Engineering Design. (Cross-listed with A. E, Aer E, Cpr E, E E, Engr, Mat E, M E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing, and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

I E 481. e-Commerce Systems Engineering. (Dual-listed with 581). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 148.* Design, analysis, and implementation of e-commerce systems. Information infrastructure, enterprise models, enterprise processes, enterprise views. Data structures and algorithms used in e-commerce systems, SQL, exchange protocols, client/server model, web-based views.

I E 483. Knowledge Discovery and Data Mining. (Dual-listed with 583). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 148, 312, and Stat 231.* Introduction to data warehouses and knowledge discovery. Techniques for data mining, including probabilistic and Statistical methods, genetic algorithms and neural networks, visualization techniques, and Mathematical programming. Advanced topics include web-mining and mining of multimedia data. Case studies from both manufacturing and service industries. A computing project is required. Nonmajor graduate credit.

I E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Senior classification, permission of instructor.* Independent study and work in the areas of industrial engineering design, practice, or research.
A. Manufacturing
B. Human Factors
C. Operations Research
D. Enterprise Computing and Information Management
E. Engineering Management
H. Honors

I E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

I E 501. M.S. Research Basics and Communications. Cr. R. Repeatable. Principles and practices for research tasks at the M.S. level including proposal writing, presentations, paper preparation, and project management.

I E 503. Introduction to Sustainable Production Systems. (Dual-listed with 403). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Credit or enrollment in 341.* Quantitative introduction of sustainability concepts in production planning and inventory control. Review of material recovery (recycling) and product/component recovery (remanufacturing) from productivity perspectives. Sustainability rubrics ranging from design and process to systems. Application to multi-echelon networks subject to forward/backward flow of material and information. Closed-loop supply chains. Comparative study of sustainable vs. traditional models for local and global production systems. A course project is required for graduate credit.

I E 508. Design and Analysis of Allocation Mechanisms. (3-0) Cr. 3. *Prereq: 312 or Math 307.* Market-based allocation mechanisms from quantitative economic systems perspective. Pricing and costing models designed and analyzed with respect to decentralized decision processes, information requirements, and coordination. Case studies and examples from industries such as regulated utilities, semiconductor manufacturers, and financial engineering services.

I E 510. Network Analysis. (3-0) Cr. 3. *Prereq: 312. Form*ulation and solution of deterministic network flow problems including shortest path, minimum cost flow, and maximum flow. Network and graph formulations of combinatorial problems including assignment, matching, and spanning trees. Introduction to deterministic and stochastic dynamic programming.

I E 513. Analysis of Stochastic Systems. (3-0) Cr. 3. *Prereq: Stat 231.* Introduction to modeling and analysis of manufacturing and service systems subject to uncertainty. Topics include the Poisson process, renewal processes, Markov chains, and Brownian motion. Applications to inventory systems, production system design, production scheduling, reliability, and capacity planning.

I E 514. Production Scheduling. (3-0) Cr. 3. *Prereq: 312, 341.* Introduction to the theory of machine shop systems. Complexity results for various systems such as job, flow and open shops. Applications of linear programming, integer programming, network analysis. Enumerative methods for machine sequencing. Introduction to stochastic scheduling.

I E 519. Simulation Modeling and Analysis. (3-0) Cr. 3. *Prereq: Com S 311, Stat 401.* Event scheduling, process interaction, and continuous modeling techniques. Probability and Statistics related to simulation parameters including run length, inference, design of experiments, variance reduction, and stopping rules. Aspects of simulation languages.

I E 531. Quality Control and Engineering Statistics. (Cross-listed with Stat). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Stat 401; Stat 342 or 447.* Wu. Statistical methods and theory applicable to problems of industrial process monitoring and improvement. Statistical issues in industrial measurement; Shewhart, CUSUM, and other control charts; feedback control; process characterization studies; estimation of product and process characteristics; acceptance sampling, continuous sampling and sequential sampling; economic and decision theoretic arguments in industrial Statistics.

I E 533. Reliability. (Cross-listed with Stat). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Stat 342 or 432 or 447.* Meeker. Probabilistic modeling and inference in reliability; analysis of systems; Bayesian aspects; product limit estimator, probability plotting, maximum likelihood estimation for censored data, accelerated failure time and proportional hazards regression models with applications to accelerated life testing; repairable system data; planning studies to obtain reliability data.

I E 534. Linear Programming. (3-0) Cr. 3. *Prereq: 312.* Develop linear models. Theory and computational aspects of the simplex method. Duality theory and sensitivity analysis. Introduction to interior point methods and column generation. Multiobjective linear programs.

I E 537. Reliability and Safety Engineering. (3-0) Cr. 3. *Prereq: Stat 231 or Stat 401.* Mathematical basics for dealing with reliability data, theory, and analysis. Bayesian reliability analysis. Engineering ethics in safety evaluations. Case studies of accidents in large technological systems. Fault and event tree analysis.

I E 541. Inventory Control and Production Planning. (3-0) Cr. 3. *Prereq: 341.* Economic Order Quantity, dynamic lot sizing, newsboy, base stock, and (Q,r) models. Material Requirements Planning, Just-In-Time (JIT), variability in production systems, push and pull production systems, aggregate and workforce planning, and capacity management.

I E 545. Rapid Prototyping and Manufacturing. (3-0) Cr. 3. *Prereq: 248 or similar manufacturing experience.* Introduction to rapid prototyping processes and other rapid manufacturing methodologies. Operating principles and characteristics of current and developing rapid prototyping processes. Use of rapid prototypes in product design, development, and service. Selection of rapid prototyping systems based on rapid methodologies used in manufacturing processes and rapid tooling approaches.

I E 546. Geometric Variability in Manufacturing. (Dual-listed with 446). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: I E 348, or Mat E 341, or M E 324.* Assessment, accommodation, and control of geometric variability of manufacturing processes. Use of CMMs, vision and scanning systems, and prolifometers. Techniques to successfully accommodate variation through design of product, tooling or process plan including plastic injection molding, metalcasting, welding, machining, powder metallurgy. Methodologies to control geometric variability.

I E 549. Computer Aided Design and Manufacturing. (Dual-listed with 449). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 248, some experience with theory of matrices.* Representation and interpretation of curves, surfaces and solids. Parametric curves and surfaces and solid modeling. Use of CAD software and CAD/CAM integration. Computer numerical control, CNC programming languages, and process planning.

I E 561. Continuous Quality Improvement of Process. (3-0) Cr. 3. *Prereq: 361.* Methods for continuous quality improvement in process analysis. The systems analysis for process improvement model based on W. Edwards Deming. Quality function deployment methods. Case studies of applications to manufacturing and other heavy industries. Use of process analysis computerized programs and tools for design analysis.

I E 565. Systems Engineering and Analysis. (Cross-listed with Aer E, E E). (3-0) Cr. 3. *Prereq: Coursework in basic Statistics.* Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated systems. Life cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test and evaluation, and systems engineering planning and organization. Not available for degrees in industrial engineering.

I E 566. Applied Systems Engineering. (3-0) Cr. 3. *Prereq: 565.* Design for reliability, maintainability, usability, supportability, producibility, disposability, and life cycle costs in the context of the systems engineering process. Students will be required to apply the principles of systems engineering to a project including proposal, program plan, systems engineering management plan, and test and evaluation plan. Not available for degrees in industrial engineering.

I E 570. Systems Engineering and Project Management. (3-0) Cr. 3. *Prereq: Coursework in basic Statistics.* Systems view of projects and the processes by which they are implemented. Focuses on qualitative and quantitative tools and techniques of project management. Specific systems concepts, methodologies, and tools for effective management of both simple and complex projects. Introduction of important performance parameters for planning, cost control, scheduling, and productivity, including discussions of traditional and state of the art tools and systems.

I E 571. Occupational Biomechanics. (3-0) Cr. 3. *Prereq: EM 274, Stat 231.* Anatomical, physiological, and biomechanical bases of physical ergonomics. Anthropometry, body mechanics, strength of biomaterials, human motor control. Use of bioinstrumentation, passive industrial surveillance techniques and active risk assessment techniques. Acute injury and cumulative trauma disorders. Static and dynamic biomechanical modeling. Emphasis on low back, shoulder and hand/wrist biomechanics.

I E 572. Design and Evaluation of Human-Computer Interaction. (3-0) Cr. 3. *Prereq: 577.* Human factors methods applied to interface design, prototyping, and evaluation. Concepts related to understanding user characteristics, usability analysis, methods and techniques for design and evaluation of the interface. The evaluation and design of the information presentation characteristics of a wide variety of interfaces: web sites (e-commerce), computer games, information presentation systems (cockpits, instrumentation, etc.), and desktop virtual reality.

I E 576. Human Factors in Product Design. (3-0) Cr. 3. *Prereq: 577.* Investigation of the human interface to consumer and industrial systems and products, providing a basis for their design and evaluation. Discussions of human factors in the product design process: modeling the human during product use; usability; human factors methods in product design evaluation; user-device interface; safety, warnings, and instructions for products; considerations for human factors in the design of products for international use.

I E 577. Human Factors. (3-0) Cr. 3. *Prereq: 271, Stat 231 or 401.* Physical and psychological factors affecting human performance in systems. Signal detection theory, human reliability modeling, information theory, and performance shaping applied to safety, reliability, productivity, stress reduction, training, and human/equipment interface design. Laboratory assignments related to system design and operation.

I E 581. e-Commerce Systems Engineering. (Dual-listed with 481). (3-0) Cr. 3. *Prereq: 148.* Design, analysis, and implementation of e-commerce systems. Information infrastructure, enterprise models, enterprise processes, enterprise views. Data structures and algorithms used in e-commerce systems. SQL, exchange protocols, client/server model, web-based views.

I E 582. Enterprise Modeling and Integration. (3-0) Cr. 3. *Prereq: 3 credits in information technology or information systems.* The design and analysis of enterprise models to support information engineering of enterprise-wide systems. Representation of system behavior and structure including process modeling, information modeling, and conceptual modeling. Applications in enterprise application integration, enterprise resource planning systems, product data management systems, and manufacturing execution systems.

I E 583. Knowledge Discovery and Data Mining. (Dual-listed with 483). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 148, 312, and Stat 231.* Introduction to data warehouses and knowledge discovery. Techniques for data mining, including probabilistic and Statistical methods, genetic algorithms and neural networks, visualization techniques, and Mathematical programming. Advanced topics include web-mining and mining of multimedia data. Case studies from both manufacturing and service industries. A computing project and an additional project with more theoretical content are required.

I E 585. Requirements Engineering. (3-0) Cr. 3. *Prereq: 3 credits in information technology or information systems.* Principles and practices for requirements engineering as part of the product development process with emphasis on software systems engineering. Problem definition, problem analysis, requirements analysis, requirements elicitation, validation, specifications. Case studies using requirements engineering methods and techniques.

I E 588. Information Systems for Manufacturing. (3-0) Cr. 3. *Prereq: 148, 448.* Design and implementation of systems for the collection, maintenance, and usage of information needed for manufacturing operations, such as process control, quality, process definition, production definitions, inventory, and plant maintenance. Topics include interfacing with multiple data sources, methods to utilize the information to improve the process, system architectures, and maintaining adequate and accurate data for entities internal and external to the enterprise to achieve best manufacturing practices.

I E 590. Special Topics. Cr. arr. Repeatable. Advanced study of a research topic in the field of industrial engineering.

I E 599. Creative Component. Cr. arr. Repeatable.

A. Industrial Engineering
C. Operations Research

Courses for graduate students

I E 601. Ph.D. Research Basics and Communications. Cr. R. Repeatable. Principles and practices for conducting research at the Ph.D. level, including problem definition, proposal writing, presentations, conference proceedings, paper preparation, and project management.

I E 613. Stochastic Production Systems. (3-0) Cr. 3. *Prereq: 513.* Modeling techniques to evaluate performance and address issues in design, control,

and operation of systems. Markov models of single-stage make-to-order and make-to-stock systems. Approximations for non-Markovian systems. Impact of variability on flow lines. Open and closed queuing networks.

I E 631. Nonlinear Programming. (3-0) Cr. 3. *Prereq: 534.* Develop nonlinear models, convex sets and functions, optimality conditions, Lagrangian duality, unconstrained minimization techniques. Constrained minimization techniques covering penalty and barrier functions, sequential quadratic programming, the reduced gradient method.

I E 632. Integer Programming. (3-0) Cr. 3. *Prereq: 534.* Integer programming including cutting planes, branch and bound, and Lagrangian relaxation. Introduction to complexity issues and search-based heuristics.

I E 642. Simultaneous Engineering in Manufacturing Systems. (3-0) Cr. 3. *Prereq: 549 or M E 415.* Current engineering methods for the product life cycle process. Feature-based design, computer-aided process planning, and data-driven product engineering.

I E 690. Advanced Topics. Cr. arr. Repeatable. *Prereq: Permission of the instructor.* Advanced topics related to Ph.D. research in industrial engineering under the direction of the instructor.

I E 697. Engineering Internship. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of department.* Professional work period for a maximum of one semester per academic year. Satisfactory-fail only.

I E 699. Research. Cr. arr. Repeatable.
A. Industrial Engineering
C. Operations Research

Information Assurance

www.iac.iastate.edu

(Interdepartmental Graduate Major)

Supervisoy Committee: D. Jacobson (Chair), C. Bergman, J. McCormick, J. Wong.

Work is offered for the degree Master of Science with a major in information assurance under a cooperative arrangement with various departments including Electrical and Computer Engineering, Computer Science, Political Science, Logistics, Operations, and Management Information Systems, Mathematics, Industrial and Manufacturing Systems Engineering. Students graduating from the major will help to fill the need for well-educated system security specialists in the government, private sector, and academia. The program objectives identified as being critical to the accomplishment of this mission are: (1) Impart and enhance knowledge about information infrastructure security; (2) Expand and develop ability to engineer complex systems; (3) Instill and nurture social awareness, and the ability to function in a team; (4) Instill and nurture a sense of ethics; and (5) Develop an understanding of strategic and policy issues.

Students interested in the interdepartmental major apply and are admitted to both a home department (the department that is most closely aligned with the student's research interest and background) and to the program. The home department sets the admission standards, course requirements, and thesis standards.

The program is broadly based and uses courses in the various departments. The program will consist of 24 course credits with 6 credits of research work for a Master of Science with thesis. A non-thesis Master of Science will consist of 27 credits of courses and 3 credits of creative component. The courses are divided into three categories: core, electives, and thesis research.

A student's Program of Study Committee, in consultation with the student, determines the elective courses to be taken and the acceptability of transfer credits. The major professor will be selected from the discipline where the student is admitted (home department).

The basic prerequisite for admission to this program is a baccalaureate degree in engineering, mathematics, computer science, management information systems, political science, or closely related field. The GRE or GMAT examination may be required based on the standards of the home department. If the GRE or GMAT is not required it will be considered in admissions decisions if offered. Potential students with baccalaureate degrees in the physical sciences, statistics, or other related fields will be considered on an individual basis, possibly with provisional admission. The degree awarded is a master of science in information assurance.

A graduate certificate in Information Assurance is offered, which consists of four courses (12 credits) (InfAs 530, 531, 532, (533 or 535)).

For additional information students should contact the chair of the Supervisory Committee, 2215 Coover Hall, ISU, Ames, Iowa 50011, or www.iac.iastate.edu.

Courses for graduate students

InfAs 530. Advanced Protocols and Network Security. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Cpr E 381.* Detailed examination of networking standards, protocols, and their implementation. TCP/IP protocol suite, network application protocols, IP routing, network security issues. Emphasis on laboratory experiments.

InfAs 531. Information System Security. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Cpr E 489 or 530 or Com S 586 or MIS 535.* Computer and network security: basic cryptography, security policies, multilevel security models, attack and protection mechanisms, legal and ethical issues.

InfAs 532. Information Warfare. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Cpr E 531.* Computer system and network security: implementation, configuration, testing of security software and hardware, network monitoring. Authentication, firewalls, vulnerabilities, exploits, countermeasures. Ethics in information assurance. Emphasis on laboratory experiments.

InfAs 533. Cryptography. (Cross-listed with Math, Cpr E). (3-0) Cr. 3. S. *Prereq: Math 301 or Cpr E 310 or Com S 330.* Basic concepts of secure communication, DES and AES, public-key cryptosystems, elliptic curves, hash algorithms, digital signatures, applications. Relevant material on number theory and finite fields.

InfAs 534. Legal and Ethical Issues in Information Assurance. (Cross-listed with Cpr E, Pol S). (3-0) Cr. 3. S. *Prereq: Graduate classification, Cpr E or InfAs 531.* Legal and ethical issues in computer security. State and local codes and regulations. Privacy issues.

InfAs 535. Steganography and Watermarking. (Cross-listed with Math, Cpr E). (3-0) Cr. 3. S. *Prereq: Cpr E 531 or E E 524 or Math 533/Cpr E 533/InfAs 533.* Basic principles of steganography and watermarking. Algorithms based on spatial domain approaches, transformations of data, statistical approaches. Techniques for images, video, and audio data. Communications models for data hiding. Analysis, detection and recovery of hidden data. Military, commercial and e-commerce applications. Known theoretical results. Software packages for data hiding. Social and legal issues, case studies, and digital rights management issues that affect technological development of steganography and watermarking. Current developments in the area.

InfAs 536. Computer and Network Forensics. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Cpr E 381 and Cpr E 489 or 530.* Fundamentals of computer and network forensics, forensic duplication and analysis, network surveillance, intrusion detection and response, incident response, anonymity and pseudonymity, privacy-protection techniques, cyber law, computer security policies and guidelines, court testimony and report writing, and case studies. Emphasis on hands-on experiments.

InfAs 592. Seminar in Information Assurance. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Projects or seminar in Information Assurance.

InfAs 632. Information Assurance Capstone Design. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: 531, 532, 534.* Capstone design course which integrates the security design process. Design of a security policy. Creation of a security plan. Implementation of the security plan. The students will attach each other's secure environments in an effort to defeat the security systems. Students evaluate the security plans and the performance of the plans. Social, political and ethics issues. Student self-evaluation, journaling, final written report, and an oral report.

InfAs 697. Information Assurance Summer Internship. Cr. R. *Prereq: Permission of department, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

Interdisciplinary Graduate Studies

www.grad-college.iastate.edu/igs/

(Interdepartmental Graduate Program)

Supervisory Committee: G. A. Jackson, Chair; J. Courteau (Arts and Humanities), J. Mayfield (Biological and Physical Sciences), G. A. Jackson (General), S. Freeman (International Development Studies), S. J. Crase, (Social Sciences), C. Flora (Community Development)

The degree of master of science or master of arts with major in interdisciplinary graduate studies is available to graduate students who wish to have a more diversified program of advanced study than that generally permitted students who specialize in a single subject. Areas of specialization in arts and humanities, biological sciences, international development studies, physical sciences, social sciences, community development (see below) and a general area are designed to broaden and supplement a student's program. Students must take courses in three different graduate subject matter areas, each subject contributing a minimum of nine credits toward the 35 graduate credits required for the degree. Courses which may be used for credit toward this degree program are selected from those listed in the Graduate College Catalog for graduate credit.

Both thesis and nonthesis options are available except in arts and humanities in which a thesis is required. If the thesis option is chosen, a minimum of three credits of IGS 699 (Research) is required and a maximum of five credits of IGS 699 may be counted in the total of 35 required credits. If the nonthesis option is elected, evidence of original creative effort must be presented. This may be in the form of a demonstration of independent creativity such as a written report of laboratory, field, or library research; a project in fine arts; or some other original contribution acceptable to the student's committee. In the nonthesis option a minimum of three credits of IGS 599 (Creative Component) is required and a maximum of five credits of IGS 599 may be counted toward the total of 35 graduate credits. The student, in consultation with the program of study committee, will decide on the option. The committee also aids the student in planning a program of study and in selecting appropriate courses. Graduates will have

experience in designing their own program centered around issues they have identified. Because of the interdisciplinary nature of IGS, students are expected to synthesize knowledge from three different areas of study.

Students who wish to apply for admission to interdisciplinary graduate studies should communicate with the chair of the program, the chair of the supervisory committee or one of its members (see above).

Students in IGS may select a 37-credit area of specialization in Community Development. The Community Development area of specialization, offered in collaboration with five other universities in the Great Plains Interactive Distance Education Alliance, is offered exclusively through courses on the Web.

Courses for graduate students

IGS 599. Creative Component. Cr. arr. Repeatable.

IGS 699. Thesis Research. Cr. arr. Repeatable.

Interdisciplinary Studies

www.las.iastate.edu/academics/interdisciplinarystudies.shtml

(Interdepartmental undergraduate major administered by the College of Liberal Arts and Sciences)

A major in interdisciplinary studies is offered in the College of Liberal Arts and Sciences for undergraduate students who have unique interdisciplinary educational goals. The student, a faculty review board, and an academic adviser design the major. Leading to either the bachelor of arts or the bachelor of science degree, the major includes 36 to 48 credits of coursework chosen to provide a coherent, carefully planned program in an area of interest that bridges two or more departments. This specialized area is identified on the diploma. Learning goals are individually crafted for each proposed major.

A degree in Interdisciplinary Studies may be particularly attractive to students who wish to develop an area of interest based upon one of the College's cross-disciplinary programs. Areas of interest in Interdisciplinary Studies have included Classical Studies, Criminology and Criminal Justice, International Relations, Ecology Studies, African American Cultural Studies, Asian Studies, and U.S. Latino/a Studies.

A student seeking admission to the program in interdisciplinary studies writes a letter of application that explains how the proposed major meets specific educational and learning goals. A faculty review board screens applications. Since students are expected to earn at least 30 credits after they are admitted into the program, the proposal is ordinarily submitted to the review board in the sophomore or junior year. The proposal will be considered if the area of interest properly falls within the College of Liberal Arts and Sciences and if the student's educational goals cannot be met by a more traditional combination of existing majors, minors, and electives.

The interdisciplinary studies major must satisfy the requirements of the liberal arts and sciences curriculum in the College of Liberal Arts and Sciences. A major emphasizing the humanities or communicative arts normally leads to a B.A.; a major emphasizing the natural or social sciences normally leads to a B.S. Different requirements for the B.A. and B.S. degrees are determined by the nature of the chosen field of study. Courses listed in the individualized major may come from any department of the university with the following restrictions:

1. The selection of courses needs to focus on a single theme and be consistent with the career and educational goals of the student.

2. At least one half of the courses in the major will come from departments within the College of Liberal Arts and Sciences.

3. The courses will be chosen from at least two disciplines.

All courses in the major must be at the 200-level or higher. At least 15 credits must be at the 300-level or higher with at least 6 credits at the 400-level or higher. An average grade of C or better must be earned in 15 credits at the 300-level or higher in the major. To meet the English and communication proficiency requirement, a grade of C or better must be earned in either an advanced English composition course or a course in the major with a significant writing component.

Further information may be obtained from the college office.

International Agriculture

www.ageds.iastate.edu/intrnlag/index.htm

(Interdepartmental Undergraduate Program)

Supervisory Committee: Robert A. Martin, Chair; Michael D. Kenealy, Ebby Luvaga

The international agriculture program provides opportunities to develop knowledge and skills related to the factors that interact to impact agricultural and environmental issues, production, processes, distribution and utilization worldwide. The program puts emphasis on international experience through structured internships and study abroad. The international agriculture program is appropriate for students seeking positions that require knowledge and experience related to global agricultural issues and their impact on local, regional, national and international policies and practices. Students preparing for careers in the following areas will benefit from the international agriculture program; governmental and non-governmental development agencies, agribusinesses, educational institutions, and non-profit assistance agencies. Outcomes from participation in this program include developing an awareness for the role of international agriculture in the career development process, analyzing international agricultural issues and policies, acquiring skills for solving problems in international development and agribusiness and experiencing real situations and gaining perspectives about agriculture in a global setting.

Secondary Major

International agriculture is an undergraduate secondary major that may be taken only in conjunction with a primary major in an agriculture and life sciences curriculum. Students choosing international agriculture will strengthen their career placement with a business or agency involved in international activities. Technical knowledge of a primary major discipline will be strengthened by a global awareness of agriculture and life sciences. A secondary major in international agriculture will give students practical insight into the role of agriculture in a world of increasing food and fiber needs. It is ideal for those who wish to broaden their international perspective or prepare for international work in agriculture. The secondary major includes an emphasis on international internship or study abroad and/or foreign languages, and selection of appropriate courses (from an approved list) to meet the needs and interests of the student.

Courses for the secondary major include Agron 342; six credits of study abroad, travel, or language courses or any combination thereof; and six credits in selected international agriculture courses in the College of Agriculture and Life Sciences. Fifteen credits of the secondary major cannot be used to meet requirements of the major or any other college or university requirement.

See *International Agriculture, Curriculum*, for the specific program. Students interested in earning a secondary major in international agriculture must contact a program adviser. The early indication of an interest in international agriculture allows for effective integration of the secondary major course requirements with those of the primary major.

Minor

A minor in international agriculture is available to interested students regardless of their major. Students selecting the minor should have at least minimal familiarity with agriculture and life sciences and agricultural systems.

Courses for the minor include Agron 342; 3 to 6 credits of study abroad and/or foreign language and 3 to 6 credits in selected international agriculture courses in the College of Agriculture and Life Sciences. Nine credits of the 15 credit total for the minor can not be used for meeting requirements for the major.

For more information about a secondary major or minor in international agriculture, see descriptions in the designated departments or the supervisory committee.

For more information about courses for either a secondary major or a minor in international agriculture, see descriptions in the designated departments.

International Business

Interdepartmental Undergraduate Secondary Major

Supervisory Committee: Dr. Ann Coppernoll-Farni (contact person) and others annually appointed by College.

The international business program is designed to provide students with information that will enable them to work for companies that are involved with international business. Students are expected to develop an understanding of international business issues applied to the different functional areas of business. They will also develop skills to prepare themselves for business positions with international responsibilities. The program is designed to prepare students for employment in multinational companies and for business assignments beyond the United States.

International business is an undergraduate secondary major that may be taken only in conjunction with a primary major in business. Technical knowledge of international business will strengthen the expertise acquired with the primary major. Business students pursuing this program should strengthen their placement opportunities with multinational corporations.

A student in the College of Business may earn a secondary major in International Business. The requirements for this major include 12 credits in international business courses, one year of the same university-level foreign language (minimum of 6 credits) and an approved international experience (minimum 3 months). Students who pursue this secondary major will be required to complete the requirements for a primary major in Business. Fifteen of the 18 credits required for the International Business major must not be used for the primary major.

International Studies

www.las.iastate.edu/international/major.shtml

(InterdepartmentalUndergraduate Major and Minor, Administered by the College of Liberal Arts and Sciences)

Director: Dawn Bratsch-Prince

Faculty Steering Committee: Charles Dobbs, Chad Gasta, Hsain Ilahaine, Olga Mesropova, Thomas Waldemer.

Undergraduates completing the International Studies major understand the interconnections between local and global issues and events. They can integrate their understanding of a selected global issue with knowledge of the major culture, values, and problems of a selected geographical area. They can communicate with persons of cultures other than their own and, in so doing, appreciate the impact of their own cultural and educational experience on their perception of the world. The international studies program provides opportunities for students to develop skills and understanding about international events and problems, and global issues. The program is designed for students who wish to prepare for work or advanced study in the international arena, such as in foreign service, journalism, advocacy organizations, scientific or research institutions, business, nongovernmental development organizations (NGOs), humanitarian agencies, environmental organizations, human rights organizations, think tanks, international agriculture, engineering, and other fields.

A secondary major and a minor in International Studies are available for undergraduates. The program requirements are structured around a combination of a designated Topical Module and a Geographic Regional Studies Component. Each student's program of study is designed to reflect programmatic opportunities at Iowa State University and the academic, intellectual, and professional interests of the student.

Secondary Major

A student seeking a secondary major in International Studies must successfully complete a minimum of 27 semester credits in courses approved for use in the International Studies program, including: IntSt 235, 430; 21 credits in courses approved for the International Studies program, with a minimum of 9 credits (at least 6 of which are numbered 300 or above) in a designated Topical Module and a minimum of 9 credits (at least 6 of which are numbered 300 or above) in a Geographic Regional Studies Component; Fulfillment of Language Proficiency (see below); study abroad.

The major must include a minimum of 12 credits not used to meet any other department, college, or university requirement.

Minor

A student seeking a minor in International Studies must successfully complete a minimum of 18 semester credits in courses approved for use in the International Studies program, including: IntSt 235, IntSt 430; 12 credits in courses approved for the International Studies program, with a minimum of 6 credits (at least 3 of which are numbered 300 or above) in a designated Topical Module and a minimum of 6 credits (at least 3 of which are numbered 300 or above) in a Geographic Regional Studies Component; Fulfillment of Language Proficiency (see below); study abroad.

The minor must include a minimum of 9 credits not used to meet any other department, college, or university requirement.

Language Proficiency

Students with a major or minor in International Studies fulfill the Language Proficiency requirement through one of the following options:

•Completion of two years of university-level language instruction in a single, appropriate foreign language, as demonstrated by a foreign language course numbered 202 or higher. Students whose first language is other than English fulfill Language Proficiency with Engl 250 at a grade of "C" or better.

•Passing an examination given by the Dept. of World Languages and Cultures or otherwise certifying proficiency equivalent to two years of college instruction. Students proficient in languages not offered at ISU may petition for special consideration.

•Intensive study abroad experience that includes in-the-field-use of a language other than English (individual prior approval of committee required for this option).

A. Topical Modules
•Global Environmental Issues
•Globalization and Economic Development
•International Issues in Science and Technology
•International Communication
•International Conflict
•Social and Cultural Change

B. Geographic Regional Studies Component
•Africa and Middle East
•Asia
•Latin America
•Western Europe
•Russia, East Europe and Central Asia

International Studies students are required to participate in study and/or work abroad programs. Students may petition to use up to 9 credits in the major (6 credits in the minor) earned in study abroad and/or international internship programs to substitute for courses within the Topical Module, Geographic Regional Studies Component, and/or Language Proficiency requirements.

Courses primarily for undergraduate students

IntSt 235. Introduction to International Studies. (3-0) Cr. 3. F.SS. Overview of international studies, emphasizing cultural, geographic, economic, and political characteristics of major world areas and nations.

IntSt 350. Topics in International Studies. Cr. arr.

IntSt 430. Seminar in International Studies. (3-0) Cr. 3. S. Capstone seminar in international studies focused on economic development, women's issues, war and ethnic conflict, population, the environment, globalization, human rights, international trade and business and other issues. Students develop a project on a subject linked to their area of professional interest or academic specialization.

IntSt 446. International Issues and Challenges in Sustainable Development. (Cross-listed with Agron, Globe). Cr. 4. S. *Prereq: 3-credit biology course, Sophomore or higher classification, permission of Instructor.* Mullen. Interdisciplinary study and analysis of agricultural, biophysical, environmental, sociological, economical, political, and historical factors affecting sustainable development of communities and countries from art and science perspectives. International field experience with foreign language training required. A program fee is charged to students for international study abroad.

IntSt 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of International Studies Advisory Committee Chair and faculty supervisor.* Designed to meet the needs of students who wish to study in areas other than those in which courses are offered or to integrate areas of study appropriate to special problems with international foci. No more than 3 credits of IntSt 490 may be used in the International Studies major or minor..

Iowa Lakeside Laboratory

www.lakesidelab.org

(Interinstitutional Program)

Participating Faculty: Neil P. Bernstein (Biology, Mount Mercy College), Bonnie S. Bowen (Ecology, Evolution and Organismal Biology, Iowa State University), C. Lee Burras (Agronomy, Iowa State University), C. Arthur Croyle (Art and Design, Iowa State University), John F. Doershuk (Anthropology, University of Iowa, and State Archaeologist), Mark B. Edlund (Science Museum of Minnesota, St. Croix Watershed Research Station), Jim Heynen (English, St. Olaf College), Laura L. Jackson (Biology, University of Northern Iowa), Stephen Juggins, (School of Geography, Politics & Sociology, University of Newcastle, UK), Kenneth L. Lang (Biological Sciences, Humboldt State University), Michael J. Lannoo (Muncie Center for Medical Education, Ball State University), William R. Norris (Natural Sciences, Western New Mexico University), Clay L. Pierce (Natural Resource Ecology and Management, Iowa State University), Thomas R. Rosburg (Biology, Drake University), Daryl D. Smith (Native Roadside Vegetation Center, University of Northern Iowa), Sarah A. Spaulding (Inst. of Arctic & Alpine Research, University of Colorado), Lois H. Tiffany (Ecology, Evolution and Organismal Biology, Iowa State University), Arnold van der Valk (Ecology, Evolution, and Organismal Biology), James L. Wee (Biological Sciences, Loyola University).

Iowa Lakeside Laboratory is run cooperatively by the Iowa Lakeside Laboratory Consortium whose members include Drake University, Iowa State University, the University of Northern Iowa, and the University of Iowa. Lakeside courses can be taken for credit through all Consortium members. Students should check with their advisers to determine whether Lakeside courses can be used to satisfy major or minor requirements or college or university general education requirements.

The Laboratory was established in 1909 for the conservation and study of the rich flora and fauna of northwest Iowa, especially those of the Iowa Great Lakes region with its numerous lakes, wetlands, and prairies. Its campus is located on approximately 140 acres of restored prairie, wetland, and gallery forest along the west shore of West Okoboji Lake. Lakeside's mission is to provide undergraduate and graduate students an opportunity to get hands-on experience working with a variety of natural and human environments through its field-oriented summer courses and to provide research facilities and support for graduate students and faculty working on research projects in northwestern Iowa. Each summer, Iowa Lakeside Laboratory offers students a unique educational experience: small, full-immersion, field-oriented courses in the natural sciences (archaeology, ecology, environmental science, hydrology, evolution, geology, soils, taxonomy). All courses meet all day from Monday through Friday. The majority of courses run for 4 weeks. Enrollments in most courses are limited to 8 to 10 students. Courses are taught at the undergraduate (sophomore and junior) and the senior/graduate level. Students obtain one credit for each week (40 hours) in class. One and two week courses are also available, including courses designed especially for teachers. Weather permitting, students normally spend at least part of each day doing field work, either as part of their class work or working on individual or group projects. Because some courses are offered intermittently, the current Iowa Lakeside Laboratory summer brochure or the Lakeside Lab Website (www.lakesidelab.org) should be consulted for the list of courses being offered in a given summer session. The Lakeside Lab Website

(www.lakesidelab.org) also contains additional information about the Laboratory and about each course being offered.

Research projects by undergraduates, graduate students and faculty can be done either on the campus or at many nearby natural areas. Undergraduate and graduate students are strongly encouraged to do independent projects at Lakeside and graduate students are welcome to use it as a base for their thesis and dissertation research. Laboratory space and other facilities are available for long-term or short-term research projects.

Teaching and research facilities include eight laboratory buildings, a library, and a lecture hall. Living accommodations include cottages, motel-style units, and a large mess hall. All students are encouraged to stay at Lakeside while they are taking courses to take full advantage of its educational, professional, and social life.

Financial Aid

Iowa Lakeside Laboratory Scholarships are available to both undergraduates and graduate students. All scholarships cover room and board. Information about how to apply for Iowa Lakeside Laboratory Scholarships is included on the Website (www.lakesidelab.org). Students should also consult the Student Financial Aid Office for other scholarship, work study, and loan programs for which they are eligible.

Registration

Students can only enroll in Iowa Lakeside Lab courses by submitting an Iowa Lakeside Lab Registration and Scholarship form and Housing form to the Iowa Lakeside Laboratory Administrative Office. These forms are found on the Iowa Lakeside Laboratory Website: (www.lakesidelab.org) where they can be submitted online or downloaded. For further information, contact

Iowa Lakeside Laboratory
1838 Highway 86
Milford, IA 51351
Phone: (712) 337-3669
FAX: (712) 337-0361
E-Mail: peter-vanderlinden@uiowa.edu

Early registration is advisable. Because enrollment in Lakeside courses is limited, students should register before May 1 for the following summer session. Housing is also limited and students must apply for housing or indicate that they plan to live off campus at the time of registration.

Courses primarily for undergraduate students

Ia LL 302. Plant-Animal Interactions. Cr. 4. Alt. SS., offered 2011. *Prereq: One course in the biological sciences.* Introduction to ecology and co-evolution of plants and animals; emphasis on dispersal, pollination, and plant-herbivore interactions; field and laboratory work, reading, discussion.

Ia LL 303I. Undergraduate Internships. (Cross-listed with NREM). Cr. arr. SS. *Prereq: Permission of instructor and sophomore standing.* Placement with county conservation boards, camps, parks, etc. for experience as interpreters, rangers, and technicians.

Ia LL 312I. Ecology. (Cross-listed with A Ecl, EnSci). Cr. 4. SS. An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

Ia LL 326I. Ornithology. (Cross-listed with A Ecl). Cr. 4. SS. The biology, ecology, and behavior of birds with emphasis on field studies of local avifauna. Group projects stress techniques of population analysis and methodology for population studies.

Ia LL 364. Biology of Aquatic Plants. Cr. 4. Alt. SS., offered 2010. A field-oriented introduction to the taxonomy and ecology of aquatic plants in lakes, wetlands and rivers. Individual or group projects.

Ia LL 367. Plant Taxonomy. Cr. 4. SS. Principles of classification and evolution of vascular plants; taxonomic tools and collection techniques; use of keys. Field and laboratory studies emphasizing identification of local flowering plants and recognition of major plant families.

Ia LL 371I. Introduction to Insect Ecology. (Cross-listed with Ent). (3-3) Cr. 4. Alt. SS., offered 2011. Field and laboratory study of insects, their diversity, life history; emphasis on ecology and behavior.

Ia LL 402I. Watershed Hydrology and Surficial Processes. (Cross-listed with Agron, EnSci. Cr. 4. SS. *Prereq: Four courses in physical or biological sciences or engineering.* Effects of geomorphology, soils, and land use on transport of water and materials (nutrients, contaminates) in watersheds. Fieldwork will emphasize investigations of the Iowa Great Lakes watershed. Nonmajor graduate credit.

Ia LL 403. Evolution. Cr. 4. SS. Mechanisms and patterns in microevolution and macroevolution. Field exercises will emphasize studies of natural selection, adaptation, genetic variation, and population genetics of local plant and animal populations. Nonmajor graduate credit.

Ia LL 404I. Behavioral Ecology. (Cross-listed with A Ecl). Cr. 4. Alt. SS., offered 2010. *Prereq: Two semesters of biology.* Animal coloniality, courtship, territoriality, predator defense, habitat selection, foraging, mating systems, and parental care will be examined in the field in order to evaluate various ecological and evolutionary theories of animal behavior.

Ia LL 415. Freshwater Invertebrates. Cr. 4. SS. *Prereq: One or more ecology courses.* Field-oriented introduction to the identification, life-history, and ecology of common, free-living freshwater invertebrates of north-temperate lakes, rivers, and wetlands. Emphasis on the role of invertebrates in aquatic food chains and litter processing. Nonmajor graduate credit.

Ia LL 419I. Vertebrate Ecology and Evolution. (Cross-listed with A Ecl). Cr. 4. SS. Field and laboratory study of representative vertebrates of northwestern Iowa. Observations and experimentation emphasize ecological histories by integrating concepts of functional morphology, behavioral ecology, and evolutionary biology. Nonmajor graduate credit.

Ia LL 420I. Amphibians and Reptiles. (Cross-listed with A Ecl). Cr. 4. Alt. SS., offered 2010. *Prereq: Two semesters of biology.* Ecology, behavior, and conservation biology of amphibians and reptiles with emphasis on their anatomy and morphology; temperature and water regulation; locomotion; life history; reproduction; population and community ecology; and conservation.

Ia LL 422I. Prairie Ecology. (Cross-listed with EnSci). Cr. 4. SS. *Prereq: Familiarity with basic principles in biological sciences and ecology.* Basic patterns and underlying physical and biotic causes of both regional and local distributions of plants and animals of North American prairies; field and laboratory analyses and projects. Nonmajor graduate credit.

Ia LL 425I. Aquatic Toxicology and Wetland Dynamics in Freshwater Systems. Cr. 4. SS. *Prereq: Introductory biology course and general chemistry course.* Fundamental knowledge and understanding of the scientific concepts related to the physio-chemical and biological environment. Problems and issues (global, national, regional, and local) associated with freshwater systems and how wetland restoration can be used to ameliorate problems. Discussion and application of basic tools used to assess aquatic toxicological problems. Nonmajor graduate credit.

Ia LL 427I. Archaeology. (Cross-listed with Anthr). Cr. 4. SS. Nature of cultural and environmental evidence in archaeology and how they are used to model past human behavior and land use; emphasis on Iowa prehistory; basic reconnaissance surveying and excavation techniques. Nonmajor graduate credit.

Ia LL 435I. Illustrating Nature I Sketching. (Cross-listed with BPM I). Cr. 2. SS. Sketching plants, animals and terrain. Visual communication, development of a personal style, and integration of typographic and visual elements on a page will be emphasized.

Ia LL 436I. Illustrating Nature II Photography. (Cross-listed with BPM I). Cr. 2. SS. Beginning to intermediate technical and compositional aspects of color photography of natural areas and their plants and animals.

Ia LL 461I. Introduction to GIS. (Cross-listed with EnSci, Env S, L A). Cr. 4. SS. Descriptive and predictive GIS modeling techniques, spatial Statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management. Nonmajor graduate credit.

Ia LL 463I. Soil formation and Landscape Relationships. (Dual-listed with 563I). (Cross-listed with Agron, EnSci). Cr. 4. Alt. SS., offered 2010. *Prereq: Agron 154 or 260.* Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Nonmajor graduate credit.

Ia LL 484. Plant Ecology. Cr. 4. SS. Principles of plant population, community, and ecosystem ecology illustrated through studies of native vegetation in local prairies, wetlands and forests. Group or individual projects. Nonmajor graduate credit.

Ia LL 490I. Undergraduate Independent Study. (Cross-listed with Anthr, NREM). Cr. arr. Repeatable. SS. *Prereq: Junior or senior classification and permission of instructor.*

Ia LL 493. Natural History Workshop. Cr. arr. SS. Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.
A. Amphibians and Reptiles
B. Birds and Birding
C. Nature Photography
D. Mushrooms and Other Fungi
E. Iowa's Trees and Forests
F. Fish Biology
G. Prairies
I. Common Insects
J. Aquatic Plants
K. Life in Rivers
L. Life in Lakes
M. Mosses and Liverworts
N. Natural History of Iowa Great Lakes Region
P. Field Archaeology
Q. Common Algae
S. Scuba Diving
T. Astronomy
U. Sketching Nature

Ia LL 494. Ecosystems of North America. Cr. arr. SS. *Prereq: A general ecology course and permission of the instructor.* An extended field trip to study a particular type of ecosystem (prairie, coastal wetland, forest, alpine, coral reefs, etc.) or the ecosystems of a specific region (Rocky Mountains, Gulf Coast, Appalachian Mountains, Deserts of the Southwest, Central America, etc.). Prior to the field trip, there will be an orientation period and after each field trip a review and synthesis period. A field trip fee will be assessed to cover travel expenses. Nonmajor graduate credit.

Ia LL 499. Undergraduate Research. Cr. arr. *Prereq: Junior or senior classification and permission of instructor.*

Courses primarily for graduate students, open to qualified undergraduate students

Ia LL 501I. Freshwater Algae. (Cross-listed with EEOB). Cr. 4. SS. Structure and taxonomy of freshwater algae based on field collected material; emphasis on genus-level identifications, habitats visited include lakes, fens, streams, and rivers; algal ecology.

Ia LL 503. Graduate Internships. Cr. arr. SS. *Prereq: Permission of instructor and graduate standing.* Placement with county conservation boards, camps, parks, schools, etc. For experience as interpreters, rangers, technicians, and teachers.

Ia LL 508I. Aquatic Ecology. (Cross-listed with EnSci, NREM). Cr. 4. SS. *Prereq: Courses in ecology, chemistry, and physics.* Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

Ia LL 523I. Fish Ecology. (Cross-listed with A Ecl). Cr. 4. Alt. SS., offered 2010. Basic principles of fish interaction with the biotic and abiotic environment. Field methods, taxonomy, and biology of fish with emphasis on the fish fauna of northwestern Iowa.

Ia LL 526I. Advanced Field Ornithology. (Cross-listed with A Ecl). Cr. 2. SS. *Prereq: Concurrent registration in Ia LL 326I.* Field study of birds of the upper Midwest; extended field trip to Minnesota and Wisconsin; individual or group project.

Ia LL 531I. Conservation Biology. (Cross-listed with EEOB, A Ecl). Cr. 4. Alt. SS., offered 2010. *Prereq: Ia LL 312I.* Population-and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

Ia LL 532. Analysis of Environmental Data. (2-0) Cr. 2. SS. *Prereq: An undergraduate course in statistics, understanding of basic concepts such as correlation and regression, and familiarity with PC-based software for data analysis.* Analysis of Environmental Data will provide students with training in the theory and application of a range of Statistical techniques useful for the analysis of ecological and paleoecological data. Topics will include data management, exploratory data analysis, regression analysis, direct and indirect ordination methods, classification techniques, transfer functions and the analysis of temporal data. Practical classes will provide hands-on training in the use of Statistical and graphical software including R, CANOCO, C2, and TWINSPAN. The course will be directed towards advanced undergraduate, graduate and working professionals in ecology and paleoecology.

Ia LL 535I. Restoration Ecology. (Cross-listed with A Ecl, EnSci, EEOB). Cr. 4. Alt. SS., offered 2010. *Prereq: A course in ecology.* Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

Ia LL 563I. Soil formation and Landscape Relationships. (Dual-listed with 463I).(Cross-listed with Agron, EnSci). Cr. 4. Alt. SS., offered 2010. *Prereq: Agron 154 or 260.* Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use.

Ia LL 564I. Wetland Ecology. (Cross-listed with EnSci, EEOB). Cr. 4. SS. *Prereq: Ia LL 312I.* Ecology, classification, creation, restoration, and management of wetlands. Field studies will examine the composition, structure and functions of local natural wetlands and restored prairie pothole wetlands. Individual or group projects.

Ia LL 573. Techniques for Biology Teaching. (Cross-listed with EEOB, A Ecl). Cr. arr. Repeatable. SS. The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A. Animal Biology (Same as A Ecl 573A)
B. Plant Biology
C. Fungi and Lichens
D. Aquatic Ecology
E. Prairie Ecology
F. Wetland Ecology
G. Limnology (Same as A Ecl 573G)
H. Animal Behavior (Same as A Ecl 573H)
I. Insect Ecology
J. Biology of Invertebrates
K. Non-invasive Use of Living Organisms
W. Project WET (Same as A Ecl 573W)

Ia LL 575I. Field Mycology. (Cross-listed with EEOB). Cr. 4. Alt. SS., offered 2010. Identification and classification of the common fungi; techniques for identification, preservation, and culture practiced with members of the various fungi groups.

Ia LL 580I. Ecology and Systematics of Diatoms. (Cross-listed with EEOB). Cr. 4. SS. Field and laboratory study of freshwater diatoms; techniques in collection, preparation, and identification of diatom samples; study of environmental factors affecting growth, distribution, taxonomic characters; project design and execution including construction of reference and voucher collections and data organization and analysis.

Ia LL 590I. Graduate Independent Study. (Cross-listed with A Ecl, Anthr, EEOB). Cr. arr. Repeatable. SS. *Prereq: Graduate classification and permission of instructor.*

Ia LL 593. Natural History Workshop. Cr. arr. *Prereq: Permission of instructor.* Graduate workshop on some aspect of the natural history of the Upper Midwest or on techniques for studying natural history.

Courses for graduate students

Ia LL 699I. Research. (Cross-listed with A Ecl, Anthr, EEOB, GDCB). Cr. arr. Repeatable.

Journalism and Communication, The Greenlee School of

www.jlmc.iastate.edu

Michael Bugeja, Director

Professors: Abbott, Beell, Bugeja, Peterson, Rodriguez, Smith

Professors (Emeritus): Disney, Emmerson, Friederich, Gillette, Kunerth, Shelley, Wechsler

Associate Professors: Geske, Mack, Prior-Miller

Associate Professors (Emeritus): Coon, Fowler, Haws

Assistant Professors: Blevins, Bulla, Chamberlin, Cozma, Dahlstrom, Dimitrova, Groshek, Han, Harms, Lee, Newell, Sar

Senior Lecturers: Wilgenbusch

Lecturers: D. Bugeja, Haag, Monahan, Rouse, Thomas

Clinicians: Ames, Gibson

The Greenlee School of Journalism and Communication offers work for the bachelor of arts in advertising, and the bachelor of science degree in journalism and mass communication. The unit, founded in 1905, has been continuously accredited every six years since 1948 by the Accrediting Council on Education in Journalism and Mass Communications and was last reaccredited in 2004. Accreditation is based on the principle that students need a broad-based, liberal arts education, as well as a solid core of courses within the discipline.

Undergraduate Study

Students who complete degrees in advertising or journalism and mass communication will develop competencies in 12 key areas:

History/role of professionals and institutions: Demonstrate an understanding of the history and role of professionals and institutions in shaping communications;

First Amendment/Law: Understand and apply the principles and laws of freedom of speech and press, including the right to dissent, to monitor and criticize power, and to assemble and petition for redress of grievances;

Theory: Understand concepts and apply theories in the use and presentation of images and information;

Research and evaluation: Conduct research and evaluate information by methods appropriate to the communications professions in which they work;

Diversity: Demonstrate an understanding of the diversity of groups in a global society in relationship to communications;

Ethics: Demonstrate an understanding of professional ethical principles and work ethically in pursuit of truth, accuracy, fairness and diversity;

Critical thinking: Think critically, creatively and independently;

Writing: Write correctly and clearly in forms and styles appropriate for the communications professions, audiences and purposes they serve;

Visual Communication: Conceptualize, prepare or select appropriate methods to convey information in visual form, whether as a complement or supplement to words;

Numeracy: Apply basic numerical and statistical concepts; ***Critical Evaluation/Editing:*** Critically evaluate their own work and that of others for accuracy and fairness, clarity, appropriate style and grammatical correctness;

Tools and technology: Apply tools and technologies appropriate for the communications professions in which they work.

To become an advertising or journalism and mass communication major, the student must 1) have either achieved a score of 26 or higher on the ACT English exam, 590 or higher on the SAT verbal exam, or passed the School's English Usage Test as outlined in the Greenlee School's policy for meeting the English Usage Standard; and 2) have completed the pre-major core requirements (See majors). Until these requirements are successfully completed, advertising and journalism and mass communication students are designated as pre-majors. A copy of the EUT policy, including additional details and requirements, is available from the Greenlee School.

Communication Proficiency Requirement
To meet the University's Communication Proficiency requirement, all majors in the School must earn a grade of C or better in English 150 and 250 (or 250H). These additional requirements apply:

Advrt majors must earn a C+ or better in JI MC 201 and one of Advrt 334 or 336.

JI MC majors must earn a C+ or better in JI MC 201 and 202 or 206 or 321.

The Advertising Major

The advertising major prepares students for careers in business and industry or for graduate education. Students majoring in advertising find career opportunities in professions requiring applied communication expertise. Graduates are qualified for positions in the creative and account sides of advertising within businesses, agencies and media.

To become an advertising major, a student must successfully complete JI MC 101, 110, and 201 (with a C+ or better) and Advrt 230. Until the EUT standard is met and these courses are successfully completed, advertising students are designated as pre-majors. To receive a bachelor of arts degree in advertising, a student must earn at least 120 credits. A minimum of 80 credits must come from courses other than Advrt or JI MC and must include Principles of Marketing, Mkt 340. At least 65 of these credits must come from the liberal arts and sciences, and must include Principles of Statistics, Stat 101, or other approved statistics course, and Fundamentals of Public Speaking, Sp Cm 212. Overall, at least 45 credits must be from 300-level courses or above.

The degree requirements allow for a minimum of 33 and a maximum of 40 credits to be taken in Advrt and JI MC. These include the pre-major core requirements of 9 credits: Mass Media and Society, JI MC 101, 3 credits; Orientation to Journalism and Communication, JI MC 110, required; Reporting and Writing for the Mass Media, JI MC 201, 3 credits; and Principles of Advertising, Advrt 230, 3 credits.

Advrt 301, Strategic Planning for Advertising and Public Relations, JI MC 460 Law of Mass Communication, and JI MC 499 Professional Media Internship, are required of all Advrt majors. Additional recommended courses and requirements for the advertising major are available from the Greenlee School.

Advrt majors need a broad-based academic background that the School seeks to ensure by requiring a Designated Area of Concentration (DAC) made up of 21 credits with at least 12 credits from the 300-level or above. The DAC is a secondary area of expertise made up of courses selected and designed by the student, with adviser approval, to complement the student's professional and academic interests. A second major outside of Advrt or JI MC may substitute for the DAC.

The Journalism and Mass Communication Major

The major in journalism and mass communication prepares students for careers that involve all aspects of news and information. The emphasis is on generating ideas, organizing, writing, editing and presenting information for various media platforms and audiences. Graduates most likely will work in journalism (magazines, newspapers, electronic media or on-line media) and public relations and public information as well as related disciplines that expect articulate and informed writing and presentation. Students work with advisers to develop programs of study designed to prepare them for work in a variety of communication-specific areas: electronic media, print media (magazine and/or newspaper), public relations/public information, science communication or visual communication.

To be a JI MC major, a student must successfully complete JI MC 101, 110 and 201 (with a C+ or better). Until the EUT standard is met and these courses are successfully completed, journalism and mass communication students are designated as pre-majors. To receive a bachelor of science degree in journalism and mass communication, a student must earn at least 120 credits. A minimum of 80 credits must come from courses other than Advrt or JI MC. At least 65 of these credits must come from the liberal arts and sciences and must include Principles of Statistics, Stat 101, or other approved statistics course. Overall, at least 45 credits must be from 300-level or above.

The degree requirements allow for a minimum of 33 and a maximum of 40 credits to be taken in Advrt and JI MC. These include the pre-major core requirements of 6 credits: Mass Media and Society, JI MC 101, 3 credits; Orientation to Journalism and Communication, JI MC 110, required; Reporting and Writing for the Mass Media, JI MC 201, 3 credits.

JI MC 460 Law of Mass Communication and JI MC 499 Professional Media Internship are required of all JI MC majors. Additional recommended courses and requirements for the journalism and mass communication major are available from the Greenlee School.

JI MC majors need a broad-based academic background that the School seeks to ensure by requiring a Designated Area of Concentration (DAC) made up of 21 credits. All courses for the DAC must be taken outside of Advrt and JI MC. At least 12 credits must be from the 300-level or above. The DAC is a secondary area of expertise made up of courses selected and designed by the student, with adviser approval, to complement the student's professional and academic interests. A second major may substitute for the DAC.

Minors

The Greenlee School offers a minor in Advertising and a minor in Journalism and Mass Communication.

For a minor in Advertising or Journalism and Mass Communication, students complete 15 credits, beginning with JI MC 101. The remaining 12 credits, at least 9 of which must be from Iowa State University, are selected from course offerings in the advertising and journalism and mass communication majors, as follows: 6 credits from the following 200- and 300-level courses, Advrt 230, 301, and 335; JI MC 220, 301, 305, 341, and 342; and 6 credits from the following 400-level courses; JI MC 401, 406, 453, 454, 461, 462, 464, 474, 476 and 477 and Advrt or JI MC 497.

JI MC majors may not minor in Advrt and Advrt majors may not minor in JI MC.

Graduate Study

The Greenlee School of Journalism and Communication offers work for a master of science degree in journalism and mass communication. Two tracks are available: one for students who desire specialized study in communication theory and research; the second for students who wish to strengthen professional strategic skills.

Majors plan programs of study in one of two tracks:

I. Communication as theory and research – The School offers advanced academic preparation in communication theory and research leading to the master of science degree. Graduate work prepares students to use and contribute to research and scholarship in the field of communication. The degree requires a thesis or creative component based on original research, which must be defended successfully before a committee at the end of the program.

Areas of research emphasis include: science and risk communication, media performance, media effects, advertising, public relations, political communication, communication technology, law and ethics, international communication and visual communication.

II. Professional and Strategic Communication – The School offers advanced professional study in journalism and mass communication leading to the master of science degree. Graduate work prepares students for professional careers in a variety of mass communication fields. Students with limited training or experience in journalism and mass communication may include skills courses in their programs for no credit. The degree requires either a creative component or thesis.

All students must complete four core courses: Introduction to Graduate Study in Journalism and Mass Communication (JI MC 592), Theories of Mass Communication (JI MC 501), Communication Research Methods (JI MC 502) and Seminars in Mass Communication (JI MC 598). Each student selects elective courses based on his/her area of emphasis and career goal, in consultation with the student's major professor and Program of Study Committee.

The Greenlee School graduate program offers minor work for students majoring in other departments. The M.S. minor requires JI MC 501 (Communication Theory), JI MC 510 (Communication Strategies), and one other course in journalism and mass communication for a total of 9 credits taken within the Greenlee School.

Advertising (Advrt)

Courses primarily for undergraduate students

Advrt 230. Advertising Principles. (3-0) Cr. 3. F.S. Historical, social, economic and legal aspects of advertising. Evaluations of advertising research, media, strategy, and appeals. Study of the creation of print and broadcast advertising.

Advrt 301. Strategic Planning for Advertising and Public Relations. (Cross-listed with JI MC). (3-0) Cr. 3. F.S. *Prereq: 230 or JI MC 220; Sophomore classification.* Prospect analysis, market segmentation, positioning, strategic planning, public opinion formation, communication strategy formation and development of critical thinking skills.

Advrt 334. Advertising Creativity. (2-2) Cr. 3. *Prereq: C+ or better in JI MC 201; Advrt/JI MC 301.* Development and execution of creative advertising materials. Copywriting, art direction and computer applications for print, broadcast and digital media. Creative strategy development, execution and evaluation.

Advrt 335. Advertising Media Planning. (3-0) Cr. 3. *Prereq: Advrt/JI MC 301.* Concepts of media planning and selection in the development, execution and evaluation of advertising campaigns. Characteristics and capabilities of the advertising media. Utilization of market segmentation, consumer buying and media audience databases.

Advrt 336. Advertising Account Management. (3-0) Cr. 3. *Prereq: C+ or better in JI MC 201; Advrt/JI MC 301.* Fundamentals of account management with emphasis on leadership, sales techniques, relationship building, presentation skills, and strategic thinking. Includes aspects of agency revenue growth, team building, client management, evaluating creative concepts and media plans, and developing strategic proposals and campaign recommendations.

Advrt 390. Professional Skills Development. (Cross-listed with JI MC). Cr. arr. Repeatable. *Prereq: C+ or better in 201, other vary by topic; instructor permission.* Credit not given for working on student or professional media. Check School for course availability.

Advrt 434. Advertising Campaigns. (3-0) Cr. 3. F.S. *Prereq: Advrt/JI MC 301; C+ or better in 334 or 336, and major Status.* Development of advertising campaigns for business and social institutions. Projects

involve budgeting, media selection, market analysis, campaign strategy, and creative execution.

Advrt 435. Advertising Competition. Cr. arr. Repeatable. S. *Prereq: Permission of instructor, Junior/senior standing strongly recommended.* Preparation of materials for regional and national competitions.

Advrt 436. Advertising Portfolio Practicum. (2-2) Cr. 3. *Prereq: C+ or better in 334, instructor permission.* Advanced advertising writing and design. Emphasis on creative strategy, problem solving and execution of creative materials in print, broadcast and on-line media for a variety of clients.

Advrt 497. Special Topics in Communication. (Cross-listed with Jl MC). Cr. arr. Repeatable. Seminars or one-time classes on topics of relevance to students in communication.

Journalism and Mass Communication (Jl MC)

Courses primarily for undergraduate students

Jl MC 101. Mass Media and Society. (3-0) Cr. 3. F.S. Communication models and their application to the mass media; the mass communication process; organization, characteristics and responsibilities of the mass media; media-related professional operations.

Jl MC 110. Orientation to Journalism and Communication. Cr. R. F.S. Orientation to career opportunities, emphasis areas and requirements in the Greenlee School. Satisfactory-fail only.

Jl MC 201. Reporting and Writing for the Mass Media. (1-4) Cr. 3. F.S. *Prereq: Engl 250 (or testout) and either a score of 26 or higher on the ACT-English exam, 590 or higher on the SAT verbal exam or a passing score on the School's English Usage Test.* Generating story ideas, exercising news judgment and gathering information via interviews, observation and documentary sources to produce news and informational material for the mass media. Emphasis on analyzing and organizing information, as well as accuracy and principles of good writing.

Jl MC 202. Intermediate Reporting and Writing for the Mass Media. (2-2) Cr. 3. F.S. *Prereq: C+ or better in 201.* Designed for students interested in writing for newspapers, magazines and online media. Enhancing and refining skills in developing sources and generating story ideas. information-gathering techniques, reporting and writing. Includes segments on local government and judiciary.

Jl MC 206. Reporting and Writing for the Electronic Media. (2-3) Cr. 3. F.S. *Prereq: C+ or better in 201.* Researching, organizing, and writing for radio, television and online media. Basic principles of news, information and entertainment programming. An emphasis on development, content and structure.

Jl MC 220. Principles of Public Relations. (3-0) Cr. 3. F.S. Introduction to public relations in business, government and non-profit organizations; functions, processes, and management; attitudes, public opinion and persuasion; overview of theory.

Jl MC 301. Strategic Planning for Advertising and Public Relations. (Cross-listed with Advrt). (3-0) Cr. 3. F.S. *Prereq: Advrt 230 or Jl MC 220; Sophomore classification.* Prospect analysis, market segmentation, positioning, strategic planning, public opinion formation, communication strategy formation and development of critical thinking skills.

Jl MC 305. Publicity Methods. (3-0) Cr. 3. *Prereq: Engl 250, Sophomore classification.* Communication and publicity fundamentals and the use of media for publicity purposes. Preparing releases for print and broadcast; basics of publication layout. Publicity campaigns. Not available to Jl MC and Advrt majors.

Jl MC 306. Electronic Media Production. (2-2) Cr. 3. F.S. *Prereq: C+ or better in Jl MC 201.* Introduction to studio production using professional equipment. Course focus on visual concepts, maintenance and practical operation of studio equipment.

Jl MC 308. Electronic News Gathering and Production. (2-3) Cr. 3. *Prereq: C+ or better in 202 or 206 or 321; 306.* Field techniques in single-camera video production used to shoot and edit visual stories. Introduction to electronic news gathering.

Jl MC 310. Fundamentals of Photojournalism. (1-3) Cr. 3. *Prereq: C+ or better in 201.* Basic photojournalism techniques. Includes camera operation, lighting, composition, and photo reproduction techniques for print or computer-mediated applications. Emphasis on using the camera as a reporting tool. Basic use of digital imaging and editing software. Ethical issues involving photojournalism.

Jl MC 315. Multimedia Production. (2-2) Cr. 3. *Prereq: 306 or 342L or 343L or equivalent computer design proficiency.* Concepts and principles for evaluating, constructing, and designing information for the Web and other computer-mediated communication systems. Explores the use of computer-generated animation and graphics, audio and video. Issues of ethics and ownership of work pertinent to the new media are discussed.

Jl MC 321. Public Relations Writing. (2-3) Cr. 3. *Prereq: C+ or better in 201; 220 or Advrt 230; 342 and 342L or computer design proficiency recommended. May be taken concurrently with 301.* Developing and writing public relations materials with an emphasis on media relations and news. Techniques addressed include media kits, brochures, newsletters and speeches.

Jl MC 341. Contemporary Magazine Publishing. (Dual-listed with 541). (3-0) Cr. 3. *Prereq: Junior classification.* Analysis of magazine industry and specific audiences served by print and online magazines. Editorial procedures and policies, advertising, circulation, and history of the industry. Individual study of magazines.

Jl MC 342. Visual Principles for Mass Communicators. (3-0) Cr. 3. *Prereq: Sophomore classification.* Understanding of the visual message. Visual perception, visual communication theory, design syntax, design elements and how they are applied in journalism and mass communication.

Jl MC 342L. Laboratory in Basic Visual Principles. (2-2) Cr. 3. *Prereq: Credit or enrollment in 342.* Introduction to desktop publishing, beginning techniques in layout. Application of visual principles to design simple print projects.

Jl MC 343L. Laboratory in Intermediate Visual Principles. (2-2) Cr. 3. *Prereq: 342L or equivalent computer design proficiency.* Application of more advanced features of desktop publishing and other document-enhancing software. Production of newsletters, multi-page brochures and other documents.

Jl MC 344. Depth Reporting and Writing. (2-2) Cr. 3. F. *Prereq: C+ or better in 202 or 206 or 321.* Developing and writing comprehensive news features and magazine articles. Majors may not apply both 344 and Engl 303 toward graduation.

Jl MC 346. Public Affairs Reporting. (2-2) Cr. 3. S. *Prereq: C+ or better in 202 or 206 or 321.* Reporting on government, business, and other institutions; identification of and access to public records; investigative reporting techniques; developing major stories on government and non-profit organizations, and issues for print and broadcast media.

Jl MC 347. Science Communication. (Dual-listed with 547). (2-2) Cr. 3. S. *Prereq: C+ or better in 202 or 206 or 321 for Jl MC majors; C+ or better in Jl MC 201 and Advrt 334 or 336 for Advrt majors. Nonmajors by permission of instructor.* Reporting and writing about science and technology topics for general audiences. Outlets for stories include print, broadcast and online media. Story topics include reporting about basic, applied sciences and social sciences, as well as ethical, political and policy issues related to science and technology.

Jl MC 349. Print Media Editing. (1-5) Cr. 3. *Prereq: C+ or better in 202 or 206 or 321.* Grammar, punctuation, usage, syntax and logic. Editing newspaper, magazine and online copy. Headline, title writing and visual presentation. Use of computer editing programs.

Jl MC 354. Advanced Electronic Media Production. (2-3) Cr. 3. *Prereq: 306 and 308.* Application of advanced television techniques: producing, directing and managing live and recorded information programs.

Jl MC 390. Professional Skills Development. (Cross-listed with Advrt). Cr. arr. Repeatable. *Prereq: C+ or better in 201, other vary by topic. Instructor permission.* Credit not given for working on student or professional media. Check School for course availability.

Jl MC 401. Mass Communication Theory. (3-0) Cr. 3. *Prereq: Junior classification.* Theory and research in mass communication processes and effects; the scientific process; methods of measuring, evaluating and reporting mass communication research.

Jl MC 406. Media Management. (Dual-listed with 506). (3-0) Cr. 3. *Prereq: Junior classification.* Decision-making functions of media. Basic media market analysis, media organization and management, circulation and audience development, technological developments affecting management decisions, and relationships with labor and regulatory agencies that affect media operations.

Jl MC 424. Public Relations Campaigns. (3-0) Cr. 3. *Prereq: 220, 301, and C+ or better in 321; junior classification. Section B: C+ or better in 202 or 206; instructor permission only.* Developing public relations and corporate communication campaigns for business and social institutions.

Jl MC 449. Advanced Print Media Editing. (3-0) Cr. 3. S. *Prereq: 342, 342L, 349 or concurrent enrollment; junior classification.* Developing higher-level editorial skills needed for issue-planning, editorial management and decision making. Designing, developing, and repositioning existing and new magazines, newspapers, and new media. Editing complex manuscripts, with continued emphasis on grammar, punctuation, usage, syntax and logic. Use of computer publishing programs. Nonmajor graduate credit.

Jl MC 453. Electronic Media Technology and Public Policy. (3-0) Cr. 3. *Prereq: Junior classification.* Issues and policies affecting historical, contemporary and future developments of electronic media and their technologies.

Jl MC 454. Critical Analysis and History of the Moving Image. (3-0) Cr. 3. *Prereq: Junior classification.* Evolution of motion picture and television content and other visual technologies. Theories and techniques for evaluating and critiquing film and video. Nonmajor graduate credit.

Jl MC 460. Law of Mass Communication. (3-0) Cr. 3. F.S. *Prereq: C+ or better in 201; junior classification.* First Amendment law, libel, privacy, obscenity, contempt, copyright, trademark, the Federal Communications Act; laws affecting advertising, legal publication, and other business activities of the media, including the Internet. Nonmajor graduate credit.

Jl MC 461. History of American Journalism. (3-0) Cr. 3. *Prereq: Junior classification.* Role of the mass media, including advertising and public relations, in shaping the social, economic and political history of America; impact of change in these areas on the development, traditions, and philosophies of the media. Nonmajor graduate credit.

Jl MC 462. Media Ethics, Freedom, Responsibility. (3-0) Cr. 3. *Prereq: Junior classification.* Media ethics and performance; functions of the media in relation to the executive, judicial and legislative branches of government; agencies of media criticism; right to know versus right to privacy.

Jl MC 464. Journalism and Literature. (3-0) Cr. 3. *Prereq: Junior classification.* A study of journalism's impact on literary writing and literature's impact on journalism, as seen through the works of such American author-journalists as Ernest Hemingway, Truman Capote, Joan Didion, John McPhee, Tom Wolfe, Hunter Thompson. Nonmajor graduate credit.

JI MC 474. Communication Technology and Social Change. (Cross-listed with T SC). (3-0) Cr. 3. *Prereq: Junior classification.* Examination of historical and current communication technologies, including how they shape and are shaped by the cultural and social practices into which they are introduced.

JI MC 476. World Communication Systems. (Dual-listed with 576). (3-0) Cr. 3. *Prereq: Junior classification.* World communication systems and social, political, and economic factors determining flow, character, and volume of news. Impact of media information and entertainment content on nations and societies. Comparative analysis of role and impact of traditional modes of communication, the mass media, and computer-mediated systems.

JI MC 477. Ethnicity, Gender, Class and the Media. (3-0) Cr. 3. *Prereq: Junior classification.* Portrayals of ethnic groups, genders, and classes in the media in news, information, and entertainment; the effects of mass media on social issues and population groups. Nonmajor graduate credit.

JI MC 490. Independent Study in Communication. Cr. arr. *Prereq: Junior classification and contract with supervising professor to register.* Independent studies are research-based. Students may study problems associated with a medium, a professional specialization, a philosophical or practical concern, a reportorial method or writing technique, or a special topic in their field. Credit is not given for working on student or professional media without an accompanying research component. See Greenlee School Student Services Office for more information. No more than 3 credits of JI MC 490 may be used toward a degree in journalism and mass communication or advertising.

JI MC 497. Special Topics in Communication. (Cross-listed with Advrt). Cr. arr. Repeatable. Seminars or one-time classes on topics of relevance to students interested in communication.

JI MC 499. Professional Media Internship. Cr. 3. *Prereq: JI MC majors, C+ or better in 202 or 206 or 321; Advrt majors, C+ or better in JI MC 201; Advrt 301; All students, junior classification, formal faculty adviser approval of written proposal.* Required of all JI MC and Advrt majors. A 400-hour internship in the student's journalism and mass communication or advertising specialization. Assessment based on employer evaluations, student reports and faculty reviews. Available only to JI MC and Advrt majors. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

JI MC 501. Theories of Mass Communication. (3-0) Cr. 3. F. *Prereq: 6 credits in social science or admission to the graduate program.* Examination of major areas of research activity and theoretical development related to organization, functions, and effects of mass communication.

JI MC 502. Communication Research Methods. (3-2) Cr. 4. S. *Prereq: 501 or equivalent communication theory course.* Research methods in journalism and mass communication, including problem selection, sampling, hypothesis formulation, research design, data collection and analysis. Designing a research strategy appropriate for a variety of communication-related questions and assessing the appropriateness, validity, and generalizability of research results.

JI MC 506. Media Management. (Dual-listed with 406). (3-0) Cr. 3. S. *Prereq: 6 credits in social science (economics highly recommended) or admission to the graduate program.* Decision-making functions of media. Basic media market analysis, media organization and management, circulation and audience development, technological developments affecting management decisions, and relationships with labor and regulatory agencies that affect media operations.

JI MC 510. Strategies of Communication. (3-0) Cr. 3. *Prereq: 501.* The process of developing professional communication and persuasion strategies, with emphasis on problem definition, behavioral objectives, situation analysis, strategy formulation, and justification through application of communication theories and research results.

JI MC 520. Persuasion Theory and Methods. (3-0) Cr. 3. *Prereq: 6 credits in social science.* Theories and research methods applied to the study and practice of public relations.

JI MC 521. Theories of Visual Communication. (2-2) Cr. 3. *Prereq: 6 credits in social science.* Introduction to the study of picture-based media (film, television, photography, advertising, etc.). Exploration of theoretical concepts of vision and perception, visual literacy, visual language, visual persuasion/manipulations, and the cultural implications of visual images.

JI MC 541. Contemporary Magazine Publishing. (Dual-listed with 341). (3-0) Cr. 3. *Prereq: 502 or Instructor permission.* Analysis of magazine industry and specific audiences served by print and online magazines. Editorial procedures and policies, advertising, circulation, and history of the industry. Roundtable on research literature.

JI MC 547. Science Communication. (Dual-listed with 347). (2-2) Cr. 3. S. *Prereq: 6 credits of social science or admission to the graduate program.* Reporting and writing about science and technology topics for general audiences. Outlets for stories include print, broadcast and online media. Story topics include reporting about basic, applied and social sciences, as well as ethical, political and policy issues related to science and technology. Nonmajors by permission of instructor.

JI MC 561. Media and Society: Interrelationships. (3-0) Cr. 3. F. *Prereq: 6 credits in social science.* Media functions in a democratic society; conflicts between the media and social institutions; ethical and social controls on the media.

JI MC 574. Communication Technologies and social Change. (Cross-listed with T SC). (3-0) Cr. 3. *Prereq: 6 credits in social science.* Personal, organizational, and social implications of the use of communication technologies. Includes theories and empirical research across the continuum of perspectives, from techno-utopianism through an anti-technology stance.

JI MC 576. World Communication Systems. (Dual-listed with 476). (3-0) Cr. 3. World communication systems and social, political, and economic factors determining flow, character, and volume of news. Impact of media information and entertainment content on nations and societies. Comparative analysis of role and impact of traditional modes of communication, the mass media and computer-mediated systems.

JI MC 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
A. Media Studies
B. Professional Specialization
C. Research Problems and Methods
D. Technique and Style
E. Specialized Communication

JI MC 591. Professional Internship. Cr. arr. F.S.SS. *Prereq: Permission of instructor.* Supervised internship experience. Satisfactory-fail only.

JI MC 592. Introduction to Graduate Study in Journalism and Mass Communication. Cr. R. F. *Prereq: Graduate classification.* Overview of advanced study in journalism and mass communication with special emphasis on requirements for obtaining the master of science degree.

JI MC 598. Seminars in Mass Communication. Cr. arr. Repeatable.
A. Audiences and Effects
B. Communication Technology
C. Professional Communication
D. Development Communication
E. Evaluation Methods
F. International Communication
G. Mass Communication History
H. Mass Communication Law
I. Media Management
J. Research Methods
K. Society and Mass Communication
L. Journalism and Mass Communication Education
M. Visual Communication
N. Broadcast Communication
O. Communication Theory
P. Computer Mediated Communication
Q. Science, Technology and Risk Communication.

JI MC 599. Creative Component. Cr. arr. *Prereq: Approved creative component proposal.*

Courses for graduate students

JI MC 699. Thesis Research. Cr. arr. Repeatable. *Prereq: Approved thesis proposal.*

Kinesiology

(www.edu.iastate.edu/hhp/homepage.htm)

Philip Martin, Chair of Department Distinguished Professors (Emeritus): Forker, Toman

Professors: Anderson, Bloedel, Franke, King, Martin, Sharp

Professors (Emeritus): Frye, Hutchison, Schneider, J. Thomas

Professor (Emeritus Adjunct): Beran

Associate Professors: Derrick, Ekkekakis, Engelhorn, Gillette, Kohut, Smiley-Oyen, K. Thomas, Welk

Associate Professor (Emeritus): Wood

Assistant Professors: Baker, Murdoch, Schabel, Selsby, Welch

Assistant Professor (Emeritus): McDonald

Assistant Professors (Collaborators): Buck, Senchina

Instructors (Adjunct): Coberley, Meier, O'Mara, Pak

Senior Lecturers: Atkinson, Denton, Lipsey, Power

Lecturers: Dukes, Franke, Gundlach, Miller, Nespor, Norris, Packheiser, Peel, Spry-Knutson, Wissink

Mission

We promote health and well-being by creating and disseminating knowledge about physical activity and active living. Through discovery, learning and engagement we improve the lives of citizens of Iowa, the United States and the world.

Goals

The department has identified the following goals to support this mission:

1. We seek to improve the lives of citizens of Iowa, the United States, and the world by the creation and dissemination of knowledge about physical activity and its relationship to health and well-being.

2. We prepare scholars and professionals in the study of physical activity at the undergraduate and graduate levels.

3. We educate the public and the University community in the scientific aspects of physical activity especially exercise, sport, and the role of movement throughout the lifespan.

Overview of Programs

The Department Kinesiology provides opportunities for matriculation leading to the degrees of Bachelor of Science, Master of Science, and Doctor of Philosophy. At both the undergraduate and graduate level, there are opportunities for study in the department's two specializations: the behavioral and biological bases of physical activity.

Undergraduate Study

Dance. Coursework in dance provides opportunities for students to develop an understanding and appreciation of dance as part of a liberal education. Those interested in teaching dance and Physical Education in the public schools may major in

health and human performance (teacher licensure option) and minor in dance.

An interdisciplinary Performing Arts major with a dance emphasis is available through the College of Liberal Arts and Sciences. For further information see *Index, Theatre and Performing Arts*.

The department offers a minor in dance that may be earned by completing the following: Dance 220, 222, 270, 320, 360, 384, 385 or 386, and three additional credits selected from dance courses numbered 200 or above. Participation in Orchesis I or II is recommended.

Kinesiology. Kinesiology. The undergraduate curriculum in Kinesiology is comprised of four components: general education, the Basic Core, the Advanced Core, and the option component. The intent of the general education component is to promote intellectual and personal growth and to prepare students for success in the basic, advanced and option components. The Basic Core enables students to understand, define and explore their own health and physical activity through the cognitive, affective and psychomotor domains. The Advanced Core extends this learning to include disciplinary concepts and tools of inquiry that comprise scientific literacy associated with health and physical activity. Finally, coursework within each specialization option builds upon this personal and scholarly learning by enabling students to master content and skills specific to career applications. The specialization Options comprise a focused area of study within Kinesiology. Options available are 1) Athletic Training, 2) Community and Public Health, 3) Exercise Science, 4) General Studies, and 5) Health/Fitness Management and 6) Physical Education/Licensure. Enrollment in the Athletic Training and Physical Education Licensure options is limited because of accreditation requirements and the provision of more individualized field experiences.

Academic options within the undergraduate program. Students in the CAATE accredited Athletic Training option are prepared for the National Athletic Training Association Board of Certification examination or for graduate work in athletic training. Graduates of this option will effectively use their expertise to plan Strategies aimed at the prevention, treatment and rehabilitation of athletic injuries.

Academic options within the undergraduate program. Students in the CAAHEP accredited Athletic Training option are prepared for the National Athletic Training Association Board of Certification examination or for graduate work in athletic training. Graduates of this option will effectively use their expertise to plan Strategies aimed at the prevention, treatment and rehabilitation of athletic injuries.

Students in the Community and Public Health option are prepared for professional employment at local, state or national health agencies, medical centers, and other public organizations that seek to promote health in the population. The curriculum prepares students to take the Certified Health Education Specialist certification examination upon graduation.

Students in the Exercise Science option utilize an interdisciplinary approach to the study of human movement. In so doing, they become prepared for graduate study in Kinesiology or advanced study leading to careers in medicine, physical therapy, or other allied health programs.

Students in the General Studies option combine kinesiology with a concentration in another area of study to support an individualized program, such as community sport and recreation, dance, and other sport, exercise, or health related fields. Programs of study must be approved by the undergraduate program coordinator.

Students in the Health/Fitness Management option are prepared for professional roles as health and fitness leaders or program managers. Employment opportunities include work in corporate fitness programs, health clubs, cardiac rehabilitation programs or personal training. Graduates are able to plan, implement and supervise exercise programs which will improve fitness and health. Graduates also have a basic understanding of economic and management issues related to business applications in the health and fitness field.

Students in the Physical Education Licensure option are prepared to teach Physical Education in grades K-12 and to meet the State of Iowa learning outcomes for teachers. Graduates can plan developmentally appropriate physical education, and individualize instruction and assessment for diverse audiences.

Learning outcomes for the undergraduate degree. Despite the diversity in specialization Options, the Learning Outcomes comprise a common framework for each student as they matriculate through Iowa State University.

The learning outcomes emphasized in academic coursework in the Department of Kinesiology are:

Content knowledge. The student has a broad conceptual view of physical activity and health, recognizes its scientific underpinnings (e.g. history, content, disciplinary concepts, and tools of inquiry) and appreciates the interdisciplinary nature of the study of physical activity and health. Literacy will be gained from the personal, scholarly and professional perspectives.

Discovery and critical thinking. The student can use accepted techniques of discovery and apply critical thinking within and outside of the discipline area. The student will be able to solve problems independently and evaluate opinions and outcomes at the personal scholarly and professional level.

Communication. The student uses knowledge of effective verbal, nonverbal and media communication techniques to foster inquiry, collaboration, and engagement in physical activity and health related settings.

Numeracy. The student understands and uses qualitative and quantitative analysis through formal and informal assessment strategies.

Technology. The student understands and uses a variety of technological applications to improve personal understanding and to enhance scholarly pursuits and professional practice in their chosen area of study.

Learning in the following domains occurs both in and outside the Iowa State University experience. The department will foster development in these domains through its courses and other activities.

Citizenship. The student uses value and ethics based decision making to demonstrate personal, professional and world citizenship through fostering relationships, embracing leadership, accepting social responsibility, seeking and completing opportunities to improve the quality of life for others.

Lifelong learning. The student is a reflective professional who actively seeks to further self-knowledge and seeks opportunities to grow professionally.

Diversity. The student understands how individuals differ in their approaches to initiating and maintaining a physically active, healthy lifestyle, and creates appropriate environments for diverse participants.

The department offers a minor in athletic coaching. The minor may be earned by completing the following: Kin 220, 258, 315, 355, 358, 365; Biol 155; and Psych 230.

The department offers a minor in sport and culture. The minor may be earned by completing the following: Kin 360 and 365; and completing 9 credits from the following: Kin 242, 315, 331, 442, and 445.

Endorsement to Coach Interscholastic Athletics. The State Department of Education has provided for the endorsement of licensed teachers for the coaching of athletic teams in schools. The endorsement does not lead to licensure to teach physical education. For requirements of the program, leading to the coaching endorsement, see *Teacher Education, Requirements for Areas of Specialization*.

Basic Activity Instruction Program. The department offers a wide selection of beginning, intermediate, and advanced courses in the areas of aquatics, dance, and sports. These courses are designed to serve general education purposes for all students.

B.S./M.S. degree in Diet and Exercise. A combined Bachelor of Science and Master of Science (B.S./M.S.) degree in diet and exercise is available. The program is jointly administered by the Department of Food Science and Human Nutrition (FS HN), within the Colleges of Agriculture and Human Sciences, and the Department of Kinesiology, within the College of Human Sciences. Students interested in this program must enroll as freshmen in the pre-diet and exercise program In the fall of the junior year students will apply for admission to the B.S./M.S. program. Students not accepted into the program will continue toward completion of a B.S. degree in dietetics or kinesiology. Coursework has been designed to facilitate a 4-year graduation date for those students not accepted into the program and electing to complete a single undergraduate degree. Students accepted into the program will progress toward completion of B.S./M.S. degrees in diet and exercise.

Graduate Study

The Department of Kinesiology graduate seeks to integrate discovery and learning by preparing graduate students to understand and create basic and applied knowledge in the study of physical activity, exercise and sport. For all graduate degrees the department offers specializations in behavioral basis of physical activity and biological basis of physical activity. The normal prerequisite to major graduate work is the satisfactory completion of a curriculum essentially equivalent to that required of undergraduate students in kinesiology at this university. However, it is possible for students to qualify for graduate study if undergraduate preparation has been in a related area.

Students in the M.S. and Ph.D. degrees are required to complete original research and write a thesis or dissertation. There is a nonthesis degree option for M.S. students requiring more coursework and an internship experience or other creative component. Specific information about the requirements for these degree options is available from the department office or from the department web site (www.kin.hs.iastate.edu/graduate).

The department participates in the interdepartmental minor in gerontology (see *Index*).

Courses primarily for undergraduate students

Kin 101. Swimming I. (0-3) Cr. 1. F.S. Basic course for nonswimmers. Emphasis on two fundamental strokes and personal water safety skills. Satisfactory-fail only.

Kin 102. Swimming II. (0-3) Cr. 1. F.S. *Prereq: 101 or equivalent skill.* Intermediate course. Emphasis on learning and improving five basic strokes and personal water safety skills. Satisfactory-fail only.

Kin 108. Aquatic Fitness. (0-3) Cr. 1. *Prereq: 102 or equivalent skill.* Water related exercises, activities, and swimming workouts to improve physical fitness. Satisfactory-fail only.

Kin 114. Lifeguard Training. (0-3) Cr. 1. F.S. *Prereq: Ability to swim 500 yards continuously of front crawl, sidestroke, and breaststroke; perform a standing and surface dive; swim under water; and tread water for one minute. Minimum age 16.* Specific training for Red Cross Lifeguard certification. First aid and CPR included. Satisfactory-fail only.

Kin 116. Water Safety Instructor Practicum. (0-3) Cr. 1. *Prereq: H S 105, CPR certification, and permission of instructor.* Supervised teaching experience in swimming, aquatic fitness, lifeguard training, and WSI courses. Satisfactory-fail only.

Kin 117. Lifeguard Training Instructor. (0-2) Cr. 1. F.S. *Prereq: Minimum age 17; able to swim 500 yards; current lifeguard, first aid, and CPR certifications.* The students will learn skills (rescue skills and CPR for the Professional Rescuer) necessary to certify prospective Lifeguards in the American Red Cross Lifeguard Training Program. Satisfactory-fail only.

Kin 118. Water Safety Instructor. (1-3) Cr. 2. S. *Prereq: Minimum age 17; able to swim 500 yards; current first aid and CPR certification.* The students will learn the skills necessary to teach and certify individuals in the following American Red Cross courses. Learn to Swim Program (Levels 1-6), Parent and Child Aquatics (Level A 6 months-2 years; Level B 18 months-5 years), Safety Training for Swim Team Coaches, Community Water Safety, Home Pool Safety, Aquatic Leader Program, and Basic Water Rescue. Satisfactory-fail only.

Kin 119. Archery. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 122. Badminton. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 126. Pocket Billiards. (0-2) Cr. 1. F.S. Introduction to the basic strokes (stop, draw, follow) and contemporary game forms associated with pocket billiards. Satisfactory-fail only.

Kin 129. Bowling. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 135. Golf. (0-2) Cr. 1. F.S. Beginning skills only. Satisfactory-fail only.

Kin 144. Racquetball. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 153. Ice Skating. (0-2) Cr. 1. Satisfactory-fail only.

Kin 158. Tennis. (0-2) Cr. 1. F.S.SS. Introduction to basic skills (forehand, backhand, service) and basic knowledge of game play. Satisfactory-fail only.

Kin 162. Triathlon Training. (0-3) Cr. 1. F.S. *Prereq: 102 or equivalent skill.* Introduction to the sport of triathlon integrating the discipline(s) of running, cycling, and swimming. Emphasis on cross-training systems and skill enhancement. Satisfactory-fail only.

Kin 163. Physical Fitness. (0-3) Cr. 1. Evaluation of fitness Status. Exercises, activities, and programs to improve physical fitness. Relationship between physical activity and weight control. Credit for only Ex Sp 163 or 258 may be applied toward graduation. Satisfactory-fail only.

Kin 164. Walking for Fitness. (0-3) Cr. 1. F.S. Fitness walking as an activity to improve health and fitness; values of this type of activity as a lifetime endeavor. Satisfactory-fail only.

Kin 166. Weight Training. (0-3) Cr. 1. F.S. Satisfactory-fail only.

Kin 170. Tae Kwon Do/Karate I. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 171. Tae Kwon Do/Karate II. (0-2) Cr. 1. Satisfactory-fail only.

Kin 173. Hap Ki Do/Martial Self-Defense. (0-2) Cr. 1. F.S. Satisfactory-fail only.

Kin 182. Volleyball. (0-2) Cr. 1. Satisfactory-fail only.

Kin 185. Soccer. (0-2) Cr. 1. Satisfactory-fail only.

Kin 220. Basic Athletic Training. (1-2) Cr. 2. *Prereq: Biol 155 or 255 and 256.* Introduction to methods of prevention and immediate care of athletic injuries. Basic information concerning health supervision of athletes, and some basic wrapping and strapping techniques for common injuries.

Kin 221. Pre-Athletic Training Clinical Practicum. (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 222 and permission of athletic training program director.* Athletic training clinical observation experiences to accompany 222. Utilize knowledge to evaluate, analyze and demonstrate appropriate taping, wrapping and basic skill techniques. Open to students interested in the athletic training option. Satisfactory-fail only.

Kin 222. Basic Athletic Training for Athletic Trainers. (2-2) Cr. 3. S. *Prereq: Biol 255, 255L.* Provides pre-athletic training students with the knowledge of the profession of a certified athletic trainer, factors associated with injury prevention, treatment, emergency care of athletic injuries, protective equipment, basic organization, administrative, and legal concepts in the athletic training setting. To be taken concurrently with 221.

Kin 223. Clinical Practicum in Athletic Training. (0-3) Cr. 1. F. *Prereq: Permission of Athletic Training Program Director.* Athletic training clinical experiences for athletic training students during pre-season intercollegiate football. Clinical experiences include: Professional Rescuer CPR, AED certification, emergency splinting and spineboarding, medical record keeping and HIPPA regulations, environmental conditions, prevention of injury screening strategies, athletic training room and education program policies and procedures, review of athletic taping techniques, acute injury management, mouthpiece formation, and anatomy review. Satisfactory-fail only.

Kin 224. Evaluation of Athletic Injuries I. (2-3) Cr. 3. F. *Prereq: Permission of athletic training program director.* Sport injury assessment procedures and evaluation techniques for lower body injuries. Includes an overview of mechanisms of injury, general musculoskeletal disorders, and dermatological conditions. Designed for students in the athletic training option or preprofessional health programs.

Kin 225. Athletic Injuries I Clinical Practicum. (0-3) Cr. 1. F. *Prereq: Permission of athletic training program director.* Athletic training clinical experience to accompany 224. Open to students in the athletic training option. Satisfactory-fail only.

Kin 226. Evaluation of Athletic Injuries II. (2-3) Cr. 3. S. *Prereq: Permission of athletic training program director.* Sport injury assessment procedures and evaluation techniques for upper body injuries. Includes an overview of common illnesses of athletes and sport specific injuries. Designed for students in the athletic training option or preprofessional health programs.

Kin 227. Athletic Injuries II Clinical Practicum. (0-3) Cr. 1. S. *Prereq: Permission of athletic training program director.* Athletic training clinical experience to accompany 226. Open to students in the athletic training option. Satisfactory-fail only.

Kin 230. Fundamentals of Aquatics. (0-3) Cr. 1. S. *Prereq: 101 or equivalent.* Eligibility for admission to Kin teacher education program. Basic water safety and emergency water safety. Skill enhancement, understanding, and progressions.

Kin 231. Fundamentals of Tumbling and Gymnastics. (0-3) Cr. 1. F. *Prereq: Eligibility for admission to Kin teacher education program.* Fundamentals of tumbling and gymnastics apparatus. Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 232. Fundamentals of Indoor Team Sports. (0-3) Cr. 1. S. *Prereq: Eligibility for admission to Kin teacher education program.* Fundamentals of indoor team sports, for example basketball, volleyball, team handball. Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 233. Fundamentals of Outdoor Team Sports. (0-3) Cr. 1. F. *Prereq: Eligibility for admission to Kin teacher education program.* Fundamentals of outdoor team sports, for example flag football, soccer, softball. Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 235. Fundamentals of Racquet Sports. (0-3) Cr. 1. S. *Prereq: Eligibility for admission to Kin teacher education program.* Fundamentals of racquet sports, for example tennis, badminton, racquetball. Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 236. Fundamentals of Individual Sports. (0-3) Cr. 1. F. *Prereq: Eligibility for admission to Kin teacher education program.* Fundamentals of individual sports, for example track and field, golf, archery and bowling. Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 237. Fundamentals of Self-Defense. (0-3) Cr. 1. S. *Prereq: Eligibility for admission to Kin teacher education program.* Skill enhancement, analysis, understanding practice and the development of progressions.

Kin 238. Fundamentals of Outdoor and Adventure Activities. (0-3) Cr. 1. F. *Prereq: Eligibility for admission to Kin teacher education program.* Techniques of individual and group facilitation for initiatives involving outdoor adventure activity. Topics include ropes/challenge course events, activity presentation, and sequencing, safety techniques, preparation principles and new games Philosophy. Participation is required in one weekend of fieldwork.

Kin 240. Introduction to Taping, Equipment, and Bracing Techniques. (0-3) Cr. 1. S. *Prereq: Permission of athletic training program director.* Basic information and laboratory instruction regarding basic taping techniques, athletic equipment fitting procedures, and the use and proper fitting of prophylactic braces. Open to students in the athletic training option. Satisfactory-fail only.

Kin 242. Introduction to the Management of Community and Recreational Sport. (3-0) Cr. 3. F. Introduction to the study of the organization, structure, and management of community-based sport programs and facilities.

Kin 252. Disciplines and Professions in Kinesiology and Health. (2-0) Cr. 2. F.S. Overview of the various disciplines and professions that comprise the field of Kinesiology (the study of human movement) and help students determine the career option that best fits their interests.

Kin 253. Orientation in Kinesiology and Health. (1-0) Cr. 1. S. *Prereq: Concurrent enrollment or credit in 252.* Overview of ISU policies and procedures, academic advising operations, degree requirements, program of study planning, and campus resources. Satisfactory-fail only.

Kin 254. Learning Communities in Kinesiology/Health. (0.5-0) Cr. 0.5. F.S. *Prereq: Concurrent enrollment or credit in 253.* Semester long course for new students in the Kinesiology Learning Community to be taken concurrently with the general orientation class for Kinesiology majors. Students will take field trips and work with faculty, staff and mentors to explore careers in kinesiology and complete assignments related to identification & development of their skills and interests. Required for freshmen only. Satisfactory-fail only.

Kin 258. Physical Fitness and Conditioning. (1-3) Cr. 2. F.S. *Prereq: Kinesiology and health majors only.* Development of personal fitness using a variety of conditioning and exercise techniques such as aerobics, weight training, and aquatic fitness. Introduction to acute and chronic responses to exercise, and the role of exercise in health promotion and weight management. Credit for only one of the following courses may be applied toward graduation: Kin 163, 258.

Kin 259. Leadership Techniques for Fitness Programs. (1-3) Cr. 2. F.S. *Prereq: 258.* Development of exercise leadership skills for a variety of activities. Includes planning, promotion, and teaching techniques for developing fitness in others using a variety of exercise modalities including aerobics, weight training, and aquatic fitness.

Kin 266. Advanced Strength Training and Conditioning. (1-2) Cr. 2. F.S. *Prereq: 258, 259.* This course is designed to enhance the student's current level of knowledge and expertise to an advanced level in the area of strength training and conditioning. The course will prepare students interested in taking the National Strength and Conditioning Association Certified and Conditioning Specialist's exam. The course will focus on the assessment and implementation of training programs with strong emphasis on the areas of resistance training, metabolic training, flexibility, reaction time, speed, and agility.

Kin 280. Directed Field Experience in Elementary Physical Education. (0-3) Cr. arr. S. Observing, planning, and facilitating movement experiences of children in an elementary school setting. Satisfactory-fail only.

Kin 281. Directed Field Experience in Physical Education. (0-3) Cr. arr. *Prereq: Admission to University Teacher Education Program.* Observing, planning, and facilitating movement experiences of students in a public school setting. Satisfactory-fail only.

Kin 284. Elementary and Pre-school Movement Education. (2-3) Cr. 3. F.S.SS. *Prereq: 3 credits in human development and family studies.* Approaches to teaching movement skills to pre-school and elementary school age children. Emphasis on planning and conducting developmentally appropriate movement experiences for preschool and elementary aged children based upon motor development research. Practical experience provided. Credit in only one of the following courses may be applied toward graduation: Kin 284, 312.

Kin 285. Pre-Internship in Kinesiology. Cr. arr. F.S.SS. *Prereq: Kinesiology and Health major and permission of internship coordinator.* Pre-internship experience with a community sport and recreation or health fitness organization. Satisfactory-fail only.

Kin 312. Movement Education in Elementary School Physical Education. (2-3) Cr. 3. S. *Prereq: Concurrent enrollment in 280.* Planning for management and instruction of developmentally appropriate physical education for children pre-school through elementary grade 6. Laboratory experience required. Credit for only one in the following courses can be applied toward graduation: Kin 284, 312.

Kin 315. Coaching Theory and Administrative Issues. (3-0) Cr. 3. S. Study in the theory, ethics, strategy, and mechanics of coaching various interscholastic and/or intercollegiate sports. Emphasis on formulating a Philosophy, identifying goals and psychological aspects, teaching skills, and developing strategies.

Kin 323. Therapeutic Modalities for Athletic Trainers. (2-2) Cr. 3. F. *Prereq: Permission of athletic training program director.* Theory and technique of therapeutic modalities used in the management of injuries.

Kin 324. Therapeutic Modalities Clinical Practicum. (0-3) Cr. 1. F. *Prereq: Permission of athletic training program director.* Athletic training clinical experience to accompany 323. Open to students in athletic training option. Satisfactory-fail only.

Kin 326. Rehabilitation of Athletic Injuries. (2-2) Cr. 3. S. *Prereq: Permission of athletic training program director.* Theory and practical application of rehabilitation principles used in the management of athletic injuries.

Kin 327. Rehabilitation of Athletic Injuries Clinical Practicum. (0-3) Cr. 1. S. *Prereq: Permission of athletic training program director.* Athletic training clinical experience to accompany 326. Open to students in the athletic training option. Satisfactory-fail only.

Kin 331. Youth Sports. (Dual-listed with 531). (3-0) Cr. 3. S. The research findings from non-school related sport programs for children and adolescents and how these impact programs, parents and children including bio-physical, social, psycho-motor and cognitive factors.

Kin 345. Management of Health-Fitness Programs and Facilities. (3-0) Cr. 3. F.S. Application of management concepts to the fitness industry, e.g., understanding customers, marketing, program management, financial management, legal issues, and evaluation and planning.

Kin 355. Biomechanics. (2-2) Cr. 3. F.S. *Prereq: Phys 106 or 111.* Mechanical basis of human performance; application of mechanical principles to exercise, sport and other physical activities. Nonmajor graduate credit.

Kin 358. Physiology of Exercise. (2-2) Cr. 3. F.S. *Prereq: Biol 255, 255L, 256 and 256L.* Physiological basis of human performance; effects of physical activity on body functions. Nonmajor graduate credit.

Kin 360. Sociology of Sport and Exercise. (3-0) Cr. 3. F.S. *Prereq: Soc 134 and one of Stat 101, 104 or 226/326, or Kin 471.* Sport and exercise as social systems and as institutions related to other institutions such as the polity, the economy, mass media, and education.

Kin 365. Sport Psychology. (3-0) Cr. 3. F.S. *Prereq: Psych 101 or Psych 230.* Psychological factors that influence performance in sport settings. The influence of personality, anxiety, motivation, social factors, and psychological skills training.

Kin 366. Exercise Psychology. (3-0) Cr. 3. F.S. *Prereq: Psych 101 or Psych 230.* Psychological theories for understanding and predicting health-oriented exercise behavior. Psychological and psychobiological responses to exercise. Psychological interventions for increasing exercise participation and adherence rates.

Kin 372. Motor Control and Learning Across the Lifespan. (2-2) Cr. 3. F.S. *Prereq: Psych 101 or Psych 230, Biol 255, 256.* Introduction to major concepts of neuromotor control, behavioral motor control and motor learning in the child, adult and older adult, with emphasis on the adult system.

Kin 375. Teaching Physical Education. (2-3) Cr. 3. S. *Prereq: admission to University Teacher Education Program.* Current theory, practice and research on teaching focusing on management, instructional, and learning styles of students in secondary schools.

Kin 385. Search Strategies for Field Experiences and Employment. (Cross-listed with H S). Cr. R. F.S. *Prereq: Junior classification; to be taken minimum of two semesters prior to Kin 485.* Search techniques and preparation of materials utilized for acquisition of jobs and/or internships in kinesiology and health fields. Internship process and policies/procedures will be covered.

Kin 395. Adapted Physical Education. (Dual-listed with 595). (2-3) Cr. 3. F. *Prereq: 375.* Specific disabling conditions in terms of etiology, characteristics, needs, and potential for movement experiences. Techniques of assessment, prescription, adaptation of activities, methods, and program planning. Laboratory experience required. Kin 595 may not be taken by students who have previously earned credit in Kin 395.

Kin 417. Supervised Teaching in Physical Education in the Secondary School. Cr. 8. F.S. *Prereq: 355, 358, 375, 395, 471, 475. Students must be fully admitted to Teacher Education and must apply for approval to enroll at beginning of the semester prior to registering.* Supervised teaching in the secondary schools.

Kin 418. Supervised Teaching in Physical Education in the Elementary School. Cr. 8. F.S. *Prereq: 280, 312, 355, 358, 375, 395, 471, 475. Students must be fully admitted to Teacher Education and must apply for approval to enroll at the beginning of the semester prior to registering.* Supervised teaching in the elementary schools.

Kin 425. Organization and Administration of Athletic Training. (3-0) Cr. 3. F. *Prereq: Permission of athletic training program director, senior classification.* Current administrative, professional, and legal issues pertaining to athletic training. Job search techniques and strategies including preparation of materials for athletic training students.

Kin 442. Sport, Recreation, and Tourism. (3-0) Cr. 3. F. *Prereq: 242, 290; Soc 134.* The role of sport in developing fitness, recreational opportunities, and tourism, with special emphasis on issues related to youth sport, volunteerism, and the marketing of sport events and facilities.

Kin 445. Legal Aspects of Sport. (3-0) Cr. 3. S. Students will understand legal concepts and terminology relevant to sport/activity, identify strategies for limiting liability in sport/fitness programs, and identify solutions for elimination of discriminatory practices in sport and physical activity.

Kin 450. Medical Concerns for the Athletic Trainer. (3-0) Cr. 3. F. *Prereq: Permission of athletic training program director.* Current medical issues and concerns, including pathology of illness and injury, dermatological conditions, exposure to allied health care professionals, and pharmacological indications in relation to the profession of athletic training and in patient/athlete care.

Kin 458. Principles of Fitness Assessment and Exercise Prescription. (3-2) Cr. 4. F.S. *Prereq: 358.* Physiological principles of physical fitness; design and administration of fitness programs; testing, evaluation, and prescription; cardiac risk factor modification.

Kin 459. Internship in Exercise Leadership. (0-3) Cr. 1. *Prereq: C- or better in 259, CPR certification, concurrent enrollment in 458.* Observation and practice of exercise leadership techniques in an on-campus adult fitness program.

Kin 462. Medical Aspects of Exercise. (3-0) Cr. 3. F.S. *Prereq: 358.* The role of exercise in preventive medicine. Impact of exercise on various diseases, and the effect of various medical conditions on the ability to participate in vigorous exercise and competitive sports. Principles of exercise testing and prescription for individuals with these conditions. Environmental and nutritional aspects of exercise.

Kin 471. Measurement in Physical Education. (Dual-listed with 571). (3-0) Cr. 3. S. Study of grading, assessment and evaluation in physical education with a focus on measuring cognitive and psycho-motor achievement.

Kin 472. Neural Basis of Human Movement. (Dual-listed with 572). (3-0) Cr. 3. S. *Prereq: 372 or Psych 310.* Addresses the role of the central nervous system in the control of voluntary human movement, with the focus on the cerebral cortex, basal ganglia and cerebellum. Content organized around specific nervous system damage (such as stroke, apraxia, spasticity, or spinal cord damage) and functional movements (such as reaching and grasping, balance and gait). Converging evidence from human movement disorders, brain imaging, animal lesion and single cell studies provide the primary basis for the content. Nonmajor graduate credit.

Kin 475. Physical Education Curriculum Design and Program Organization. (Dual-listed with 575). (3-0) Cr. 3. F. *Prereq: Admission to University Teacher Education Program.* Current theory, practices and principles applied to curriculum development for programs in physical education, K-12. Organizing for teaching in a variety of school settings.

Kin 480. Functional Anatomy. (3-0) Cr. 3. S. *Prereq: 355; Biol 155 or 255 and 256.* The structure and function of human muscular, skeletal and nervous systems. The relationship of these systems to efficient and safe human motion. Nonmajor graduate credit.

Kin 485. Internship in Sport and Exercise Science. Cr. arr. *Prereq: Senior classification and advance registration.* Observation and practice in selected sport and exercise science agencies. Satisfactory-fail only.

A. Health/Fitness Management. Prereq: C- or better in 458 and 459, Kinesiology and Health majors only. Cumulative GPA 2.0.
B. Sport and Physical Activity. Prereq: Kinesiology and Health majors only. Cumulative GPA 2.0.

Kin 488. Research topics in Athletic Training. Cr. arr. Repeatable. F.S. *Prereq: Permission of athletic training program director.* Clinical experiences in application of athletic training techniques under supervision of certified athletic trainers. Participation in monthly research journal discussion. Satisfactory-fail only.

Kin 489. Review of Athletic Training Competencies and Clinical Proficiencies. Cr. R. F.S. *Prereq: Senior classification, permission of athletic training program director.* Preparation for professional endorsement and certification by review of required competencies and clinical proficiencies. Required for endorsement or approval to sit for Board of Certification Exam. Satisfactory-fail only.

Kin 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits from Kin advanced core and permission of coordinator.* Independent study of problems of areas of interest in exercise and sport science and related areas.
A. Exercise and Sport Science
B. Coaching
H. Honors

Kin 495. Seminar in Exercise and Sport Science. Cr. arr. *Prereq: Senior classification.* Satisfactory-fail only.

Kin 501. Research Methods in Physical Activity. (3-0) Cr. 3. Repeatable. *Prereq: Graduate classification in kinesiology and health.* Methods and techniques used in the design and interpretation of research involving physical activity. Emphasis on styles of writing, library use, and computer applications.

Kin 505. Research Laboratory Techniques in Exercise Physiology. (0-4) Cr. 2. *Prereq: Kin 358 or equivalent course with basic laboratory experience.* Application and use of laboratory research equipment in exercise physiology, including operation, calibration, and use in selected situations.

Kin 510. Advanced Medical Aspects of Exercise. (2-0) Cr. 2. *Prereq: Kin 358.* The role of exercise in preventive medicine. Impact of exercise on various diseases, and the effect of various medical conditions on the ability to participate in vigorous exercise and competitive sports. Principles of exercise testing and prescription for individuals with these conditions.

Kin 512. Methods in Physical Education. (3-0) Cr. 3. S. Study of learning and teaching in physical education for elementary and secondary schools.

Kin 516. Quantitative Analysis of Human Movement. (3-1) Cr. 3. *Prereq: Kin 355.* Application of the principles of mechanics to the analysis of human motion. Investigation of the effects of kinematics and kinetics on the human body with special emphasis on exercise and sport applications. Includes consideration of two-dimensional and three-dimensional imaging techniques and force measurements.

Kin 517. Musculoskeletal Modeling. (3-1) Cr. 3. F. *Prereq: 355 or permission from instructor.* Systematic problem-solving approaches and design of computer programs for biomechanical analyses. Estimation of anthropometric parameters and mechanical properties of muscles, bones, and joints. Integration of anthropometrics, kinematics, and muscle mechanics into simulations of human movement.

Kin 518. Student Teaching in Elementary Physical Education. (0-8) Cr. 8. F.S. *Prereq: 512, 570, 575.* Student teaching for 8 weeks in an elementary school.

Kin 519. Student Teaching in Secondary Physical Education. (0-8) Cr. 8. F.S. *Prereq: 512, 570, 575.* Student teaching for 8 weeks in a middle or high school.

Kin 520. The Social Analysis of Sport. (3-0) Cr. 3. *Prereq: 360; open to majors only or by permission of instructor.* Sociological analysis of sport with emphasis on Sociological theory, sports structure, and function in modern industrialized Society; the systems of sport in regard to their role structure; formal organization, and professionalization and its differentiation along social class, age, and sex.

Kin 521. Advanced Topics in Exercise and Sport Psychology. (3-0) Cr. 3. *Prereq: 365 or 366, 3 courses in psychology; open to majors only or by permission of instructor.* Aspects of psychology which form a basis for understanding and explaining behavior in the context of exercise and sport. Emphasis on evaluating published research, particularly theory and research methodology. Student presentations.

Kin 531. Youth Sports. (Dual-listed with 331). (3-0) Cr. 3. S. The research findings from non-school related sport programs for children and adolescents and how these impact programs, parents and children including bio-physical, social, psycho-motor and cognitive factors.

Kin 549. Advanced Vertebrate Physiology I. (Cross-listed with An S, B M S). (3-0) Cr. 3. F. *Prereq: Biol 335; credit or enrollment in BBMB 404 or 420.* Neurophysiology, sensory systems, muscle, neuroendocrinology, endocrinology.

Kin 550. Advanced Physiology of Exercise I. (2-3) Cr. 3. *Prereq: 505.* Concepts and methods of assessing neurological, muscular, cardiovascular, and respiratory adjustments to exercise.

Kin 551. Advanced Physiology of Exercise II. (2-3) Cr. 3. *Prereq: 505.* Analysis of factors affecting work capacity and performance. Human energy metabolism concepts and measurement.

Kin 552. Advanced Vertebrate Physiology II. (Cross-listed with An S, B M S, NutrS). (3-0) Cr. 3. *Prereq: Biol 335; credit or enrollment in BBMS 404 or 420.* Cardiovascular, renal, respiratory, and digestive physiology.

Kin 558. Physical Fitness - Principles, Programs and Evaluation. (2-3) Cr. 3. *Prereq: Kin 358.* Physiological principles of physical fitness, design and administration of fitness programs; testing, evaluation, and prescription; electrocardiogram interpretation.

Kin 560. Principles of Motor Control and Learning. (2-3) Cr. 3. *Prereq: Kin 372.* Theoretical perspectives of motor control and learning will be examined as well as factors that facilitate motor learning. Motor control and learning will also be addressed by studying functional tasks such as reach and grasp, posture and locomotor, handwriting, catching and/or speech.

Kin 561. Motor Development. (2-0) Cr. arr. *Prereq: Psych 230.* The physical development and characteristic reactions of children in relation to motor performance. Identification of special psychomotor needs of various age groups of children. All literature and theories applied to the physical education environment.

Kin 570. Physical Activity Assessment for Health Related Research. (2-2) Cr. 3. This course will cover the broad scope of research in physical activity and public health. Emphasis will be placed on the application of physical activity assessment techniques since accurate measures are needed to more accurately assess the health benefits from physical activity and to evaluate the effectiveness of behavioral interventions designed to promote physical activity.

Kin 571. Measurement in Physical Education. (Dual-listed with 471). (3-0) Cr. 3. S. Study of grading, assessment and evaluation in physical education with a focus on measuring cognitive and psycho-motor achievement.

Kin 572. Neural Basis of Human Movement. (Dual-listed with 472). (3-0) Cr. 3. *Prereq: Kin 372 or Psych 310.* Addresses the role of the central nervous system in the control of voluntary human movement, with the focus on the cerebral cortex, basal ganglia and cerebellum. Content organized around specific nervous system damage (such as stroke, apraxia, spasticity, or spinal cord damage) and functional movements (such as reaching and grasping, balance and gait). Converging evidence from human movement disorders, brain imaging, animal lesion and single cell studies provide the primary basis for the content.

Kin 575. Physical Education Curriculum Design and Program Organization. (Dual-listed with 475). (3-0) Cr. 3. F. Current theory, practices and principles applied to curriculum development for programs in physical education, K-12. Organizing for teaching in a variety of school settings.

Kin 590. Special Topics. Cr. arr. Repeatable.
A. Physical Education
B. Health and Exercise Promotion
D. Exercise Physiology
E. Sport Sociology
F. Sport/Exercise Psychology
G. Motor Behavior
H. Biomechanics
I. Human Growth and Puberty

Kin 591. Supervised Field Experience. Cr. arr. *Prereq: 10 graduate credits in health and human performance and/or related areas.* Supervised on-the-job field experience in special areas.
A. Physical Education
B. Health and Exercise Promotion
D. Exercise Physiology

Kin 595. Adapted Physical Education. (Dual-listed with 395). (2-3) Cr. 3. F. *Prereq: 375.* Specific disabling conditions in terms of etiology, characteristics, needs, and potential for movement experiences. Techniques of assessment, prescription, adaptation of activities, methods, and program planning. Laboratory experience required. Kin 595 may not be taken by students who have previously earned credit in Kin 395.

Kin 599. Creative Component. Cr. arr. Repeatable.

Kin 615. Seminar. Cr. arr. Repeatable.

Kin 620. Advance Research Methods in Physical Activity. (3-0) Cr. 3. S. *Prereq: 501, Stat 401 and 402. Doctoral students only.* Culminating seminar designed to synthesize Statistical and design courses with practical research issues using data from physical activity.

Kin 699. Research. Cr. arr. Repeatable.

Athletics (Ath)

Courses primarily for undergraduate students

Ath 101. Intercollegiate Athletics. Cr. 1. Repeatable. F.S. *Prereq: Permission of head coach.* Limited to 1 credit per year to a maximum of 4. Credit for a sport section of Ath 101 may not be applied toward graduation if credit is also received for Kin 166 or any skill technique course in the same sport. Satisfactory-fail only.
B. Basketball (men)
C. Basketball (women)
D. Cross Country (men)
E. Cross Country (women)
F. Football (men)
G. Golf (men)
J. Gymnastics (women)
K. Softball (women)
M. Swimming/Diving (women)
O. Tennis (women)
P. Track and Field (men)
Q. Track and Field (women)
R. Volleyball (women)
S. Wrestling (men)
T. Golf (women)
U. Soccer (women)

Dance (Dance)

Dance 120. Modern Dance I. (0-3) Cr. 1. F.S. Introduction and practice of basic dance concepts, including preparatory techniques and guided creativity problems. No previous modern dance experience required. Satisfactory-fail only.

Dance 130. Ballet I. (0-3) Cr. 1. F.S. Introduction to the basic skills, vocabulary, and tradition of ballet with concentration on control and proper alignment. No previous ballet experience required. Satisfactory-fail only.

Dance 140. Jazz I. (0-3) Cr. 1. F.S. Introduction to the modern jazz style with concentration on isolation and syncopation. No previous jazz experience required. Satisfactory-fail only.

Dance 150. Tap Dance I. (0-3) Cr. 1. F. Instruction and practice in basic tap technique and terminology. No previous tap experience required. Satisfactory-fail only.

Dance 160. Ballroom Dance I. (0-2) Cr. 1. F.S. Instruction and practice in foxtrot, waltz, swing, cha cha, rhumba, tango, and selected contemporary dances. Satisfactory-fail only.

Dance 199. Dance Continuum. Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Advance registration required. Continued instruction and practice in either modern dance, recreational dance, ballet, jazz and/or compositional skills. Satisfactory-fail only.

Dance 211. Fundamentals and Methods of social and World Dance. (1-3) Cr. 2. S. Skill enhancement, teaching, progressions with emphasis on world and social dance. Designed for kinesiology and health majors, open to others.

Dance 220. Modern Dance Composition. (1-3) Cr. 2. F. *Prereq: 120 or previous modern dance experience.* Theory and practice of the creative skills involved in solo and small group composition.

Dance 222. Modern Dance II. (0-3) Cr. 1. F. *Prereq: 120 or previous modern dance experience.* Dance techniques emphasizing strength, balance, endurance, rhythmic activity and extended combinations.

Dance 223. Modern Dance III. (0-3) Cr. 1. S. *Prereq: 222.* Continued experience in dance techniques and extended combinations. Emphasis on maturation of skill and artistry. Exposure to a variety of modern dance technical styles.

Dance 224. Concert and Theatre Dance. (Cross-listed with Thtre). (0-3) Cr. arr. Repeatable. F.S. *Prereq: By audition only.* Choreography, rehearsal, and performance in campus dance concerts and/or musical theatre productions. Satisfactory-fail only.

Dance 232. Ballet II. (0-3) Cr. 1. S. *Prereq: Previous ballet experience.* Technical skills in the classical movement vocabulary. Emphasis on alignment, techniques, sequence development, and performing quality.

Dance 233. Ballet III. (0-3) Cr. 1. F. *Prereq: 232.* Concentration on technical proficiency at the intermediate level. Pointe work and partnering opportunities available.

Dance 242. Jazz II. (0-3) Cr. 1. S. *Prereq: Previous jazz dance experience.* Dance concepts within the jazz idiom. Instruction in extended movement sequences and artistic interpretation.

Dance 270. Dance Appreciation. (3-0) Cr. 3. F.S.SS. Introduction to the many forms and functions of dance in world cultures. Develop abilities to distinguish and analyze various dance styles. No dance experience required.

Dance 320. Sound and Movement. (2-2) Cr. 3. S. *Prereq: 220.* Intermediate composition based on the relationship of movement to improvised sounds, rhythmic scores, and the musical works of composers from various periods.

Dance 360. History and Philosophy of Dance. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 270.* Study of the history of dance from early to modern times with emphasis on the theories and Philosophies of contemporary modern dance, dancers, and dance educators.

Dance 370. Advanced Studies in Dance. Cr. arr. Repeatable. F.S. *Prereq: 2 credits in dance.* Advance registration required. Designed to meet special interests and talents of students to include both group and independent study in various aspects of dance as a performing art including production, choreography, and performance.

Dance 384. Teaching Children's Dance. (1-3) Cr. 2. S. Content, experiences, and methods of a comprehensive dance program at the elementary school level. Theories and practice in guiding elementary school children in expressive movement experiences.

Dance 385. Methods of Teaching Dance. (1-3) Cr. 2. F. Methods and techniques of teaching social and world dance forms. Introduction to teaching educational modern dance.

Dance 386. Teaching Dance Technique and Composition. (1-3) Cr. 2. *Prereq: 320.* Teaching of dance as an expressive art form with emphasis on technique, rhythm, and the creative teaching process.

Dance 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in dance and permission of coordinator.* Independent study of problems or areas of interest in dance.

Health Studies (H S)

H S 105. First Aid and Emergency Care. (1-2) Cr. 2. F.S. Discussion and application of the basic techniques of administering first aid and cardiopulmonary resuscitation. ARC certification available.

H S 110. Personal and Consumer Health. (3-0) Cr. 3. F.S. Physical, mental, and social aspects of health as a basis for understanding and preventing health problems. False and misleading advertising and effects of cultists and faddists on consumer health. Study of legislation and agencies concerned with consumer protection and health insurance.

H S 215. Drug Education. (3-0) Cr. 3. *Prereq: Psych 101 or 230.* Use and abuse of mood modifying substances in contemporary Society. Includes study of tobacco, alcohol, and other drugs.

H S 275. Health Education in the Elementary School. (3-0) Cr. 3. *Prereq: HD FS 102 or 226.* An overview of school health services, healthful school living, and health instruction for teachers at the elementary level. Credit for both H S 275 and 375 may not be applied toward graduation.

H S 305. Instructor's First Aid and Cardio-pulmonary Resuscitation. (1-2) Cr. 2. S. *Prereq: 105, current Standard First Aid and Community CPR Certification.* Discussion and practice of skills needed to teach first aid and cardiopulmonary resuscitation. ARC certification available.

H S 310. Community and Public Health. (3-0) Cr. 3. *Prereq: 110.* Introduction to community health problems, programs of prevention, environmental health agencies, and health services. Study of local, state, and national community health agencies, their purposes and functions.

H S 350. Human Diseases. (3-0) Cr. 3. *Prereq: 110 and Biol 255, 256.* Discussion of disease process and ill-health in the twentieth century. Emphasis on epidemiology, prevention, treatment, and the understanding of the etiology of communicable and noncommunicable diseases.

H S 375. Teaching-Learning Process in Health Education. (3-0) Cr. 3. *Prereq: 105, 110, 215.* Principles, methods, materials, and resources involved in the teaching of health. Includes organization and development of the health education curriculum (K-12). Credit for both H S 275 and 375 may not be applied toward graduation.

H S 380. Worksite Health Promotion. (3-0) Cr. 3. *Prereq: KIN 258, 366, FS HN 167.* The design and implementation of worksite health promotion programs and the benefits these programs have for both employees and employers. Review of various health risk appraisals and planning theory-based incentive programs designed to promote positive lifestyles.

H S 385. Search Strategies for Field Experience and Employment. (Cross-listed with Kin). Cr. R. F.S. *Prereq: Junior classification, to be taken minimum of two semesters prior to KIN 485.* Search techniques and preparation of materials utilized for acquisition of jobs and/or internships in kinesiology and health fields. Internship process and policies/procedures will be covered. Satisfactory-fail only.

H S 390. Administration of the School Health Program. (3-0) Cr. 3. F. *Prereq: 310.* History and legal basis of school health programs. Procedures for developing, organizing, administering, and evaluating a modern program of health services, healthful school living, and health instruction. Includes administration, community and school relationships.

H S 417. Supervised Teaching in Health Education in the Secondary School. Cr. 12. F.S. *Prereq: 375.* Advance registration required.

H S 430. Community Health Program Development. (3-0) Cr. 3. F. *Prereq: 380.* Techniques of needs assessment, program design, administration, and evaluation of community health education programs in various settings.

H S 485. Directed Field Experience in Health Education. Cr. arr. *Prereq: All required health studies courses and permission of coordinator.* Advance registration required. Supervised experience in health education. Satisfactory-fail only.

H S 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in health studies and permission of coordinator.*

Landscape Architecture

www.design.iastate.edu/LA/

Douglas Johnston, Chair of Depatment

Distinguished Professor (Emeritus): Dyas

Professors: Anderson, Engler, Hightshoe, Johnston, Keller

Professors (Emeritus): Boon, Harvey, Lane

Associate Professors: Badenhope, Grundmann, Hohmann, Martin, Wagner

Assistant Professors: Rogers, Seeger

Assistant Professors (Adjunct): Kane, M. Miller, Pritchard

Lecturers: Belkacemi, Groe

Undergraduate Study

Landscape architecture is an environmental design discipline. Landscape architects actively shape the human environment: they map, interpret, imagine, draw, build, conceptualize, synthesize, and project ideas that transform landscapes. The design process involves creative expression that derives from an understanding of the context of site (or landscape) ecosystems, cultural frameworks, functional systems, and social dynamics. Students in our program learn to change the world around them by re-imagining and re-shaping the landscape to enhance its aesthetic and functional dimensions, ecological health, cultural significance, and social relevance. The profession addresses a broad range of landscapes in urban, suburban, rural, and wilderness settings. The scale of landscape architecture projects varies from broad, regional landscape analysis and planning to detailed, individual site-scale designs. The curriculum at Iowa State prepares students for this challenge as they develop their abilities to design and communicate ideas through a sequence of foundational courses and studios.

Graduates draw upon scientific and historical/cultural knowledge in applying their creative and technical skills in the planned arrangement of natural and constructed elements on the land with a concern for the stewardship and conservation of natural, constructed, and human resources. The resulting environments serve useful, aesthetic,

safe, and enjoyable purposes. Graduates are able to communicate clearly and work effectively with others on complex land design and planning problems. They understand the ethical, social, and environmental/ecological dimensions of issues involving changes in the landscape.

The curriculum includes one year of the College's core design program followed by a four-year professional program. Admission to the professional program is subject to the approval of a faculty committee at the completion of the preprofessional program. Scholastic performance, aptitude, and personal development are the qualifications considered. The department also cooperates in the undergraduate minor in design studies.

Following admission to the professional program, students embark on the traveling studio during the fall semester of their second year. This studio is a full semester's credit of integrated departmental courses and involves extensive travel within and beyond the great midwest region of North America, to study regional natural systems and the cultural response to those systems.

To enhance the study of landscape architecture in off-campus settings, the department recommends that each student participate in optional College or Department-led international study opportunities such as the Rome or Pacific Rim summer offerings. In addition, the department requires students to choose from among the following three options during the spring and summer of their fourth year: a professional internship, an independent study abroad experience, or National Student Exchange. The department assists students with placement, and additional information through the department and the College of Design's Career Services Office.

Personal laptop/notebook computers and appropriate software are regularly used in classes starting with the second year. Refer to the college for options and recommendations.

The curriculum is accredited by the Landscape Architecture Accreditation Board and provides the education which, combined with experience, is necessary for professional licensure.

For undergraduate curriculum in landscape architecture leading to the degree bachelor of landscape architecture, see *College of Design, Curricula.*

Graduate Study

The department offers opportunities for post-professional study leading to the degree master of landscape architecture. Minor work is offered to students taking major work in other departments.

The M.L.A. degree is granted upon completion of 36 credits and the acceptance of a thesis or creative component. Typically, the program will require four semesters of study for students with a bachelor's degree in landscape architecture. Students with a bachelor's degree in landscape architecture may also enter a special program to earn both the M.L.A. and the master of community and regional planning (M.C.R.P.) degrees in three years. Graduate students who do not possess a bachelor's degree in landscape architecture may complete additional coursework in the fundamental skill areas of the profession. This is accomplished by concurrent enrollment in the undergraduate program to earn the B.L.A. degree before fully engaging in graduate study. The time necessary to earn the B.L.A. in addition to the M.L.A. will vary according to the student's background upon admission. Students interested in the concurrent B.L.A./M.L.A. and double degree M.L.A./M.C.R.P. programs should contact the department to receive a detailed description of requirements.

Graduates have a broad understanding of landscape architecture and related disciplines. They are able to communicate effectively with colleagues in the sciences and/or humanities as well as in the allied professions. Graduates are prepared to work individually and in multidisciplinary teams to address complex problems dealing with the cultural/ecological environment. They are skilled at undertaking research and/or creative activities and communicating the results of these efforts in a concise and persuasive manner. The department participates in the Graduate Certificate Program in Geographic Information Systems (GIS), administered by the Department of Community and Regional Planning.

Courses primarily for undergraduate students

L A 201. Studio: Landscape Interpretation and Representation. (1-15) Cr. 6. F. *Prereq: Enrollment in the professional program.* Reading and representing varied landscapes; development of aesthetic sensitivity to the geomorphology, vegetation and cultural influences on these landscapes. Small scale interventions and exploration of landscape phenomena and change. Emphasis on a variety of documentation and drawing techniques.

L A 202. Studio: Site Design I. (1-15) Cr. 6. S. *Prereq: 201.* Fundamental issues of landscape planning and design at a site scale. Projects introduce a variety of (objective and subjective) site inquiry methods, space and place making, and sensitive integration of architecture and landscape for specific land uses. User needs, precedent study, programming, site engineering, planting design, and outdoor space design expressed through a variety of three-dimensional modeling, graphic, and written media.

L A 221. Native Plants of the Savanna Ecotone. (2-3) Cr. 3. F. *Prereq: Enrollment in the professional program.* Observation and study of the wetland, prairie, and woodland vegetation native to the savanna ecotone. Emphasis on plant communities, their distribution, structure, habitat and aesthetics. Plant identification and use in landscape design. Precedent and case studies of vegetation preservation, restoration and use in built works.

L A 222. Introduced Plants of the Midwest. (2-3) Cr. 3. S. *Prereq: 221.* Identification, observation and study of plants introduced to cultivation in the Midwest region. Plant cultural requirements, including adaptations to climate changes, solar exposure and soil conditions. Investigation of history of plant introduction and use in designed landscape, including consequent impacts of plant introduction such as plant invasion. Introduction to planting design at the site scale, including matching plant cultural requirements to site conditions, functional uses of plants and expressive composition using plant form, texture and color.

L A 241. Developing Identity as a Landscape Architect. (1-0) Cr. 1. F. *Prereq: Enrollment in the professional program.* Designed to accompany L A 201, 221, 272, 281. Development of life skills for conflict resolution, effective interpersonal communication, and CPR/First Aid. Examination of personal values as they relate to the backgrounds, abilities, attitudes, and values of others; exploration of how these influence personal decision-making and group interaction. Reading, discussion, class activities, journal-keeping, writing.

L A 272. Cultural Landscape Studies. (3-0) Cr. 3. F. *Prereq: Enrollment in the professional program.* Exploration of cultural landscapes, from broad settlement patterns to individual sites, with an emphasis on the origins and evolution of landscapes. Investigation of relationships between vernacular and designed landscapes. Landscapes considered as modes of cultural production that shape and are shaped by social, political, and economic processes. Exploration of landscapes as persistent (yet ephemeral) repositories of culture. Lectures, reading, field studies, and writing.

L A 274. The Social and Behavioral Landscape. (Cross-listed with Dsn S). (3-0) Cr. 3. S. Exploration of social and behavioral factors pertinent to design of the domestic, civic, and commercial landscape. Focus on working familiarity with design principles as they relate to the behavior and activities of people across a broad demographic and cultural spectrum; application of these principles to design of outdoor environments. Lectures and discussions, including group exercises and field trips.

L A 281. Investigating Landscape form, Process, and Detail. (1-6) Cr. 3. F. *Prereq: Enrollment in professional program.* Exploration of the poetics and principles of landscape construction. Investigation and interpretation of landform and geomorphic processes such as the hydrologic cycle, erosion, and sedimentation. Close observation and representation of detail design, with an emphasis on material types, their connections and weathering. Readings, field studies, and drawings.

L A 285. The National Parks: Culture and Nature. (Cross-listed with NREM). (2-0) Cr. 2. Alt. F., offered 2010. Reviews cultural setting for park establishment and management, ideas about wilderness, and Philosophy of parks as types of land use. History of landscape architecture in the National Park Service, the development of American parks, the history of park wildlife management and nature interpretation. Recent initiatives in ecosystem management, community conservation, and international points of comparison. Readings, discussion, exercises.

L A 301. Site Design II. (1-15) Cr. 6. F. *Prereq: 202.* Development of half-acre to hundred-acre landscape design and planning proposals. Apply critical methodological frameworks to shape site systems while providing appropriate support for diverse user groups and creating culturally meaningful places. Assess and interpret a program of use, organize subjective and objective site inventory and analysis, develop functional and poetic design strategies for infrastructure and natural systems, and craft artistic and functionally explicit landscape architectural proposals. Development of appropriate technique and high level of craft in representations to support design thinking process and final scheme presentation.

L A 302. Ecological Design at the Regional Scale. (1-15) Cr. 6. S. *Prereq: 301, 381, 465 and Agronomy 156.* Application of ecological theories and processes in design and planning at the hundred plus-acre scale specifically focusing on urban and urban fringe landscapes. Apply advanced landscape analysis of soil, water, and vegetation utilizing geographic information systems. Particular focus on stream and wetland restoration, mitigation, and regulations and developing design representations for public use.

L A 309. Field Travel. Cr. 1. Repeatable. F.S.SS. *Prereq: Enrollment in the professional program and permission of instructor.* Observation of professional practice and landscapes in urban, rural, and wilderness areas. Satisfactory-fail only.

L A 322. Fundamentals of Planting Design. (2-6) Cr. 4. Alt. F., offered 2009. *Prereq: 221.* The art and techniques of creating plant compositions in the landscape that respond to cultural and biophysical contexts. Investigation of soil properties and plant/soil relationships relevant to the built environment. Methods of site inventory and analysis, developing plant palettes and composing plant assemblages that address expressive and functional needs. Introduction to the techniques of preparing planting plans, including standards for plant selection, plant lists and plant specification.

L A 341. Contemporary Landscape Architecture. (1-0) Cr. 1. S. *Prereq: 301.* Exploration of contemporary landscape architecture practice through individualized research into practicing firms. Preparation of paper and presentation outlining broad framework and specific parameters of a selected area of contemporary practice using specific projects as examples. Work may result in invitation of current practitioner(s) as a lecture series or event. Resume and portfolio preparation in advance of required off-campus semester (L A 451 A, B or C).

L A 371. Landscape Architectural History: 1750 to Present. (Cross-listed with Dsn S). (3-0) Cr. 3. S. Investigation of landscape design concepts and trends as observed over time, from approximately 1750 to the present, with emphasis on the United States and Europe. Examination of significant figures and outstanding works (sites, gardens, landscapes, monuments, subdivisions, city plans, etc.) of varied geographic regions. Analysis of the social, economic, political, and technical forces contributing to the development of landscape design styles, vocabulary, and literature. Lectures, readings, projects, research papers.

L A 373. Landscape Architectural History: Prehistory to 1750. (Cross-listed with Dsn S). (3-0) Cr. 3. F. Investigation of international landscape design concepts and trends as observed over time, from pre-history to the mid 18th century. Examination of significant figures and outstanding works (sites, gardens, landscapes, monuments, subdivisions, city plans, etc.) of varied geographic regions. Analysis of the social, economic, political, and technical forces contributing to the development of landscape design styles, vocabulary, and literature. Lectures, readings, projects, research papers.

L A 381. Shaping the Land. (3-0) Cr. 3. F. *Prereq: 281, Math 141.* Manipulation of the land form and its change through the use of contour maps and models. Transformation of the landform and its implications on the surrounding environment. Surface drainage and storm water runoff calculations, contour manipulation to insert swales, channels, ditches, walls, walks, steps, terraces, buildings, road layout and alignment and other constructed elements. Class exercises, case study precedents, and preliminary construction documents.

L A 401. Community Design. (1-15) Cr. 6. F. *Prereq: 402.* Design of urban and/or rural places utilizing participatory methods and techniques. Projects address midwestern community issues including reuse of abandoned sites, in-fill, recreation, and peri-urban agriculture. Emphasis on development of user-client relationship skills and design research.

L A 402. Urban Design. (1-15) Cr. 6. F. *Prereq: 302.* Comprehensive planning and design for urban Sites or for sites within urban contexts. Projects typically include planning for a variety of integrated land uses, and cover the full range of design scales from master planning to proposals for site details. Emphasis on written and verbal as well as graphic communications. Integrated seminar component.

L A 403. Senior Thesis Preparation Tutorial. Cr. 2. F. *Prereq: 402, permission of thesis advisor, enrollment in Honors program.* Preparation for senior thesis.

L A 404. Advanced Landscape Architectural Design. (Cross-listed with Dsn S). (1-15) Cr. 6. Repeatable. S. *Prereq: L A 401.* Advanced forum for the demonstration of sophistication in landscape architectural design. Experimentation and innovation are encouraged.

L A 405. Senior Thesis. (0-15) Cr. 6. S. *Prereq: 401, 402, 403, and enrollment in Honors program; permission of advisor, chair and thesis advisor.* Individual advanced forum for the demonstration of sophistication in landscape architectural design. Experimentation and innovation are expected.

L A 421. Advanced Planting Design. (2-6) Cr. 4. Alt. S., offered 2011. *Prereq: 221, 222 or equivalent.* Introduction to the theory and practice of planting design, with emphasis on the ecological, cultural and aesthetic factors affecting planting design and vegetation management in the built environment. Three venues for collaborative learning form the basis of the course: topical research inquiry, case history investigation and completion of one comprehensive project design.

L A 441. Professional Practice. (2-0) Cr. 2. S. *Prereq: 481.* Studies of conventional and developing forms of public and private practice. Explore relationships between professional life and the culture of the professional design firm; investigate firm identities and structures; understand design projects, their delivery process, and contractual agreements. Lecture and class discussion.

L A 451. Landscape Architecture Professional Internship, Study Abroad, or National Student Exchange. Cr. R. Repeatable. F.S.SS. *Prereq: L A 341, permission of adviser and chair.* Independent educational enrichment through exploration of landscape architectural practice in a professional internship (451A), international studies (451B), or out-of-region national study experience (451C)
A. Professional Internship.
B. Study Abroad.
C. National Student Exchange.

L A 461I. Introduction to GIS. (Cross-listed with la LL, EnSci, Env S). Cr. 4. SS. Descriptive and predictive GIS modeling techniques, spatial Statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management. Nonmajor graduate credit.

L A 465. Landscape Change and Conservation. (Dual-listed with 565). (Cross-listed with NREM). (3-0) Cr. 3. F. *Prereq: 202.* Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

L A 478. Topical Studies in Landscape Architecture. (Dual-listed with 578). (Cross-listed with Dsn S). Cr. arr. Repeatable. F.S.SS. *Prereq: L A 371 or senior classification or graduate standing.* Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.
A. Landscape Design
B. Planting Design
C. Construction
D. History/Theory/Criticism
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social/Behavioral
N. Natural Resources

L A 481. Landscape Construction. (1-4) Cr. 3. F. *Prereq: 381.* Development of construction details with emphasis on materials and their aesthetic and functional uses as building materials. Explore characteristics and uses of construction materials; investigate structural theory; application of wood systems, paving systems, retaining walls, masonry and concrete systems, and metals. Preliminary preparation of construction documents.

L A 482. Advanced Landscape Construction. (1-4) Cr. 3. S. *Prereq: 481.* Advanced site construction issues, with emphasis on water and irrigation systems, mechanical and electrical systems, site lighting, proposal preparation, project scheduling, project costing and estimating. Final construction document preparation including drawings and specifications.

L A 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on required form.* Investigation of a topic of special interest to the student.
A. Landscape Design
B. Planting Design
C. Construction
D. History
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social/Behavioral
N. Natural Resources

Courses primarily for graduate students, open to qualified undergraduate students

L A 501. Landscape Architectural Theory. (3-0) Cr. 3. S. *Prereq: Admission to graduate program or permission of instructor.* Exploration of major theories of landscape architectural design and their relationships to broader cultural and theoretical practices. Examination of key texts and projects in landscape architecture, architecture, art, and related fields. Emphasis on developing critical ways of analyzing ideas. Lectures, readings, discussion, and writings.

L A 541. Principles of Research for Landscape Architects. (3-0) Cr. 3. F. *Prereq: Admission to graduate program or permission of instructor.* Examination of design inquiry and research methods appropriate to landscape architectural projects, including bibliographical, historical, numerical, statistical, survey, and geographical methods. Readings, discussions, and application problems. Preparation of a research proposal.

L A 562. Studio in Resource Conservation and Management. Cr. arr. Repeatable. S. *Prereq: 465 or 565, admission to graduate program or permission of instructor.* Developing plans and policies that feature ecological landscape description, planning, and resource conservation. Hands-on field experience with professional resource planners and managers. Contact hours (1-3) to (1-15) depending on number of credits.

L A 565. Landscape Change and Conservation. (Dual-listed with 465). (Cross-listed with NREM). (3-0) Cr. 3. F. *Prereq: 202.* Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

L A 567. Advanced GIS Landscape Modeling. (0-6) Cr. 3. *Prereq: 302 or C R P 451/551.* Application of Geographic Information Systems (GIS) modeling techniques to landscape planning and management issues. Selection, acquisition, and conversion of digital landscape data. Modeling applications for studio projects, outreach projects, and research projects.

L A 572. Landscape Architectural History and Preservation. (3-0) Cr. 3. F. *Prereq: Admission to graduate program or permission of instructor.* Methods applied to preservation of historic landscapes, including current federal standards and regulations. Outstanding historic landscapes and recent landscape preservation projects of varied time periods and scales used to familiarize students with methods of archaeological and documentary research, Philosophical issues of significance and interpretation, and technical concerns of treatment, management, and maintenance. Lectures, readings, discussion, and independent and group research.

L A 578. Topical Studies in Landscape Architecture. (Dual-listed with 478). (Cross-listed with Dsn S). Cr. arr. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing.* Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.
A. Landscape Design
B. Planting Design
C. Construction
D. History/Theory/Criticism
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social/Behavioral
N. Natural Resources

L A 580. Thesis, Creative Component Tutorial. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of major professor.* Hands-on participation in a creative or research activity in the student's area of specialization. Development of a detailed prospectus that defines the thesis or creative component.

L A 582. Research Colloquium. (1-0) Cr. 1. Repeatable. F. *Prereq: Admission to graduate program or permission of instructor.* Examination and discussion of professional practice, research in landscape architecture, and environmental planning through research and projects by faculty and graduate students in landscape architecture and related fields.

L A 590. Special Topics. Cr. arr. Repeatable. F.S.SS.
A. Landscape Design
B. Planting Design
C. Construction
D. History
E. Landscape Planning
F. Urban Design
G. Graphics
H. Honors
I. Interdisciplinary Studies
J. International Studies
K. Computer Applications
L. Ecological Design
M. Social/Behavioral
N. Natural Resources

L A 591. Environmental Law and Planning. (Cross-listed with C R P, Dsn S). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

L A 599. Creative Component. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of major professor.* Comprehensive study and original development of a project selected by the student and approved by the major professor. Completed project must be submitted to and approved by a graduate faculty committee as evidence of mastery of the principles of landscape architecture.

Course for graduate students, major or minor

L A 699. Thesis Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of major professor.*

Liberal Arts and Sciences Cross-Disciplinary Studies

Zora D. Zimmerman, Associate Dean for Academic Programs

Cross-disciplinary studies in the College of Liberal Arts and Sciences encompass a variety of interdisciplinary and cross-disciplinary areas of study as well as courses that cross established departmental lines. Students may enroll in Program courses; declare majors or minors where offered, or develop an Interdisciplinary Studies major built upon Program offerings. (see Index for Program courses).

Cross-Disciplinary Programs

African American Studies Program (Minor only) see *Index, African and African American Studies.*

American Indian Studies Program (Minor only) see *Index, American Indian Studies.*

Biological/Premedical Illustration Program (Major or minor) see *Index, Biological/Pre-Medical Illustration.*

Classical Studies (Minor only)
see *Index, Classical Studies.*

Communication Studies (Major or minor)
see *Index, Communication Studies.*

Criminal Justice Studies (Minor only) see *Index, Criminal Justice Studies.*

International Studies Program (Second major or minor) see *Index, International Studies.*

Latino/a Studies, U.S. Program

Program Director: H. Avalos

U.S. Latino/a Studies is devoted to the study of Mexican Americans, Puerto Ricans, Cuban Americans and other groups of people living in the United States who trace their ancestry to the Spanish-speaking countries of Latin America, and who comprise the fastest growing ethnic groups in America. U.S. Latino/a Studies is to be distinguished from Latin American Studies, which focuses on people living in Latin America. The methodology of U.S. Latino/a Studies is cross-disciplinary, drawing from the methods established inanthropology, sociology, political science, economics, history, literary studies, and other fields.

In addition to the general requirements of a major in Interdisciplinary Studies, (see Index, Interdisciplinary Studies) a major in Interdisciplinary Studies focusing on U.S. Latino/a Studies would require the completion of 24 credits. At least 15 of the 24 credits must be in courses numbered 300 and above. These 24 credits in the major focusing on U.S. Latino/a Studies must include the following courses, each of which is worth three credits: LAS 211 (Introduction to U.S. Latino/a Studies), Anthr 323 (Peoples and Cultures of Latin America), Engl 344 (U.S. Latino/a Literature); Hist 441 (History of Mexico and Central America) or a course in U.S. Latino/a history, Relig 338 (The Latino/a Religious Experience), and Soc 332 (The Latino/a Experience in U.S. Society). The student must have an average grade of C in the required courses of the major. Fulfillment of the foreign language requirement with Spanish is strongly recommended, but not required. For a list of other eligible courses and more information on the U.S. Latino/a Studies Program, contact the program committee chair.

Linguistics Program (Major or minor; graduate minor) *see Index, Linguistics.*

Speech Communication Program (Major or minor) see Index, Speech Communication.

Teacher Education Program
see Index, Teacher Education, Courses and Programs.

Technology and Social Change (Minor, graduate minor) *see Index, Technology and Social Change.*

Women's Studies Program (Major or minor)
see Index, Women's Studies.

Interdepartmental Degree Programs

(Administered by the College of Liberal Arts and Sciences)

Bioinformatics and Computational Biology (Major only) *see Index, Bioinformatics and Computational Biology.*

Emerging Global Disease (Minor only)
see Index, Emerging Global Disease.

Entrepreneurial Studies (Minor only)
see Index, Entrepreneurial Studies.

Environmental Science (Major or minor)
see Index, Environmental Science.

Environmental Studies (Secondary minor or major) *see Index, Environmental Studies.*

Gerontology (Minor only)
see Index, Gerontology.

The Honors Program in Liberal Arts and Sciences *see Index, Honors Program.*

Interdisciplinary Studies Program (Major only) *see Index, Interdisciplinary Studies.*

Premedical and Preprofessional Health Programs *see Index, Preprofessional Study.*

Teacher Education Program *see Index, Teacher Education, Courses and Programs.*

Certificate Programs

Community Leadership and Public Service (Certificate Only)
Interdisciplinary undergraduate program
Dianne Bystrom, Director

This interdisciplinary certificate program utilizes university courses offered in a variety of academic disciplines to provide a strong foundation and appropriate experiences for undergraduate students who plan to become community leaders and engage in public service—regardless of their profession—in the public, nonprofit or private sectors.

The program requires the completion of 21 credits through three, three-hour core required courses in leadership, speech communication and public administration; a three-hour elective course in communication; six hours of elective courses in leadership; and a three-hour capstone experience through a course, internship or study abroad experience.

The certificate will be awarded by the College of Liberal Arts and Sciences. Completion of the certificate will be noted on the student's transcript and via a certificate provided by the Registrar.

Objectives:
- Provide opportunities for students to learn about leadership and organizational theories, ethics and decision-making, principles of public service, effective communication, leadership practices in groups and organizations, and diversity issues.
- Develop leadership skills—including written and oral communication, creative thinking, personal management, group and organizational effectiveness, and problem-solving—important to students' careers, communities and personal development.
- Bring students into contact with faculty members from diverse academic departments, backgrounds and leadership experiences.
- Prepare students to undertake leadership roles in their careers and in service to their community through course work and co-curricular activities.

Learning outcomes:
Upon completion of the Certificate in Community Leadership and Public Service, students will:
- Demonstrate understanding of key concepts of leadership theories and effective practices within groups and organizations and diverse communities.
- Demonstrate understanding of key concepts of organizational theories, ethics and principles of public service.
- Demonstrate proficiencies in written and oral communication.
- Demonstrate awareness of cultural values and diversity issues as they pertain to community leadership and public service.
- Become engaged citizens through service to the university and larger community.

General requirements:
The Certificate in Community Leadership and Public Service requires 21 credits. At least 9 credits must be taken in courses numbered at the 300 level or above. At least 9 credits used for the certificate cannot be used to meet any other department, college or university requirement for the baccalaureate degree except to satisfy the total credit requirement for graduation and to meet credit requirements in courses numbered 300 or above. Courses for the certificate cannot be taken pass-fail. A cumulative grade point average of at least 2.0 is required in courses taken for the certificate.

The 21 credits required for the certificate are fulfilled by:

• 9 credits of core required courses—LAS 222, Leadership Styles and Strategies in a Diverse Society, 3 credits; Sp Cm 312, Business and Professional Speaking, 3 credits; and Pol S 371, Introduction to Public Administration, 3 credits.
• 3-credit communication course chosen from the designated list.
• 6 credits of leadership courses chosen from the designated list.
• 3 credits of a capstone course or experience, which can be fulfilled by a 3-credit course from the list of approved capstone courses, or a 3-credit internship with a community leadership or public service focus, or a 3-credit study abroad experience. Capstone courses focus on the scholarship of leadership in particular fields of study whereas an internship or study abroad provides a leadership-in-practice experience.
Required courses (9 credits): LAS 222, Sp Cm 312, Pol S 371.

Additional communication course (3 credits), from: Engl 302, 309, 412; Jl MC 305; Sp Cm 212, 322, 323,327

Additional leadership topic courses (6 credits), from: AESHM 287, 379; A E/C E/E E 388; AgEds 315; Con E 380; C R P 291, 293 332. 425, 429, 435, 455, 481, 484, 491, 492; Engr 150, 327X, HD FS 395, 445; LAS/W S 333; LAS 381; M E 412; M E/Hist 488; Mgmt 371, 419, 472; Pol S 310, 311, 344, 385, 413. 477, 480, 487; Soc 310, 334, 420, 435; Sp Cm 416, 417; U St 170; W S 301, 435

Capstone Course, Internship or Study Abroad (3 credits), from: AESHM 421, C R P 432, 475; Engl 418; HD FS 449; LAS/W S 488; M E/WLC 484; Pol S 475, Psych 450, Soc 464

Instead of a capstone course, students may complete a 3-credit internship. The internship must have a public service or community leadership focus and must be approved by the department of the student's major and the Community Leadership and Public Service Advisory Committee. Information on internships is available through the participating colleges and departments, including career services offices. Examples: LAS 380, 382, 490G, 491, 499; Pol S 499; W S 491.

Instead of a capstone course or internship, students may participate in a study abroad experience that includes 3 hours of credit. The study abroad experience must include a public service or community leadership focus. It must be approved by the student's major department and by the Community Leadership and Public Service Advisory Committee. Information is available through the ISU Study Abroad Center and international programs offices in the participating colleges and departments. Examples: International Leadership Seminar in Sydney, Australia; International Leadership in Educational Technology Academy in Spain and England; International Partnership for Service Learning and Leadership; College of Design Programs in Rome: Community and Regional Planning; LAS 395, Interdisciplinary Study Abroad Series.

Additional courses may be proposed and approved for inclusion in the list of communication, leadership and capstone courses applicable to the certificate program. Students and advisers should contact the Carrie Chapman Catt Center for Women and Politics, 309 Catt Hall, 294-3181, cattcntr@iastate.edu, www.las.iastate.edu/Catt-Center/ for the current list of courses.

Application and selection process: Enrollment is limited to 20 entering students per academic year, with applications reviewed twice each year. Selection will be based on current and past leadership experiences; previous leadership education and training; academic performance; and, most important, how completion of the certificate program will add value to the student's major/minor areas of study and future leadership goals.

Applicants should meet with their adviser on course planning and questions regarding prerequisites and then submit an application packet consisting of a Application for Admission form, Leadership Involvement Worksheet, and Proposed Program of Study form (signed by the adviser) by March 1 or October 1 to the Community Leadership and Public Service Advisory Committee, 309 Catt Hall, Iowa State University, Ames, IA, 50011-1305. The committee will be comprised of one representative each from the Catt Center, Public Policy and Administration, Speech Communication and Student Affairs and one representative from another participating department.

Latin American Studies (Certificate only)
(Interdepartmental undergraduate program)
Kathy S. Leonard, Director

The certificate in Latin American Studies is a cross-disciplinary course of study in the College of Liberal Arts and Sciences and is designed for undergraduates in any major who wish to enhance their degree and employment possibilities by adding expertise in Latin America and linguistic competence in a primary and secondary foreign language.

Completion of the Certificate is noted on the student's transcript, and via a Certificate provided by the Registrar

Objectives:
• Provide opportunities for students to develop skills and understanding about issues concerning Latin America by bringing them into contact with faculty members from many different academic backgrounds
• Provide students with an international immersion experience where they gain cultural awareness and sensitivity
• Prepare students for work or advanced study in Latin America, such as in foreign service, journalism, advocacy organizations, scientific or research institutions
• Help students acquire proficiency in at least two of the languages of Latin America (Spanish and Portuguese)
• Guide students in interdisciplinary study leading to an understanding of the multi-faceted picture of the past, present, and future of Latin America
Learning Outcomes:
Upon Completion of the Certificate in Latin American Studies, students will be able to:
• Demonstrate understanding of key concepts pertaining to Latin American cultural, historical and political events
• Understand, interpret and articulate the major processes, theories and problems of selected contemporary and historical issues in Latin America
• Demonstrate oral, aural, and written proficiency in a primary foreign language (Spanish or Portuguese) equivalent to the mid advanced level
• Demonstrate oral, aural, and written proficiency in a secondary foreign language (Spanish or Portuguese) equivalent to the low Intermediate level
• Effectively communicate with persons of Latin American cultures
• Become effective global citizens through knowledge and comparison of the cultures and issues of the United States and Latin American countries
• Be able to read Latin American cultural, literary, and historical texts in the target language with comprehension and analytical insight
• Demonstrate awareness of cultural values, beliefs, and ideologies of the various Latin American countries
• Demonstrate a thorough knowledge of the geography of the Latin American countries
General Requirements:
Requirements for the Certificate in Latin American Studies are satisfied through formal language instruction and by completing a minimum of 24 credits at the 300 level or above. Students will take coursework in at least four different disciplines and departments (Spanish, Portuguese, Anthropology, and Political Science) with other possible course offerings in LAS, History, Agriculture, and Agronomy.

Course Requirements:
Students will complete 12 credits of core courses: Pol S, 343, Anthr 323

(Should one of the above courses not be offered, students should consult the adviser to find an appropriate substitute).

Choice of one of the following 3 –credit courses: Span 332, 333

Choice of one of the following 3- credit courses: Anthr 337; Span 324, 322

Other Requirements:
Students will complete an additional 12 credits selected from the approved list of courses in Latin American Studies at the 300 level or above. At least one of these courses must be at the 400 level and approved by the Latin American Studies Program adviser.

• In order to stress the interdisciplinary aspect of the Certificate no more than three courses from one single department will count toward the Certificate.
•No more than 3 credits may be taken as a 490, independent study, and the topic must deal with Latin America.
• A minimum of 12 credits applied toward the Certificate cannot be used to meet any other departmental, college, or university requirement.
• Students may receive credit on a pre-approved basis for internships completed in Latin America. No more than 3 credits from this area may be applied to the Certificate.
• Courses taken for the Certificate may not be taken on a pass not-pass basis.
• Credits for a Certificate may be used to satisfy the credit requirement for graduation and to meet the credit requirements for courses numbered 300 and above.
• A certificate is not awarded if the baccalaureate degree is not finished.
• for students earning an ISU baccalaureate degree, a certificate is awarded concurrent with or after the ISU baccalaureate degree.
• After receiving a baccalaureate degree from any accredited institution, a student may enroll at ISU to earn a certificate.
• A cumulative grade point average of at least 2.00 is required in courses taken at ISU for a certificate.
Language Requirement:
• The minimum requirement in formal language instruction is completion of two years or the equivalent of a primary language (Spanish or Portuguese) at the university level. At ISU the completion of 202 in the appropriate language satisfies this requirement.
• Students are required to take at least one year or the equivalent of a secondary language (Spanish or Portuguese) at the university level. At ISU the completion of 102 or 112 in the appropriate language satisfies this requirement.
• Native speakers, or those with in-field experience of another Latin American language with a level equivalent to 202 can have the primary language requirement waived. Equivalence will normally be assessed

by a faculty member/CLEP exam in the Dept. of World Languages and Cultures.
•While students are encouraged to enroll in language instruction courses (i.e., conversation and composition) above the 300 level, no more than 6 credits of language study (301,303, 304) may be applied toward fulfilling language requirements for the Certificate. Students should be aware that all 300-level literature and culture/civilization courses in the Dept. of World Languages and Cultures have pre requisites such as Spanish 303 and 301.

Study Abroad

Students are required to participate in an ISU-approved study abroad program in a Latin American country with a minimum duration of 4 consecutive weeks. The Study Abroad Office has a list of ISU-approved programs. Students may elect to participate in other study abroad programs with the approval of the Latin American Studies Program Advisory Committee.

Approved courses available toward the Certificate:

The decision as to whether or not a class can be counted toward the Certificate is based primarily on the course title and description as it appears in the ISU General Catalog. Courses which deal primarily with Hispanic or Latina/o cultures in the U.S. will not count towards credit for the Certificate in Latin American Studies. Courses which primarily deal with Spain or Portugal and their cultures also do not count toward the certificate. When in doubt students should consult with the Director of the Latin American Studies Program.

AgEds 496 (3 cr.); Agron 496; Anthr 323, 337, 445/545 3 cr.); Hist 340, 341, 441, 442; IntSt 420; LAS 320, 395; Port 370; Pol S 343; Span 322, 324, 326, 332, 333, 370, 395, 445, 463, 499 (3 cr.)

Note: Study Abroad courses must be in Latin America. No more than 6 credits from each study abroad program may apply to the Certificate.

Courses primarily for undergraduate students

LAS 101. Orientation for Open Option and Preprofessional Students. (1-0) Cr. 0.5. F.S. First 8 weeks. Self-responsibility and university procedures. LAS general education requirements, ISU departments and programs, time management, academic study skills, adjustment to the university environment. Required of all first year students in the Open Option and Preprofessional Health Programs. Satisfactory-fail only.

LAS 103. Frontiers of the Discipline. (1-0) Cr. 1. *Prereq: First-year student.* Seminar focusing entirely on the on "cutting edge" research activities of faculty members. Satisfactory-fail only.
A. General
B. Humanities
C. Communication.
D. Mathematics and Natural Sciences
E. Social Sciences

LAS 104. Personal Career Development. (2-0) Cr. 2. F.S. *Prereq: 12 credits of ISU coursework.* Comprehensive approach to personal career development; intensive self-analysis; utilization of a computerized career exploration system; contact with area professionals; examination of work in modern Society and the impact of technology on the future of work; exposure to job search skills necessary for career choice implementation.

LAS 125. Connections. (1-0) Cr. 1. Links a large lecture class with a small learning community / seminar session led by the same faculty member teaching the lecture. In each case the professor teaching the large lecture will facilitate a small weekly seminar. The seminar is designed to explore the connections between the lecture topic and issues and areas beyond the lecture discipline. Features informal discussions about critical issues of the day through films, public lectures and other events which students and the faculty leader attend. At the end of the semester all of the Connections seminars will have a joint event in conjunction with an exhibit at the Brunnier Museum entitled Shattered Earth.
A. General
B. Humanities
C. Communication.
D. Mathematics and Natural Sciences
E. Social Sciences

LAS 140. Advancing Citizenship Together Learning Community Seminar. (1-0) Cr. 1. Repeatable. Fowler. First semester of required seminar for participants in the ACT (Advancing Citizenship Together) Learning Community. Build citizenship skills with a focus on womens issues and politics, and includes a service-learning component. Linked with Introduction to Women's Studies and Speech Communication classes. Satisfactory-fail only.

LAS 160. Intro to Race and Ethnicity in America. (3-0) Cr. 3. *Prereq: Permission of Instructor.* One of two courses linked with the Multicultural Learning Community (MLC). Concepts and methods employed in understanding the social and cultural experiences of the major ethnic minority groups in the U.S. with explorations primarily of Native, African, Latino, and Asian Americans

LAS 161. Studies in Race and Ethnicity in America. (1-0) Cr. 1. *Prereq: 160. Permission of Instructor.* Second of two courses linked with the Multicultural Learning Community (MLC). Application of concepts and methods to understanding the social and cultural experiences of the major ethnic minority groups in the U. S. with explorations of Native, African, Latino, and Asian.

LAS 211. Introduction to U.S. Latino/a Studies. (3-0) Cr. 3. S. A survey of the people in the United States who trace their origin to the Spanish-speaking countries of Latin America, focusing principally on Mexican Americans, Puerto Ricans, and Cuban Americans. History, religion, social structure, political participation, literature, and other aspects of each group within the framework of various Sociological theories of ethnic identity and relationship.

LAS 222. Leadership Styles and Strategies in a Diverse Society. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification.* Develop and practice leadership skills through understanding personal leadership styles, leadership theory and communication theory, including how they relate to gender issues and cultural diversity; exploring personality types, communication styles, and leadership styles, networking and developing mentoring relationships; setting goals and participating in leadership opportunities and service.

LAS 250. Cultures in Transition. (3-0) Cr. 3. An interdisciplinary introduction to a world region in a state of rapid social and cultural transition. Discussion of the history, social and political institutions, arts, economy, agriculture, and environment of the new nations.

LAS 290. Special Problems. Cr. arr. Repeatable. F.S.SS. *Prereq: Freshman or sophomore classification; Permission of the director of the Catt Center for LAS 290G.: other topics need: permission of the dean of the College of Liberal Arts and Sciences..*
A. LAS Ambassadors.
B. Advising Project.
C. Pre-Law Project.
D. General.
G. Catt Center Project.

LAS 298. Internship/Co-op. Cr. R. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services; sophomore classification.* Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student Status. Satisfactory-fail only.

LAS 325. Introduction to Asian American Studies. (3-0) Cr. 3. A survey of the peoples in the United States who trace their origins to Asia, focusing primarily on the experiences of Chinese, Japanese, Korean, Filipino, South Asian and Pacific Islander Americans. Study and discussion of history, culture, literature, social relations, and political participation of these groups, with assigned readings, writings, and in-class presentations.

LAS 333. Women and Leadership. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification.* Examine historical and contemporary barriers to and opportunities for women's leadership in a variety of contexts, including professions and public service. Examine theories of women's leadership, gender differences in leadership styles, and the perceptions and expectations about women's leadership. Multiple perspectives of women's leadership will be highlighted through lectures, readings, videos, guest speakers and group work.

LAS 350. Topics in Interdisciplinary Studies. (3-0) Cr. arr. Repeatable.
A. Interdisciplinary
B. Humanities
C. Mathematics and Nature Science
D. Social Sciences

LAS 381. Life in Iowa Seminar: Place and Purpose. (3-0) Cr. 3. F.S. Study of Midwestern culture and environments with emphasis on Iowa. Students will reflect on personal identity, vocation, and other life choices in relation to sustainable communities and natural landscapes. Writing intensive.

LAS 385. The Holocaust. (2-0) Cr. arr. F. An examination of the religious, social, scientific, and historical contexts for the Nazi destruction of European Jewry. Topics covered include anti-semitism, German volkish philosophy, eugenics, World War II, the Final Solution, rescuers, and contemporary issues. Optional third credit requires a term paper.

LAS 395. Interdisciplinary Study Abroad. Cr. arr. Repeatable. Multi-faceted exploration of a selected world region directed at developing a comprehensive understanding of a selected culture's role in contemporary society.
A. Pre-Departure Seminar. Cr. 1.
B. Humanities. Cr. 1-4.
C. Communications. Cr. 1-4.
D. Mathematics and Natural Science. Cr. 1-4.
E. Social Sciences. Cr. 1-4.

LAS 398. Internship/Co-op. Cr. R. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services; junior classification.* Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student Status.

LAS 488. Interdisciplinary Research on Women and Leadership. (Cross-listed with W S). (3-0) Cr. 3. Research on women and leadership in selected content areas (e.g., Athletics, Business, Education, Politics and Public Service, and Science and Engineering). Following overview of quantitative and qualitative methods and critical analyses of journal articles on women and leadership. Students will work with a faculty mentor in selected content areas to research, write and present paper.

LAS 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the instructor for LAS 490G; other topics need: permission of the dean of the College of Liberal Arts and Sciences.* No more than 9 credits of LAS 490 may be applied toward graduation.
E. Entrepreneurial Studies.
G. Catt Center Project.

LAS 491. Service Learning. Cr. arr. F.S.SS. *Prereq: Permission of the dean of the College of Liberal Arts and Sciences.* Service work as appropriate to the student's degree program. Academic work under faculty supervision may include written project, report, and guided reading.

LAS 498. Internship/Co-op. Cr. R. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services; senior classification.* Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student Status.

LAS 499. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services.* Work experience in professional setting appropriate to the student's degree program. Academic work under faculty supervision may include written projects, reports, and guided reading.

Liberal Studies

The bachelor of liberal studies degree (B.L.S.) was established by the three Iowa Regent universities to meet the needs of Iowans who want to earn a college degree but whose circumstances present obstacles to completing a traditional on-campus degree program. The degree may be earned from Iowa State University, the University of Iowa, or the University of Northern Iowa.

The B.L.S. is a general studies degree in the liberal arts. There is no traditional major. Instead, students take coursework in three areas of distribution. These areas may be focused in a single discipline or diversified over several disciplines. With the assistance of a B.L.S. adviser, students can structure a program that meets their individual educational, vocational or personal goals.

Up to three-fourths of the total degree requirements can be transferred from accredited institutions. Work done in community colleges or other accredited colleges and universities can be applied toward the degree, as can applicable courses taken at any of the three Iowa Regent universities, whether on or off campus.

The B.L.S. program has no residence requirements. To complete the degree, students may offer credits earned in various study formats: correspondence courses; telecourses; Saturday and evening courses; off-campus courses, including those with distance-learning formats; and regular on-campus courses. Students may also earn credits by proficiency or test-out examinations.

Admission

Admission to the B.L.S. program is open to persons who meet either of the following levels of previous educational attainment:

Hold the associate in arts (A.A.) or associate in science (A.S.) degree from an accredited two-year college. (Holders of the associate in applied science or associate in applied arts degree are not automatically eligible, although some courses may be found applicable upon review.)

Have at least 62 semester credits of collegiate work acceptable toward graduation at ISU with a total cumulative grade point average of at least 2.00 (a C average).

Library

Olivia Madison, Dean of Library Sciences

Professors: Cole, Gerhard, Goedeken, Madison

Professors (Emeritus): Dobson, Galejs, Kuhn, Morris, Yates

Associate Professors: Boydston, Christian, Coffey, Gregory, Jackson, Kappmeyer, King, Kushkowski, Lawson, Leysen, Marinko, McKiernan, Parsons, Pedersen, Pellack, Shonrock, Stacy-Bates, Vega-Garcia, Wool, Zanish-Belcher

Associate Professors (Emeritus): Mathews, Pelzer, Wendell

Assistant Professors: Arcand, Dinkelman, Kuruppu, Lewin, Matava, McMinn, Passonneau, Seo

Assistant Professor (Emeritus): Fryer

Assistant Professor (Adjunct): Lesar

Undergraduate Study

A foundation of library instruction is the Library 160 course, which is a requirement for undergraduate graduation. Library faculty also offer course-related instruction for undergraduate students in the effective use of library resources in all fields of study. Offered F.S.SS. For more information, call the Library at 294-3642.

Graduate Study

Library faculty offer course-related instruction for graduate students in the effective use of library resources. These sessions cover sources of information in all fields of study. Offered F.S.SS. For more information, call the Library at 294-3642.

Courses primarily for undergraduate students

Lib 160. Library Instruction. (1-0) Cr. 0.5. F.S.SS. *Prereq: for students whose native language is not English: Completion of English 101 requirement.* 8 week course required for undergraduate degree. Use of research libraries and information sources, including services of the University Library, with an emphasis on finding, evaluating, and using scholarly information. To be taken as early as possible in the student's undergraduate career. See course descriptions of Engl 150 and 250 for prerequisite related to Lib 160. Satisfactory-fail only.

Linguistics

www.public.iastate.edu/~apling/Lingprog.html

(Interdepartmental Program)
Program Committee: C.A. Chapelle (Chair), K.S. Leonard, J. M. Levis, Nick Pendar, W. S. Robinson, H. Venkatagiri

Undergraduate Study

Linguistics is a cross-disciplinary program in the College of Liberal Arts and Sciences designed to meet the needs of students interested in various aspects of language—its structure, history, varieties, meanings, and uses. The program includes courses in anthropology, English, computer science, psychology, and speech communication and world languages and cultures, thus providing a multi-disciplinary approach to the study of human language.

Courses in linguistics serve as background for students interested in any career that involves working with language, such as linguistic anthropology, computational linguistics, second language studies, teaching English both as a first and as a second language, psycholinguistics, cross-cultural communication, speech-language pathology and audiology.

In the College of Liberal Arts and Sciences, courses in linguistics can be applied as electives or as part of the group requirements. They may also be used in a minor or in a major.

Majors in linguistics complete a minimum of 36 hours in linguistics with a grade of C or better in each linguistics course. Courses specifically required are Ling 119, 120, 207, 219, 220, 309, 371, 413, 420, and 437. In addition, linguistics majors must choose 6 credits of courses from one or more of the following areas: communication disorders (Ling 275, 286, 471), computational linguistics (Ling 331, 520), second language studies (Ling 425, 486, 487, 519, 524, 525, 526), sociolinguistics and language use (Ling 305, 422, 514, 527), or world language (351, 352, 462, 463). Additional courses on world languages are available through study abroad. Majors in linguistics must show proficiency in a foreign language equivalent to that achieved after two years of university-level study.

Minors in linguistics are individually tailored to the interests of the student, who consults with the chair of the supervisory committee for linguistics. All minors must have a minimum of 15 credits in linguistics, of which 6 must be in courses numbered over 300. All programs must include Ling 219.

Communication Proficiency requirement: The linguistics program requires grades of C+ or better in each of the following: English 150; 250 (or 250H); and one of English 305, 314, or a World Languages and Cultures 370 course; or one of Cl St 372, 373, 374, or 376.

For information about using linguistics courses in an interdisciplinary studies major, see *Liberal Arts and Sciences, Cross-Disciplinary Studies.*

Graduate Study

A graduate minor in linguistics is offered through a cooperative agreement with the departments and programs of Anthropology, Computer Science, English, Psychology, Speech Communication, and World Languages and Cultures. The minor permits students to investigate a variety of aspects of linguistics, emphasizing the ability to think about language in a systematic and disciplined way and to apply the methods of the field to research problems in their own disciplines.

For the master's degree, a declared minor consists of 9 credits in linguistics including two foundation courses (511 and either 514, 527 or 537) and one elective from the list of courses approved for graduate credit. For the Ph.D. degree, the minor consists of 12 credits in linguistics including three foundation courses (511, 527, and 537) and one elective. Additional courses beyond those listed below may be used as electives. The chair of the supervisory committee can provide information about these.

At least one member of the linguistics faculty will serve on a student's program of study committee. A list of faculty members may be obtained from the Linguistics program website. Ph.D. candidates will write one section of the preliminary examination on an area of linguistics. All students in the minor are expected to attend linguistics lectures and colloquia. Students in Teaching English as a Second Language/Applied Linguistics are not eligible for a graduate minor in linguistics.

Courses primarily for undergraduate students

Ling 101. Introduction to the Study of Linguistics. (1-0) Cr. 1. S. Cross-disciplinary perspectives on the study of linguistics. Applications of linguistics to real world problems. Careers in linguistics.

Ling 119. Introduction to World Languages. (Cross-listed with WLC). (3-0) Cr. 3. Study of language diversity and the personal, social and political effects of diversity. Language families, attitudes toward language and dialects, language and culture, multilingualism, foreign language learning, written codes, official languages, and language policy.

Ling 120. Computers and Language. (Cross-listed with Engl). (3-0) Cr. 3. Introduction to the use of linguistic knowledge in computer applications today and the basic computational techniques used in such applications. The development of these techniques throughout the history of computational linguistics. How the study of language has contributed to the advancement of technology and how certain computational problems have influenced the way linguists study language.

Ling 207. Introduction to Symbolic Logic. (Cross-listed with Phil). (3-0) Cr. 3. S. Introduction to fundamental logical concepts and logical symbolism. Development of natural deduction through first order predicate logic with identity. Applications to arguments in ordinary English and to Philosophical issues. Majors should take Phil 207 as early as possible.

Ling 219. Introduction to Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Sophomore classification.* Introduction to linguistic concepts and principles of linguistic analysis with English as the primary source of data. Sound and writing systems, sentence structure, vocabulary, and meaning. Issues in the study of usage, regional and social dialects, language acquisition, and language change.

Ling 220. Descriptive English Grammar. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Engl 250.* Overview of grammatical structures and functions. Parts of speech; phrase, clause, and sentence structure; sentence types and sentence analysis; rhetorical grammar and sentence style; terminology. Not a remedial, English composition, or ESL course.

Ling 275. Introduction to Communication Disorders. (Cross-listed with CmDis). (3-0) Cr. 3. Survey of nature, causes, and types of major communication disorders including phonological, adult and child language, voice, cleft palate, fluency, and hearing disorders.

Ling 286. Basic Sign Language. (Cross-listed with CmDis). (3-0) Cr. 3. Development of basic skills in the use and understanding of signed English, a modification of American Sign Language. Overview of the types, causes and consequences of hearing impairment, deaf culture and the education of hearing-impaired children.

Ling 305. Language, Thought and Action. (Cross-listed with Sp Cm, ComSt). (3-0) Cr. 3. F.S.SS. *Prereq: Engl 250.* The study of symbolic processes and how meaning is conveyed in words, sentences, and utterances; discussion of modern theories of meaning; and an exploration of relationships among language, thought and action. Nonmajor graduate credit.

Ling 309. Linguistic Anthropology. (Cross-listed with Anthr). (2-2) Cr. 3. F. *Prereq: Anthr 201.* Language as a human attribute; language versus animal communication; human communication in cultural context; paralanguage, kinesics, proxemics, artifacts as communication; language and culture; cross-cultural Sociolinguistics; ethnoscience; and language policies. Participatory lab: focus on analysis of a non-Western language and communication system.

Ling 331. Theory of Computing. (Cross-listed with Com S). (3-1) Cr. 3. F.S. *Prereq: C- or higher in 228, C- or higher in Com S 330 or Cpr E 310, C- or higher in Math 166, and Engl 250..* Models of computation: finite state automata, pushdown automata and Turing machines. Study of grammars and their relation to automata. Limits of digital computation, unsolvability and Church-Turing thesis. Chomsky hierarchy and relations between classes of languages. Nonmajor graduate credit.

Ling 352. Introduction to Spanish Phonology. (Cross-listed with Span). (3-0) Cr. 3. F.S. *Prereq: Spanish 301, 303 or 304.* An introductory study of the articulation, classification, distribution, and regional variations of the sounds of the Spanish language. Taught in Spanish. Nonmajor graduate credit.

Ling 371. Phonetics and Phonology. (Cross-listed with CmDis). (3-0) Cr. 3. *Prereq: CmDis 275 or Engl 219.* Analysis of speech through study of individual sounds, their variations, and relationships in context; English phonology; practice in auditory discrimination and transcription of sounds of American English; description of speech sounds in terms of their production, transmission, and perception.

Ling 413. Psychology of Language. (Cross-listed with Psych). (3-0) Cr. 3. *Prereq: Psych 101.* Introduction to psycholinguistics. Topics may include origin of language, speech perception, language comprehension, reading, bilingualism, brain bases of language, and computational modeling of language processes. Nonmajor graduate credit.

Ling 420. History of the English Language. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Engl 219, 220.* Comparison of English to other languages by family background and by type. Analysis of representative Old, Middle, Early Modern and present-day English texts, including both literary works and non-literary documents. Nonmajor graduate credit.

Ling 422. Women, Men, and the English Language. (Cross-listed with Engl, W S). (3-0) Cr. 3. *Prereq: Engl 219.* The ways men and women differ in using language in varied settings and the ways in which language both creates and reflects gender divisions. Nonmajor graduate credit.

Ling 425. Second Language Learning and Teaching. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Engl 219; junior classification.* The process of second language learning and principles and techniques of teaching second languages. Learning and teaching in specific situations and for particular purposes. Current applications of technology in teaching and assessment. Nonmajor graduate credit.

Ling 437. Grammatical Analysis. (Dual-listed with 537). (Cross-listed with Engl). (3-0) Cr. 3. *Prereq: Engl 220; junior classification.* Theories and methods for analysis of English syntax with emphasis on recent syntactic theory.

Ling 462. Contrastive Analysis of Spanish/English for Translators. (Cross-listed with Span). (3-0) Cr. 3. *Prereq: Spanish 351.* Linguistic study of the major differences between the Spanish and English grammatical systems and their applications in the translation of Spanish to English. Taught in Spanish. Nonmajor graduate credit.

Ling 463. Hispanic Dialectology. (Cross-listed with Span). (3-0) Cr. 3. *Prereq: Spanish 352.* Intensive study of the phonology, morphosyntax and lexicon of the Hispanic dialects of Spain and Latin America in their historical context. Taught in Spanish. Nonmajor graduate credit.

Ling 471. Language Development. (Cross-listed with CmDis). (3-0) Cr. 3. *Prereq: CmDis 275 or Psych 230 or Engl 219.* Definition of components of language. Overview of theories and developmental processes related to each component of linguistic skill (semantics, lexicon, syntax, morphology, phonology, pragmatics). Overview of normative information available for infants, children, adolescents, and adults. Attention to metalinguistic skills and the complementary nonlinguistic and paralinguistic skills. Nonmajor graduate credit.

Ling 486. Methods in Elementary School World Language Instruction. (Cross-listed with WLC, C I). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language.* Current educational methods and their application in the elementary school classroom. Special emphasis on planning, evaluation, and teaching strategies. Nonmajor graduate credit.

Ling 487. Methods in Secondary School World Language Instruction. (Cross-listed with WLC, C I). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language, admission to teacher education program.* Theories and principles of contemporary world language learning and teaching. Special emphasis on designing instruction and assessments for active learning.

Ling 489. Undergraduate Seminar. (Cross-listed with Engl). (3-0) Cr. 3. Repeatable. F. *Prereq: 9 credits in English beyond 250.* Intensive study of a selected topic in literature, criticism, rhetoric, writing, or language. Cross-listing with linguistics acceptable only when offered as a course in linguistics. Nonmajor graduate credit.

Ling 490B. Independent Study. (Cross-listed with Engl). Cr. arr. Repeatable. F.S. *Prereq: 9 credits in English beyond 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee.* Designed to meet the needs of students who wish study in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields.
B. Linguistics, Semantics (Engl 490B)

Ling 490D. Independent Study: Linguistic Anthropology. (Cross-listed with Anthr). Cr. arr. Repeatable. *Prereq: 9 credits in anthropology.*
D. Linguistic Anthropology (Same as Anthr 490D)

Courses primarily for graduate students, open to qualified undergraduate students

Ling 500. Language and Culture. (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 309 or 510.* Approaches to the study of the relationship between language structure, world view, and cognition; social and structural linguistic variation; cross-cultural aspects of verbal and non-verbal communication; linguistic change; contemporary applications of linguistic anthropology.

Ling 510. Introduction to Computers in Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Use of applications software for language teaching, linguistic analysis, and Statistical analysis. Issues and problems in applied linguistics related to computer methods.

Ling 511. Introduction to Linguistic Analysis. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Principles and methods of linguistic analysis with emphasis on phonology, morphology, and syntax. Description of linguistic variation and current theoretical approaches to linguistics.

Ling 512. Linguistic Change in English: Historical Analysis of Literary and Non-Literary Texts. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Graduate classification.* Linguistic change in English, connections to literary and rhetorical history. Development of formal written English and its conventions. Historical survey of ideas about the English language.

Ling 514. Sociolinguistics. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Theories and methods of examining language in its social setting. Analysis of individual characteristics (e.g., age, gender, ethnicity, social class, region), interactional factors (e.g., situation, topic, purpose) and national policies affecting language use.

Ling 515. Statistical Natural Language Processing. (Cross-listed with Engl, HCI). (3-0) Cr. 3. F. *Prereq: Stat 330 or equivalent; recommended 219 or 511.* Introduction to computational techniques involving human language and speech in applications such as information retrieval and extraction, automatic text categorization, word prediction, intelligent Web searching, spelling and grammar checking, speech recognition and synthesis, statistical machine translation, n-grams, POS-tagging, word-sense disambiguation, on-line lexicons and thesauri, markup languages, corpus analysis, and Python programming language.

Ling 517. Second Language Acquisition. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Theory, methods, and results of second language acquisition research with emphasis on approaches relevant to second language teaching.

Ling 518. Teaching English as a Second Language Methods and Materials. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Introduction to approaches, methods, techniques, materials, curricular design, and assessment for various levels of ESL instruction. Attention to issues related to the teaching of listening, speaking, reading, writing, vocabulary, pronunciation, and culture.

Ling 520. Computational Analysis of English. (Cross-listed with Engl, HCI). (3-0) Cr. 3. F. *Prereq: Engl 510 or 511.* Concepts and practices for analysis of English by computer with emphasis on the applications of computational analysis to problems in applied linguistics such as corpus analysis and recognition of learner language in computer-assisted learning and language assessment.

Ling 524. Literacy: Issues and Methods for Non-native Speakers of English. (Cross-listed with Engl). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 511 or an introductory course in linguistics.* Theoretical and practical issues and techniques in the teaching of

literacy in a variety of contexts, involving children and adults at basic skill levels and teens and adults in academic and vocational programs.

Ling 525. Methods in Teaching Listening and Speaking Skills to Nonnative Speakers of English. (Cross-listed with Engl). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 511 or an introductory course in linguistics.* Theoretical and practical issues and techniques in the teaching of second language pronunciation, listening, and speaking skills. Topics will be relevant to those intending to teach in various contexts involving both K-12 and adult learners.

Ling 526. Computer-Assisted Language Learning. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: 511 or equivalent.* Theory, research, and practice in computer use for teaching non-native speakers of English. Methods for planning and evaluating computer-based learning activities.

Ling 527. Discourse Analysis. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Methods and theoretical foundations for linguistic approaches to discourse analysis. Applications of discourse analysis to the study of texts in a variety of settings, including academic and research contexts.

Ling 537. Grammatical Analysis. (Dual-listed with 437). (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: 219, 220, or 511; junior classification.* Theories and methods for analysis of English syntax with emphasis on recent syntactic theory.

Ling 588. Supervised Practicum in Teaching English as a Second Language. (Cross-listed with Engl). (1-5) Cr. 3. F.S.SS. *Prereq: 15 credits toward the TESL/Applied Linguistics master's degree.* Intensive observation of ESL instruction and supervised practice in teaching learners of English in a context appropriate to the practicum student's goals. Seminar discussion of observed practices in relation to language teaching theories and methods.

Ling 590. Special Topics: Teaching English as a Second Language (TESL)/Applied Linguistics. (Cross-listed with Engl). Cr. arr. Repeatable. *Prereq: Permission of the English Department Graduate Studies Committee according to guidelines available in the department office.*
B. Teaching English as a Second Language (TESL)/Applied Linguistics. (Cross-listed with Engl 590B)

Ling 591. Studies in Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. Repeatable. *Prereq: 6 credits in TESL/Applied Linguistics.* Intensive study of applied linguistic theory as it relates to specific issues in language acquisition, teaching, or use.

Ling 623. Research Methods in Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: 511, 517, 518, Engl 519.* Survey of research traditions in applied linguistics. Focus on theoretical and practical aspects of quantitative and qualitative approaches to applied linguistic study, including experimental and quasi-experimental methods, classroom observation and research, introspective methods, elicitation techniques, case studies, interactional analysis, ethnography, and program evaluation. Computational tools and resources for linguistic research will be highlighted.

Ling 630. Seminar in Technology and Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: Engl 510, 511, 517, 518, others depend on the topic.* Topic changes each semester. Topics include advanced methods in natural language processing, technology and literacy in a global context, feed back in CALL programs, and advances in language assessment.

Ling 671. Discourse in Classrooms. (Cross-listed with C I). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: graduate classification.* Explores both foundational and current literature on discourse in K-12 classrooms; focuses on both discourse as a classroom phenomenon and discourse as an analytic tool for doing research in classrooms; and provides a close look at enacted and hidden curricula through an examination of interactions and communication patterns.

Ling 688. Practicum in Technology and Applied Linguistics. (Cross-listed with Engl). (1-5) Cr. 3. F.S.SS. *Prereq: Engl 510, 626, or equivalent; 2nd year PhD student.* Focus on integrating theoretical knowledge with practical expertise. Assess client needs; develop, integrate, and evaluate solutions. Practical understanding of computer applications used in multimedia development. Create web-based or CD-ROM-based multimedia materials. Work with advanced authoring applications.

Courses for graduate students

Ling 623. Research Methods in Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F. Prereq*: 511, 517, 518, Engl 519.* Survey of research traditions in applied linguistics. Focus on theoretical and practical aspects of quantitative and qualitative approaches to applied linguistic study, including experimental and quasi-experimental methods, classroom observation and research, introspective methods, elicitation techniques, case studies, interactional analysis, ethnography, and program evaluation. Computational tools and resources for linguistic research will be highlighted.

Ling 630. Seminar in Technology and Applied Linguistics. (Cross-listed with Engl). (3-0) Cr. 3. F. Prereq*: Engl 510, 511, 517, 518, others depend on the topic.* Topic changes each semester. Topics include advanced methods in natural language processing, technology and literacy in a global context, feed back in CALL programs, and advances in language assessment.

Ling 671. Discourse in Classrooms. (Cross-listed with C I). (3-0) Cr. 3. Alt. S., offered 2009. Prereq*: graduate classification.* Explores both foundational and current literature on discourse in K-12 classrooms; focuses on both discourse as a classroom phenomenon and discourse as an analytic tool for doing research in classrooms; and provides a close look at enacted and hidden curricula through an examination of interactions and communication patterns.

Ling 688. Practicum in Technology and Applied Linguistics. (Cross-listed with Engl). (1-5) Cr. 3. F.S.SS. *Prereq: Engl 510, 626, or equivalent; 2nd year PhD student.* Focus on integrating theoretical knowledge with practical expertise. Assess client needs; develop, integrate, and evaluate solutions. Practical understanding of computer applications used in multimedia development. Create web-based or CD-ROM-based multimedia materials. Work with advanced authoring applications.

Logistics and Supply Chain Management

(Administered by the Department of Logistics, Operations, and Management Information Systems)

Richard Poist, Chair of Department

Distinguished Professor (Emeritus): Baumel

Professors: Crum, Poist, Walter

Professors (Emeritus): Thompson, Voorhees

Associate Professors: Blackhurst, Johnson, Mennecke, Montabon, Nilakanta, Ruben, Suzuki, Tiwana, Townsend, Zhu

Assistant Professors: Jiang, Martens, Scheibe

Instructor (Adjunct): Choobineh

Lecturer: Helmer

Undergraduate Study

For the undergraduate curriculum in business, major in Logistics and Supply Chain Management, see *College of Business, Curricula.*

Logistics and Supply Chain Management is a program of study concerned with the efficient flow of materials, products, and information within and among organizations. Logistics management entails a wide variety of activities that have a significant influence on customer service, including inventory control, transportation, warehousing, facility location analysis, packaging, materials handling, parts and service support, and product returns. Supply chain management involves the integration of business processes across organizations, from material sources and suppliers through manufacturing and processing to the final customer. Logistics management is, thus, taught in the context and framework of inter-organizational supply chain systems.

The study of Logistics and Supply Chain Management prepares students for professional careers with shippers (e.g., manufacturers and distributors), transportation carriers, and logistics service providers. The curriculum provides the required theoretical/conceptual base and analytical methods for making sound operational and strategic business decisions.

The requirements for the Logistics and Supply Chain Management major are met by completion of the following courses: LSCM 460, 461, 485, 486, 487, plus one course from an approved list.

The department also offers a minor for non-Logistics and Supply Chain Management majors in the College of Business. The minor requires 15 credits from an approved list of courses, of which 9 credits must stand alone. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

For graduate study options, including the Ph.D. degree, see the Supply Chain Management listing

Courses primarily for undergraduate students

LSCM 360. Business Logistics. (3-0) Cr. 3. *Prereq: Econ 101.* Introduction and analysis of the logistics concept to include the management of transportation, inventory, packaging, warehousing, materials handling, order processing, facility location, and customer service.

LSCM 440. Supply Chain Information Systems. (Cross-listed with MIS, OSCM). (3-0) Cr. 3. *Prereq: MIS 330, OSCM 320, LSCM 360.* Internal and inter-organizational information systems necessary for a supply chain to achieve competitive advantage. Topics include: design, development, implementation, and maintenance of supply chain information systems; enterprise resource planning; advanced planning and scheduling, manufacturing execution systems; and the interface between manufacturing planning and control processes, logistics processes, and the information system.

LSCM 460. Decision Tools for Logistics and Operations Management. (3-0) Cr. 3. *Prereq: LSCM 360, OSCM 320.* Technical tools and skills required for problem solving and decision making in logistics and operations management. Transportation and network planning, inventory decision making, facility location planning, vehicle routing, scheduling, and production planning. Quantitative tools include linear and integer programming, non-linear programming, and simulation. Emphasis on the use of PC-based spreadsheet programs. Nonmajor graduate credit.

LSCM 461. Principles of Transportation. (3-0) Cr. 3. *Prereq: LSCM 360.* Economic, operating, and service characteristics of the various modes of transportation, with a special emphasis on freight transportation. Factors that influence transport demand, costs, market structures, carrier pricing, and carrier operating and service characteristics and their influence on other supply chain costs and supply chain performance. Nonmajor graduate credit.

LSCM 462. Transportation Carrier Management. (3-0) Cr. 3. *Prereq: Credit or enrollment in LSCM 461.* Analysis of transport users' requirements. Carrier management problems involving ownership and mergers, routes, competition, labor, and other decision areas. Nonmajor graduate credit.

LSCM 466. International Transportation and Logistics. (3-0) Cr. 3. *Prereq: LSCM 360.* Logistics systems and legal framework for the international movement of goods. Operational characteristics of providers of exporting and importing services. The effects of government trade policies on global logistics. Nonmajor graduate credit.

LSCM 469. Transportation and Logistics Issues. (3-0) Cr. 3. *Prereq: LSCM 460, 461.* An integrative course designed to study contemporary problems and issues in transportation and logistics. Nonmajor graduate credit.

LSCM 485. Demand Planning and Management. (Cross-listed with OSCM). (3-0) Cr. 3. *Prereq: LSCM 360, OSCM 320.* Demand planning process which synchronizes demand with manufacturing and distribution. Addresses linking business plans and demand forecasts both horizontally and vertically within the organization and collaboratively among supply chain partners. Forecasting, customer relationship management, sales and operations planning, customer service, distribution channels, e-fulfillment, and information systems requirements. Nonmajor graduate credit.

LSCM 486. Principles of Purchasing and Supply Management. (Cross-listed with OSCM). (3-0) Cr. 3. *Prereq: LSCM 360, OSCM 320.* Sourcing strategies, concepts, tools and dynamics in the context of the integrated supply chain. Make or buy decision, supplier evaluation and selection, global sourcing, the total cost of ownership, contracts and legal terms, negotiation, purchasing ethics, and information systems requirements. Nonmajor graduate credit.

LSCM 487. Strategic Supply Chain Management. (Cross-listed with OSCM). (3-0) Cr. 3. *Prereq: LSCM 460 or OSCM 422 or OSCM 424; LSCM 485 or LSCM 486.* Capstone course in supply chain management. Integrating and applying the theories, concepts, and methods covered in the prerequisite courses through the use of readings, case studies, projects, and industry speakers. Nonmajor graduate credit.

LSCM 490. Independent Study. Cr. arr. Repeatable. *Prereq: LSCM 360, senior classification, permission of instructor.*

Courses primarily for graduate students, open to qualified undergraduate students

The department offers graduate courses under the heading of Supply Chain Management. These courses include SCM 601, 602, 603, 604, 605, 650, 651, and 699. For descriptions of these courses, see Supply Chain Management.

Management

Thomas Chacko, Chair of Department

University Professors: McElroy, Morrow Shrader

Professors: Chacko, Van Auken, Werbel

Professor (Emeritus): Hunger

Associate Professors: Blackburn, Demarie, Herrmann, Johnson

Associate Professor (Emeritus): Aitchison

Assistant Professors: Anderson, Schwab, Zhang

Senior Lecturer: Elston, R. Smith

Lecturer: Mullen

Undergraduate Study

For undergraduate curriculum in business, major in management, see *College of Business, Curricula*.

The Department of Management offers a major in management. Students will complete the general education requirements (including business foundation courses), and business core requirements for the bachelor of science (B.S.) degree and 18 credits in the major. The instructional objective of the Department of Management is to provide students with knowledge of organizations and management functions within organizations. Management majors will demonstrate an understanding of (1) employee work-related attitudes and behaviors, (2) competitive strategy and advantage, (3) challenges and strategies in international business, and (4) human resource management practices in firms. Students will demonstrate an awareness of the role of diversity, ethics, and technology in business decisions, the impact of external forces and global issues on organizations, and an ability to think critically, to communicate effectively, and to work effectively as a member of a team.

Management is a broadly defined discipline and activity, which is neither industry nor function specific. Management concepts, theories, techniques, and skills are applicable to all business functional areas and are essential components for successful organizations. Management requires sound conceptual, technical, and human Skills for the effective utilization of organizational resources. In addition to the basic business foundation and core courses, management majors are required to complete 18 credits of management or department approved courses. Included in these 18 credits are four required courses: Mgmt 371, 377, 414, and 471.

The department also offers a minor for non-Management majors in the College of Business. The minor requires 15 credits from an approved list of courses, of which 9 credits must stand alone. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

The Department of Management participates in three graduate programs: the M.S. in Business, the M.B.A. full-time and part-time programs, and the Ph.D. program in Business and Technology. The M.S. in Business is a 30-credit curriculum culminating in a thesis. The M.B.A. program is a 48-credit curriculum. Twenty four of the 48 credits are core courses and the remaining 24 are graduate electives. The Ph.D. program is a 56 credit curriculum that culminates in a dissertation.

Courses primarily for undergraduate students

Mgmt 310. Entrepreneurship and Innovation. (3-0) Cr. 3. F.S. *Prereq: Sophomore classification.* Review of the entrepreneurial process with emphasis on starting a new business. How to analyze opportunities, develop an innovative product, organize, finance, market, launch, and manage a new venture. Deals with the role of the entrepreneur and the importance of a business plan. Speakers and field project.

Mgmt 313. Feasibility Analysis and Business Planning. (3-0) Cr. 3. S. *Prereq: 310 and Entrepreneurship Minor or Management Major.* Developing an idea for a new business venture, conducting a feasibility study, researching the potential market, analyzing the competition, and writing a formal business plan. Basic business functions are discussed in terms of their application to conducting feasibility analysis and writing a business plan for an entrepreneurial venture.

Mgmt 370. Management of Organizations. (3-0) Cr. 3. F.S.SS. *Prereq: Econ 101 or 102 or equivalent.*. A management functions approach is used to explain what managers do in organizations; how they deal with external constituents, how they structure their companies, and how they deal with employees. A contingency approach is used as a framework for understanding how to increase the effectiveness and efficiency of organizations in today's dynamic, highly competitive business environment.

Mgmt 371. Organizational Behavior. (3-0) Cr. 3. F.S. *Prereq: 370.* The study of individual attributes, interpersonal relations, and employee attitudes in organizations. Instructional emphasis is placed on how management concepts such as reward systems, job design, leadership, teams, etc., can be used to manage employee attitudes and behavior.

Mgmt 377. Competitive Strategy. (3-0) Cr. 3. F. *Prereq: Econ 101 and junior classification.* Developing competitive strategy and achieving competitive advantage in firms, including: industry analysis, generic strategies, hypercompetition, competing against time, and building distinctive capabilities.

Mgmt 414. International Management. (3-0) Cr. 3. F. The nature and economic role of the multinational firm and entrepreneurial ventures, including the impact of legal, political, and cultural variables upon firm performance and managerial activity; case studies illustrate interdependent nature of functional areas of business projected across national boundaries. Nonmajor graduate credit.

Mgmt 415. Managing New Ventures. (3-0) Cr. 3. F.S. *Prereq: 370; Mkt 340; Fin 301; LSCM 360, OSCM 320.* Examination of business problems and issues in new and growing firms. Emphasis is on analyzing existing businesses. Includes a field project. Nonmajor graduate credit.

Mgmt 419. Social Responsibility of Business. (3-0) Cr. 3. S. A consideration of the role of business in Society. Critical analysis of ethical, managerial, and public issues as they affect the corporation.

Mgmt 471. Personnel and Human Resource Management. (3-0) Cr. 3. F.S. *Prereq: Junior standing.* Recruitment and selection, utilization, and development of people in organizations. Examination of each personnel function; interrelationships among the functions.

Mgmt 472. Management of Diversity. (3-0) Cr. 3. F.S. *Prereq: Junior classification.* One of the most crucial problems in organizations today is the management of diversity. Attempts to define the difference between equal employment opportunity/affirmative action, which has a legal basis, and diversity which has an educational basis. Organized around the concepts of: (1) cultural diversity and cultural unity; (2) development of skills and tools to manage diversity; and (3) structure of diversity development programs in organizations. Nonmajor graduate credit.

Mgmt 478. Strategic Management. (3-0) Cr. 3. F.S.SS. *Prereq: 370; OSCM 320; Fin 301; Mkt 340; LSCM 360; Acct 285; graduating senior.* Strategy formulation, implementation, and evaluation and control in today's organizations. Emphasis is on strategic planning and decision making using the case method and/or projects.

Mgmt 490. Independent Study. Cr. arr. Repeatable. *Prereq: 370, senior classification, permission of instructor.*

Courses primarily for graduate students, open to qualified undergraduate students

Mgmt 501. Strategy Formation. (1-0) Cr. 1. F. *Prereq: Graduate classification.* An introduction to the strategic planning process. How to formulate strategy in context of environmental opportunities and threats, how to analyze industry competition and build competitive advantages.

Mgmt 507. Organizational Behavior. (2-0) Cr. 2. F. *Prereq: Graduate classification.* Understanding human behavior in organizations and the nature of organizations from a managerial perspective. Special emphasis is placed on how individual differences, such as perceptions, personality, and motivation, influence individual and group behavior in organizations and on how behavior can be influenced by job design, leadership, groups, and the structure of organizations.

Mgmt 511. Ethics and Social Responsibility. (1-0) Cr. 1. S. *Prereq: Graduate classification.* The ethical issues, moral dilemmas, and stakeholder responsibilities embraced by today's corporate decision makers. The morality of current management models and practices. Corporate governance and control, moral reasoning in groups, whistleblowing, employee safety, truth in advertising, environmental pollution, plant closings, insider trading, employee rights.

Mgmt 512. Strategic Management. (2-0) Cr. 2. S. *Prereq: 501, 507, OSCM 502, MIS 503, Mkt 504, Fin 505, Acct 508.* Critical analysis of case studies in strategic management with an emphasis on integrative decision making. Strategy implementation in light of the legal, regulatory, economic, social, and political contexts of business.

Mgmt 565. Technology Transfer and Feasibility Analysis. (3-0) Cr. 3. *Prereq: Graduate classification.* Commercialization of new technology. Topics covered include market analysis, intellectual property, product development, feasibility analysis, and new business evaluation.

Mgmt 566. Entrepreneurship and New Business Creation. (3-0) Cr. 3. *Prereq: Graduate classification or permission of instructor.*. The essentials of starting and operating a new business. Topics include current research on entrepreneurial perspective, starting and developing a new business, financing the venture, managing the growing firm, and special issues.

Mgmt 567. International Entrepreneurship. (3-0) Cr. 3. Essentials of operating an entrepreneurial firm in an international environment. Topics include international entrepreneurship, starting and developing a business in an international market, financing international ventures, international management issues, exchange rates, and culture.

Mgmt 570. Managing Employee Attitudes and Behaviors. (3-0) Cr. 3. F.SS. *Prereq: 371 or 507 or Psych 450.* Advanced topics germane to the management of individuals and groups over their work lives; sustained work commitment, motivation and job/career satisfaction, absenteeism, turnover, stress, leadership and career development (e.g., career ladders, mentoring).

Mgmt 571. Seminar in Personnel and Human Resources Management. (3-0) Cr. 3. S. *Prereq: 371 or 507 or Soc 420.* Topics and issues in personnel management with a focus on the management of human resources in organizations. Current personnel practices, Philosophies, and behavioral science research.

Mgmt 575. Compensation Management. (3-0) Cr. 3. F. *Prereq: 571.* Concepts, techniques, and issues dealing with remuneration of the work force. The impact of government legislation as well as organizational and Societal issues.

Mgmt 581. Strategic Planning and Environmental Analysis. (3-0) Cr. 3. F. *Prereq: 501 or permission of instructor.* Discussion of concepts and techniques used in long range strategic planning. Examination of planning practices in business and not-for-profit organizations. Topics include environmental scanning, industry analysis, forecasting, corporate and competitive strategies, and tactics.

Mgmt 582. Corporate Governance and Leadership. (Cross-listed with Acct). (3-0) Cr. 3. *Prereq: 502 or permission.* Examination of top managers and corporate boards of directors in terms of roles, responsibilities, and tasks. Examination of corporate governance structure and functioning. Topics include CEO tenure and compensation, board monitoring and composition, board responsibility and accountability, board structure and performance, CEO and board roles in strategic management, shareholder and stakeholder representation, corporate social responsibility, ethics and corporate governance, international governance, and executive leadership style.

Mgmt 583. Strategic Management of Innovation. (3-0) Cr. 3. *Prereq: 501 or permission of instructor.* Critical analysis and discussion of cases focused on strategic management of innovation. Assessment of a firm s innovative capabilities and competitive dynamics to manage innovative processes. Practical applications through emphasis on implementation including internal corporate venturing, management of the corporate R&D function, and institutionalization of innovation.

Mgmt 584. Management Consulting. (3-0) Cr. 3. *Prereq: 501 or permission of instructor.* Provides the opportunity for students to understand the role of the professional consultant, the issues facing the management consulting industry, the competencies of various management consulting firms, the nature and form of strategic consulting engagement, and the nature and scope of strategic change in business firms. Students will learn about management consulting functions and will practice the consultant role though cases and field studies.

Mgmt 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor. For students* wishing to do individual research in a particular area of management.

Courses for graduate students

Mgmt 601. Philosophy of Science. (3-0) Cr. 3. *Prereq: enrollment in the PhD program.* This course provides a Philosophical introduction to the theoretical and empirical development of scientific knowledge. It focuses on a variety of basic problems common to the social sciences: the nature of explanation, the structure of theories, forms of knowledge, scientific laws, nature of theory and ethics. The purpose of the course is to help doctoral students define a research context by addressing the purposes, assumptions and primary components of scientific inquiry.

Mgmt 602. Organizational Theory. (3-0) Cr. 3. *Prereq: enrollment in the PhD program.* This seminar involves the examination of the core theories and perspectives in organizational theory, as well as their applications and extensions. This material addresses the fundamental rationale for organizations in modern society, basic processes of organizing and organizational structure, a consideration of inter-organizational relationships and the external environment, and a variety of factors that help determine organizational effectiveness..

Mgmt 603. Strategic Management of Technology and Innovation. (3-0) Cr. 3. *Prereq: Mgmt 601.* This course will offer a critical review of organizational decision making with respect to technology and innovation. Students will learn how technological change can alter the basis of competition; how competitive strategy drives technology investment decisions; how market-orientation should be the other backbone of technological innovation; and best practices of organizing and managing the new product development process to achieve strategic goals.

Mgmt 604. Seminar in Organizational Behavior. (3-0) Cr. 3. *Prereq: enrollment in the PhD program.* The purpose of this seminar is to introduce behavioral science literature relevant to the study of behavior in organizational settings. The course will focus on the individual's role within organizations and cover topics such as individual differences, motivation, leadership, decision-making. Learning, risk taking, interpersonal relations, etc. Both theoretical and empirical contributions will be examined, with emphasis on integration of diverse theoretical perspectives.

Mgmt 650. Research Practicum I. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

Mgmt 651. Research Practicum. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

Mgmt 699. Dissertation. Cr. arr. *Prereq: Graduate classification, permission of dissertation supervisor.* Research.

Management Information Systems

(Administered by the Department of Logistics, Operations and Management Information Systems)

Richard Poist, Chair of Department

Distinguished Professor (Emeritus): Baumel

Professors: Crum, Poist, Walter

Professors (Emeritus): Thompson, Voorhees

Associate Professors: Blackhurst, Johnson, Mennecke, Montabon, Nilakanta, Ruben, Suzuki, Tiwana, Townsend, Zhu

Assistant Professors: Jiang, Martens, Scheibe

Instructor (Adjunct): Choobineh

Lecturer: Helmer

Undergraduate Study

For undergraduate curriculum in business, major in management information systems, (MIS) see *College of Business, Curricula.*

The MIS Program is designed to provide students with a strong educational foundation that prepares them as information system (IS) professionals. The academic program consists of a specially designed curriculum that emphasizes conceptual, analytical, technical and interpersonal skills. The major offers students comprehensive training in the application, use and management of information systems to prepare them to provide effective information services and support to organizations. The coursework is designed to provide the technical and conceptual skills associated with the use of information technology in business organizations. The program will: impart knowledge on existing and emerging information technologies and their impact on the IS function; train to critically analyze business processes, identify inefficiencies and problems, assess information requirements, create business solutions and technical specifications for the supporting system; provide expertise to design and develop database applications using the latest database technologies; provide expertise in the latest telecommunication technologies; train in interpersonal and communication skills to effectively interact with various information systems' clients; and provide managerial skills to manage IS projects.

The MIS major requires students to take seven courses. The required courses are: MIS 331, 432, 433, 435, and 438. In addition they will take two courses from an approved list. These courses are designed to provide the conceptual, technical, and managerial skills necessary to design and develop systems in organizations

The department also offers a minor for non-Management information Systems majors in the College of Business. The minor requires 15 credits from an approved list of courses, of which 9 credits must stand alone. The 15 credits must include either MIS 423 or 433. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

The MIS area participates in four graduate programs in the College of Business—M.S. in Business, MSIS, full-time and part-time M.B.A. programs and Ph.D. in Business and Technology. The M.S. program is a 30-credit curriculum with a thesis. The Management of Information Technology specialization in the Ph.D. program is a 56-credit curriculum with a 12-credit dissertation.

The MIS area also participates in an interdepartmental MS program in Information Assurance, as well as in a Masters and Ph.D. program in Human Computer Interaction. Students in any of these programs can be enrolled through the College of Business.

The M.B.A. program is a 48-credit curriculum. Twenty-four of the 48 credits are core business courses and the remaining 24 credits are graduate electives. Students can obtain a MIS specialization in the M.B.A. program by taking 12 credits of graduate MIS courses from a selected list of courses.

The masters of science in information systems (MSIS) is a 32 credit (minimum) curriculum designed around three inter-related areas - Foundation, IS core, and electives. All students are expected to be familiar with basic computing skills before they enter the program. The MSIS will educate students on applying IS theory and concepts to modern IS development through classes that enable them to learn and use the latest software in application projects. Students graduating from the program will have advanced technical and managerial skills to develop and manage information systems projects.

The Ph.D. in Business and Technology with a MIT specialization is a 56 credit (minimum) curriculum designed around four inter-related areas—Core, MIT specialization, Minor, and Research Methods—and dissertation. The MIT area examines issues related to the development, building, management, and use of information and knowledge-based technologies. Such technologies enable users to collect organizational data, provide a platform for organizing and disseminating the data, and offer operational, decision support, and knowledge management tools through which users can leverage data and information for making better organizational decisions. Students in the MIT specialization will study areas such as information technology analysis and development, database and knowledge management systems, decision support and data mining, human computer interaction, system security and integrity, and project management and collaborative teamwork.

Courses primarily for undergraduate students

MIS 330. Management Information Systems. (3-0) Cr. 3. *Prereq: Com S 103.* The role of information technology in organizations. Overview of methodologies for design and development of systems including decision support systems, expert systems, data bases, end-user computing, etc. Computer applications relate concepts to practice. Lecture and laboratory work emphasizes the enabling role of IT in contemporary organizations.

MIS 331. File Structures and Programming. (3-0) Cr. 3. *Prereq: Credit or enrollment in Com S 207.* Introduction to the concepts and use of data structures, file accesses and object oriented programming methodologies in contemporary business environments. Application development environments will be covered.

MIS 423. Information Systems for Managerial Decision Making. (3-0) Cr. 3. *Prereq: MIS 330.* Design development, modeling, and implementation of critical business processes that support global managerial decision making. Transforming and enhancing student abilities to act on data derived from spreadsheets, databases, business intelligence, data mining, and knowledge management sources to develop alternative plans and comprehensive solutions to common business problems. Designed to complement a range of student business majors. Students will build a variety of business models, analyze case studies, and propose solutions to real world situations. Only one of MIS 423 or 433 may count towards graduation. Nonmajor graduate credit.

MIS 431. Software Development in Contemporary Languages. (3-0) Cr. 3. *Prereq: 331.* Advanced software development and topics in contemporary programming languages. Topics include basic syntax, advanced programming techniques, file structures and management, database access, algorithm design, web forms and graphical user interfaces.

MIS 432. Information Systems Analysis. (3-0) Cr. 3. *Prereq: 330.* Critical analysis of business processes, data and process modeling, feasibility studies, CASE tools, and developing system design specifications. Nonmajor graduate credit.

MIS 433. Database Management Systems. (3-0) Cr. 3. *Prereq: Credit or enrollment in 331.* Database design, development, and implementation. Focus on data models, both classical and object oriented. Uses relational and/or object oriented database management systems. Only one of MIS 423 and 433 may count towards graduation. Nonmajor graduate credit.

MIS 434. Electronic Commerce Strategy. (3-0) Cr. 3. *Prereq: 330, Mkt 340, LSCM 360.* Overview of business strategies and technologies used for electronic commerce. Emphasis is on the strategic, operational, and technical issues associated with global electronic commerce using class lecture/discussion and case studies. Nonmajor graduate credit.

MIS 435. Business Telecommunications. (3-0) Cr. 3. *Prereq: 330.* Overview of Internet and telecommunications technology used in business applications. Understand Internet and network protocols, network and application architectures, design, and implementation. Nonmajor graduate credit.

MIS 437. Project Management. (3-0) Cr. 3. Equips students to support team activities in the general project management environment and better manage their careers. Practical experience using project management techniques and tools. Course topics include project initiation and execution, risk assessment, estimating and contracts, planning, human factors, and standard methods. Nonmajor graduate credit.

MIS 438. Information Systems Development. (3-0) Cr. 3. *Prereq: 432, 433, credit or enrollment in 435.* Design of business systems using contemporary tools and methods such as SQL, CASE tools, OOD tools, etc. Focuses on synthesizing concepts from earlier MIS courses. Nonmajor graduate credit.

MIS 439. Topics in Management of Information Systems. (3-0) Cr. 3. Repeatable. *Prereq: 330, permission of instructor.* A variety of topics will be covered and topics may vary between semesters. Some of the topics are information resources management, electronic commerce, decision support systems, and expert systems.

MIS 440. Supply Chain Information Systems. (Cross-listed with LSCM, OSCM). (3-0) Cr. 3. *Prereq: MIS 330, OSCM 320, LSCM 360.* Internal and inter-organizational information systems necessary for a supply chain to achieve competitive advantage. Topics include: design, development, implementation, and maintenance of supply chain information systems; enterprise resource planning; advanced planning and scheduling, manufacturing execution systems; and the interface between manufacturing planning and control processes, logistics processes, and the information system.

MIS 445. Advanced Data Communication. (3-0) Cr. 3. *Prereq: 435.* Contemporary theories, concepts, and practices in network infrastructure, network design, and information security. Design, install, and administer a complex network infrastructure. Study security threats and attacks and countermeasures. Investigate exposure to attacks, firewalls, and development of intrusion detection systems. Other security topics such as risk management, IT audit, and security regulations will also be addressed.

MIS 490. Independent Study. Cr. arr. Repeatable. *Prereq: 330, senior classification, permission of instructor.*

Courses primarily for graduate students, open to qualified undergraduate students

MIS 503. Management Information Systems. (2-0) Cr. 2. *Prereq: Graduate classification.* Current theories and practices of information processing and decision making. Focus on information technology and its uses in improving work practices, products, and tools for decision support. Use of artificial intelligence and other developments in technology. Competitive pressures and risks of information technology (IT). Setting IT strategy, information system planning and development of enterprise architecture. Focus on systems development and implementation.

MIS 531. Business Intelligence and Software. (3-0) Cr. 3. *Prereq: 503.* Focus on IT-enabled business intelligence systems. Conceptualize, design, and implement software applications that transform data into intelligence.

MIS 532. Advanced Business Software Development. (3-0) Cr. 3. *Prereq: 531 or equivalent.* A survey of business-oriented programming languages with emphasis on state-of-the-art development techniques for business software. Topics include object-oriented and Internet programming issues and methods.

MIS 533. Data Management for Decision Makers. (Cross-listed with Acct. (3-0) Cr. 3. *Prereq: 503.* Addresses data needs of functions such as marketing, finance, and production. Advanced skills needed to design, develop and use database, data warehousing and data mining systems for effective decision support. Emphasis on importance of contemporary technologies.

MIS 534. Electronic Commerce. (3-0) Cr. 3. *Prereq: 503.* Overview of how modern communication technologies including the internet and world wide web have revolutionized the way we do business. Provides an understanding of various internet technologies and how companies are using the internet for commercial purposes. Explores future scenarios on the use of these technologies and their impact on various industries and the Society.

MIS 535. Telecommunications Management. (3-0) Cr. 3. *Prereq: 503.* Issues involved in the management of telecommunications function. Overview of communications technology used in various business applications, local area network, wide area network, broad band network, wireless and voice networks. Internet technologies and protocols. Analyzing the strategic impact of these technologies on organizations. Strategic planning for telecommunications, including network planning and analysis.

MIS 537. Information Resource Management. (3-0) Cr. 3. *Prereq: 503.* Information Resource Management (IRM) is a popular concept of viewing information systems resources from a strategic resource perspective. Discuss the IRM concept as well as provide pragmatic tools for implementing this approach within the organization. Topics will include: IS outsourcing, total cost of ownership, IS planning and strategic analysis, justification for IT investment, management of IT human resources, traditional project management theory, and project management techniques derived from the Theory of Constraints (TOC).

MIS 538. Business Process Systems. (3-0) Cr. 3. *Prereq: 503.* Examine current and historical perspectives on business process management. Topics include

process identification, mapping, and improvement. Additional topics will address business process automation and integration, business process outsourcing. Investigate current and potential tools and methods for business process management. Include process management projects.

MIS 539. Topics in Management of Information Systems. (3-0) Cr. 3. Repeatable. *Prereq: 503.* A variety of topics may be offered in different semesters. Topics may include electronic commerce, information resources management, decision support systems, and expert systems.

MIS 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* For students wishing to do individual research in a particular area of MIS.

MIS 598. Research Seminar in Management Information Systems. (3-0) Cr. 3. *Prereq: Graduate classification.* Examines issues such as the nature and content of information systems research; aspects of starting and pursuing research topics in information systems; exploring and understanding relevant research methods and tools. Develop preliminary research proposals.

MIS 599. Creative Component. Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair.* Preparation and writing of creative component.

Courses for graduate students,

MIS 601. Behavioral Issues in IS Research. (3-0) Cr. 3. *Prereq: MIS 503 or equivalent, enrollment in PhD program.* The state of behavioral research in the IS function. MIS activities in an organization span the following three major areas: design and implementation of the MIS, use of the MIS, and management of the MIS function. Each of these processes is carried out at several levels: individual, group, organizational and inter-organizational. Identify behavioral issues of relevance for the cells defined by the process and level dimensions. Reading and discussion of the research literature surrounding the development, use, and implications of information technology.

MIS 602. Current Issues in IS Research. (3-0) *Prereq: MIS 503 or equivalent, enrollment in PhD program.* Three fundamental areas of information Systems, namely, infrastructure, management, and processes. Infrastructure studies examine the IT architecture including computing, communication, data, and application. Management focuses on addressing the value added notion of IT. Finally processing addresses topics related to enabling role of IT in myriad of areas.

MIS 603. Seminar on IT Strategy and Structure. (3-0) Cr. 3. *Prereq: MIS 601.* Strategic issues in IT management. Address issues such as aligning IT strategy with corporate strategy and functional strategies, IT structure, valuation, governance and control, and related topics. Provide students with research skills related to the boundary between IT and the firm's external environment.

MIS 604. Collaboration, Knowledge, and Intelligence in Organizations. (3-0) Cr. 3. *Prereq: MIS 601.* Research issues in the emerging areas of collaboration, knowledge management, and enterprise intelligence. Topics will include emerging and contemporary technologies of Data Mining, Knowledge Discovery from Databases, Web Mining, organizational memory, and knowledge management.

MIS 650. Research Practicum I. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

MIS 651. Research Practicum II. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

MIS 655. Organizational and Social Implications of Human Computer Interaction. (Cross-listed with HCI). (3-0) Cr. 3. *Prereq: Graduate classification.* Examine opportunities and implications of information technologies and human computer interaction on social and organizational systems. Explore ethical and social issues appurtenant to human computer interaction, both from a proscriptive and prescriptive perspective. Develop informed perspective on human computer interaction. Implications on research and development programs.

MIS 699. Research. Cr. arr. Repeatable. *Prereq: Graduate classification, permission of dissertation supervisor.* Research.

Marketing

Thomas Chacko, Chair of Department

Distinguished Professor (Emeritus): Teas

Professors: Agarwal, Laczniak, Ramaswami

Professors (Emeritus): Zober

Associate Professors: Kim, Palan, Wong

Assistant Professors: Brocato, Raju, Roy, Smarandescu, Walker

Lecturer: Folger

Undergraduate Study

For undergraduate curriculum in business, major in marketing, see *College of Business, Curricula.*

The Department of Marketing offers a major in marketing. Students will complete the general education requirements (including business foundation courses), and business core requirements for the bachelor of science (B.S.) degree and 18 credits in the major.

Marketing is concerned with management decisions that deal with the satisfaction of customer needs and wants in the purchase and use of goods and services. The primary decision areas in marketing involve the identification of market segments and decisions dealing with product design, pricing, promotion (including personal selling and marketing communications), and distribution. A major in marketing prepares the student for careers in selling and sales management, marketing research, marketing management, retail management, marketing communications, promotion management, and/or international marketing. Each area of study may be applied to consumer, business-to-business, and/or services marketing environments in business and nonprofit organizations.

The instructional objective of the Marketing department is to provide knowledge of the marketing process and an understanding of its functions. The students are expected to develop decision-making skills, computational skills, and communication skills with appreciation for global marketplace and ethical concerns. In addition to the basic business foundation and core courses, marketing majors are required to complete 18 credits of marketing or department approved courses. Included in these 18 credits are three required courses: Mkt 443, 444, and 447.

The department also offers a minor for non-Marketing majors in the College of Business. The minor required 15 credits from an approved list of courses, of which 9 credits must stand alone. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

The Department of Marketing participates in the following graduate programs: the M.S. in Business, the M.B.A. full-time and part-time programs, and the Ph.D. program in Business and Technology. The M.S. in business is a 30-credit curriculum culminating in a thesis or creative component. The M.B.A. program is a 48-credit, nonthesis, noncreative-component curriculum. Twenty four of the 48 credits are core courses and the remaining 24 are graduate electives. Within the M.B.A. program, students may develop an area of specialization in marketing. This specialization requires that 12 of the 24 credits of graduate electives be from marketing.

The Ph.D. program in Business and Technology with a Customer Management (CM) major is a 56 credit (minimum) curriculum designed around four inter-related areas–Core, CM major, Minor, and Research Methods—and dissertation. The focus of the CM major will be on customer management issues—selection of target customers, design of individualized customer programs, maximizing satisfaction, loyalty and retention and getting the maximum ROI out of customer investments.

Courses primarily for undergraduate students

Mkt 340. Principles of Marketing. (3-0) Cr. 3. F.S.SS. *Prereq: credit or current enrollment in Econ 101.* The role of marketing in Society. Markets, marketing institutions, and marketing functions with emphases on product, price, marketing communication, and marketing channel decisions.

Mkt 343. Personal Sales. (3-0) Cr. 3. *Prereq: 340.* Analysis of the theory and practice of personal selling with the context of relationship marketing and sales force automation. Topics include: goal setting, prospecting, time/territory management, questioning, presentations, objections, commitment and customer service; simulations of selling situations.

Mkt 410. Promotional Strategy. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in 447.* Principles, concepts, and problems involved in the development and implementation of promotional strategies. Coordination of a variety of promotional elements: advertising, sales promotion, direct marketing, public relations and publicity of web communications, and personal selling. Nonmajor graduate credit.

Mkt 442. Sales Management. (3-0) Cr. 3. F.S. *Prereq: 340.* Functional aspects of sales force management; personal selling methods; procedures for recruiting, selecting, and training new salespeople; compensation and expense control systems; problems of sales force motivation and supervision; methods of territorial and quota assignment; sales department budgets; distributor-dealer relations; other selected topics. Nonmajor graduate credit.

Mkt 443. Strategic Marketing Management. (3-0) Cr. 3. F.S. *Prereq: 444, 447.* Analysis of major elements of strategic marketing management. May include case studies or business simulations involving decision making using marketing tools from previous courses. (For marketing majors only.)

Mkt 444. Fundamentals of Marketing Research. (3-0) Cr. 3. F.S. *Prereq: 340, Stat 226.* Marketing research techniques: problem formulation, research design, questionnaire construction, sampling, data collection procedures, and analysis and interpretation of data related to marketing decisions. Nonmajor graduate credit.

Mkt 446. Retailing. (3-0) Cr. 3. F.S. *Prereq: 340.* Basic areas of retail management: buying, merchandising, retail promotion, store location, store layout, credit management, and inventory control. Emphasis on practical application of retail management principles.

Mkt 447. Fundamentals of Consumer Behavior. (3-0) Cr. 3. F.S. *Prereq: 340.* Study of how consumers select, purchase, use, and dispose of goods and services. Includes analyses of how markets and others influence these processes. Application of concepts and methods of the behavioral sciences to marketing management decision making. Nonmajor graduate credit.

Mkt 448. Fundamentals of International Marketing. (3-0) Cr. 3. F.S. *Prereq: 340.* Introduction to terms used in international marketing and sources of information on international markets. Development of sensitivity toward foreign business environment and familiarity with operations of multinational corporations. Nonmajor graduate credit.

Mkt 449. Marketing Seminar. (3-0) Cr. 3. *Prereq: 340.* Analysis of current issues and problems in marketing with emphasis on new theoretical and methodological developments. Additional seminars may be offered. Nonmajor graduate credit.

Mkt 451. Marketing Channels. (3-0) Cr. 3. F.S. *Prereq: 340.* Focuses on marketing channels, the downstream part of a value chain, companies that come together to bring products and services from their point of origin to the point of consumption. Topics include channel institutions, channel design, channel coordination and implementation. Highlights international and technological aspects of marketing channels so that students can Successfully develop and manage marketing channels in a contemporary business environment.

Mkt 453. Brand Management. (3-0) Cr. 3. F.S. *Prereq: 447* Examines the role of brands and branding in market environments characterized by intense competition and consumer power. Covers issues relating to why branding is important to firms, what brands represent to consumers, and what should be done to manage them effectively.

Mkt 490. Independent Study. Cr. arr. Repeatable. *Prereq: 340, senior classification; permission of instructor.*

Mkt 492. Comparative Marketing. (3-0) Cr. 3. SS. *Prereq: 340.* Provides experience to students in culture, social, economic, and political environment of marketing in a foreign country. Students complete a term project (e.g., a marketing plan) based on information collected in the foreign country. Students attend briefings by experts/officials of private and public organizations. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Mkt 504. Marketing. (2-0) Cr. 2. *Prereq: Graduate classification.* The scope of marketing and the identification and assessment of marketing opportunities. Consumer behavior and decision making process, organizational buyer behavior, and the role of research in the marketing planning process. Market definition and analysis, segmentation, competitor analysis, targeting and strategic decisions involved in developing the marketing program. Developing marketing mix strategies and relating them to the overall strategic marketing plan. Organizational design for marketing strategy implementation and control, and effectiveness.

Mkt 509. International Business. (2-0) Cr. 2. *Prereq: Graduate classification.* Survey of the structure and environment of international business. Patterns of international trade, economic and monetary systems, cross-cultural and legal aspects of international business. Global dimensions of the functional disciplines of business. Tools for developing global strategies such as economic analysis and risk analysis.

Mkt 540. Marketing Management. (3-0) Cr. 3. F.S. *Prereq: 504.* Strategic marketing and decision making, with emphasis on cases utilizing qualitative and quantitative techniques and marketing models.

Mkt 541. International Marketing. (3-0) Cr. 3. F. *Prereq: 504, 509.* Scope and nature of global marketing operation; the context of international environment in which firms operate. Recent developments of international business activities, and a framework for better understanding of the basic forces driving international business and marketing operations. Development of market entry strategies and global marketing mix policies, as well as export operations. Organizational issues related to the globalization of the firm.

Mkt 542. New Product Development and Marketing. (3-0) Cr. 3. S. *Prereq: 504.* Principles and concepts of new product development and introduction; decision areas include market definition and structure, idea generation, concept evaluation, test marketing, launch tracking, and global product planning; models and techniques of new product evaluation used by consumer product companies.

Mkt 544. Marketing Research. (3-0) Cr. 3. S. *Prereq: 504, Stat 328 or 401.* Marketing research methods are examined with emphasis on the use of advanced research methods in business research. Application of advanced sampling, measurement, and data analysis methods in research on market segmentation, market structure, consumers' perceptions and decision processes, marketing communication, new product development, and pricing.

Mkt 545. Integrated Marketing Communication. (3-0) Cr. 3. *Prereq: 504.* Introduces the student to the field of marketing communications. Covers a number of topics and areas essential for understanding how to design and evaluate communication strategies necessary for the successful marketing of products and services. An integrated marketing communications (IMC) perspective is employed in covering material, with a corresponding focus on various elements of an IMC strategy, including advertising, promotions, point-of-purchase communications, direct marketing techniques, and other topics.

Mkt 546. Customer Relationship and Business-To-Business Marketing. (3-0) Cr. 3. *Prereq: 504.* Core concepts and issues involved in customer relationship strategy and management in consumer and business-to-business markets. Emphasis on customer opportunity analyses, customer relationship management tools and strategies.

Mkt 547. Consumer Behavior. (3-0) Cr. 3. S. *Prereq: 504.* The behavior of consumers. Intensive review of literature from relevant disciplines. Applications of concepts and methods of the behavioral sciences to marketing management decision making.

Mkt 549. Global Marketing Planning and Execution. (3-0) Cr. 3. *Prereq: 501, 504, 509.* Allows students to develop the ability to plan and execute a B2B business by integrating aspects of marketing with other business functions in the international context. Product strategy, innovation, foreign market entry, supply strategies for foreign markets, pricing strategy, market research, customer service, international payments, managing international subsidiaries, licensing, distribution strategy, and responding to changing international environmental conditions. Involves a simulation-based instruction in planning and managing an international B2B business.

Mkt 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* For students wishing to do individual research in a particular area of marketing.

Courses for graduate students

Mkt 601. Seminar in Consumer Behavior. (3-0) Cr. 3. *Prereq: Mgmt 601.* A rigorous foundation of the major conceptual and methodological paradigms in the consumer-behavior literature. Seeks to aid students in understanding the psychological, sociological, and Anthropological roots of consumer behavior research. Read the latest research in the area reported in leading consumer behavior/psychology journals.

Mkt 602. Marketing Strategy. (3-0) Cr. 3. *Prereq: Mgmt 601.* Review major contributions and recent developments in marketing strategy research and practice. Review commonly used modeling approaches and research methods to study strategic interaction between firms seeking to build competitive advantages. Provide an overview of empirical research regarding measurement, level and persistence of business success and implications of findings for theory and strategy development.

Mkt 603. Customer Management Strategy and Implementation. (3-0) Cr. 3. *Prereq: Mkt 601.* Addresses key strategy and implementation issues behind customer management. Topics such as typology of CM strategies, antecedents and outcomes; environmental and managerial influences on strategy formation; technology and impact on CM strategy; and value of CM strategy. Examine theories and concepts behind important CM issues such as customer satisfaction, customer loyalty and customer profitability.

Mkt 604. Marketing Issues in Inter-Organizational Relations. (3-0) Cr. 3. *Prereq: Mgmt 602.* Inter-firm and network competition; relationship among suppliers, distributors, alliance partners, external employees, and internal employees. Theories including agency theory, network theory, relationship marketing, channels of distribution theories on cooperation versus competition, IOS theories.

Mkt 644. Research Methods. (3-0) Cr. 3. *Prereq: Knowledge of introductory Statistics, Stat 401, enrollment in the PhD program.* Introduction to methodological issues that arise when addressing a wide variety of research questions in organizational and consumer studies. Address measurement issues (scales, reliability and construct validity), design (for experiments, surveys, or qualitative studies), sampling, and analysis (univariate and multivariate Statistical procedures). Measurement issues in cross-cultural and international research will also be covered. It is assumed that students entering the course have knowledge of introductory Statistics.

Mkt 650. Research Practicum I. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

Mkt 651. Research Practicum II. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

Mkt 699. Dissertation. Cr. 12. *Prereq: Graduate classification, permission of dissertation supervisor.* Research

Materials Engineering

(Administered by the Department of Materials Science and Engineering)

Richard Lesar, Chair of Department

Distinguished Professors: Gschneidner, Pecharsky, Thiel, Thompson, Trivedi

Distinguished Professors (Emeritus): Verhoeven

University Professors: S. Martin

Professors: Akinc, Chumbley, Genalo, Gleeson, King, Lesar, Levitas, Mallapragada, Rajan, Russell, Shechtman

Professors (Emeritus): Larsen, D. Martin, McGee, Patterson, J. Smith, Wechsler, Wilder

Professors (Adjunct): Anderson, McCallum

Professors (Collaborators): Jiles, Tsukruk

Associate Professors: Bowler, K. Constant, Napolitano, X. Tan, Ustundag

Associate Professors (Adjunct): Athreya, Biner, Kramer

Assistant Professors: Beckman, Chaudhary, Hong, Kessler, Lin

Assistant Professors (Adjunct): Selby

Lecturer: A. Constant, M. Martin

Undergraduate Study

For the undergraduate curriculum in materials engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*. This curriculum is accredited by the Engineering Accreditation Committee of ABET. Materials engineering is a broadly-based discipline relating the composition, microstructure, and processing of materials to their properties, uses and performance. Materials engineering includes a variety of traditional and modern technologies involving metals, ceramics, polymers, composites, and electronic materials.

Because of its interdisciplinary nature, career opportunities for materials engineers bridge all industrial and government sectors including: materials based technologies (materials production), communication/information technologies (semiconducting materials, fiber optics), medical/environmental technologies (biomedical, energy production, waste containment), nanotechnolgies consumer products (building and construction, durable goods), and transportation industries (automotive, aerospace).

The objectives of the materials engineering program are to produce graduates who

•practice materials engineering in a broad range of industries including materials production, semiconductors, medical/environmental, consumer products, and transportation products

•respond to environmental, social, political, ethical and economic constraints to improve the quality of life in Iowa and the world

•work independently and in teams and are proficient in written, oral and graphical communication

•engage in lifelong learning in response to the rapidly expanding knowledge base and changing environment of our world

•engage in advanced study in materials and related or complementary fields.

Graduates in materials engineering are able to apply scientific and engineering principles to select or design the best materials to solve engineering problems. They are also able to control the microstructure of materials through processing to optimize properties and performance. They are skilled in creative, independent problem solving under time and resource constraints. Graduates will have gained experience in materials engineering practice through cooperative work experience or internships in industry, national laboratories, or other funded research work. They will have hands-on skills with a broad range of modern materials processing and characterization equipment and methods.

A degree in materials engineering relies on a strong foundation of math, chemistry and physics. The core materials courses include fundamentals of materials, kinetics and thermodynamics, mechanical properties, computational methods, design, and professional practice experience. Students tailor their programs to their goals and interests through the selection of two areas of specialization from the four available: ceramic materials, electronic materials, metallic materials and polymeric materials. In lieu of the second specialty from the four listed, a student may propose an individually designed, materials related technical specialty to meet specific career goals. Students must have a 3.00 gpa and a B+ in Mat E 215. Students may learn other requirements and procedures for applying in the Undergraduate Handbook or by speaking with their adviser. Approval of this proposal rests with the department's curriculum committee. Additional technical electives can be taken in other areas of interest. The breadth and depth of the program provide excellent preparation for both immediate entry into industry or further study in graduate school.

The department also offers a cooperative education program that combines classroom learning with work experience. (See *College of Engineering Cooperative Programs)*.

Well qualified juniors in materials engineering who are interested in graduate study may apply for concurrent enrollment during their senior year in the Graduate College to simultaneously pursue both bachelor of science and master of science degrees. See Materials Science and Engineering for more information.

Courses primarily for undergraduate students

Mat E 201. Materials Science and Engineering - Professional Planning. Cr. R. F. *Prereq: Sophomore classification in Mat E.* Preparation for a career in materials engineering; experiential learning, resumes, interviewing, Myers-Briggs Type Indicator, leadership, undergraduate research, international opportunities, graduate school preparation and opportunities, and alternative career paths. Satisfactory-fail only.

Mat E 214. Structural Characterization of Materials. (2-3) Cr. 3. S. *Prereq: 215, credit or enrollment in Phys 221.* Structural characterization of ceramic, electronic, polymeric and metallic materials. Techniques include optical and electron microscopy, x-ray diffraction, and thermal analysis. Identification of materials type, microstructure, and crystal structure.

Mat E 215. Introduction to Materials Science and Engineering I. (3-0) Cr. 3. F. *Prereq: Chem 177 or 167.* Materials Engineering majors only. Structure and properties of ceramic, electronic, polymeric and metallic materials, emphasizing differences based on structure and bonding. Phase equilibria and phase transformations. Only one of Mat E 215, 272, or 392 may count toward graduation.

Mat E 215L. Introduction to Materials Science and Engineering I - Lab. (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 215 or 272 or 392.* Materials Engineering majors only. Laboratory exercise in materials.

Mat E 216. Introduction to Materials Science and Engineering II. (3-3) Cr. 4. S. *Prereq: 215, Credit or enrollment in Phys 222.* Materials Engineering majors only. Fundamentals of polymers and composite materials, degradation. Electronic, thermal, magnetic and optical properties of materials. Materials for energy, biomaterials and nanomaterials. Laboratory exercise in materials property measurements.

Mat E 272. Principles of Materials Science and Engineering. (2-0) Cr. 2. F.S.SS. *Prereq: Sophomore classification; Chem 167 or 177; Math 165.* Introduction to the structure of metals, polymers and ceramics. Crystal structure and imperfections in metals. Diffusion, mechanical properties, and failure mechanisms. Phase equilibrium diagrams and heat treatment principles for steels, composite materials, and aluminum alloys. Engineering applications. Only one of Mat E 215, 272, or 392 may count toward graduation.

Mat E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

Mat E 311. Thermodynamics in Materials Engineering. (3-0) Cr. 3. F. *Prereq: 216, Chem 178, Phys 222, credit or enrollment in Math 267.* Basic laws of thermodynamics applied to materials systems. Thermodynamics of chemical reactions. Homogeneous and heterogeneous equilibrium. Phase diagrams for materials systems. Nonmajor graduate credit.

Mat E 314. Kinetics and Phase Equilibria in Materials. (3-0) Cr. 3. S. *Prereq: 216, 311.* Kinetic phenomena and phase equilibria relevant to the origins and stability of microstructure in metallic, ceramic and polymeric systems. Application of thermodynamics to the understanding of stable and metastable phase equilibria, interfaces and their effects on stability: defects and diffusion, empirical rate equations for transformation kinetics, driving forces and kinetics of nucleation, diffusional and diffusionless phase transformations. Nonmajor graduate credit.

Mat E 316. Computational Methods in Materials. (2-2) Cr. 3. S. *Prereq: 216.* Use of Mathematical and Statistical computer tools for materials design and analysis. Applications of Statistical principles to problems concerned with materials. Computer-assisted design of experiments. Nonmajor graduate credit.

Mat E 317. Introduction to Electronic Properties of Ceramic, Metallic, and Polymeric Materials. (3-0) Cr. 3. F. *Prereq: 216 and Phys 222.* Materials Engineering majors only. Introduction to electronic properties of materials and their practical applications. Classical conduction models and electronic properties of metallic and ceramic materials. Elementary quantum mechanics and band theory of electron states in solids. Quantum theory of metallic conduction. Elementary semiconductor theory and devices. Polarization and dielectric properties of materials. Electron conduction in polymeric systems. Magnetic properties and applications of metals and ceramics.

Mat E 321. Introduction to Ceramic Science. (3-0) Cr. 3. F. *Prereq: 216.* Ceramic crystal structures, defects, diffusion and transport. Phase equilibria and microstructures. Powder packing. Thermal, electronic, optical and magnetic properties of ceramics. Nonmajor graduate credit.

Mat E 322. Introduction to Ceramic Processing. (2-3) Cr. 3. S. *Prereq: 321.* Synthesis and characterization of ceramic powders. Colloidal phenomena, rheology of suspensions, ceramic forming methods, and drying. High temperature ceramic reactions, liquid and solid-state sintering, grain growth, microstructure development. Processing/microstructure/property relationships. Nonmajor graduate credit.

Mat E 332. Semiconductor Materials and Devices. (Cross-listed with E E). (3-0) Cr. 3. S. *Prereq: Phys 222, and for Mat E majors only Mat E 334.* Introduction to semiconductor material and device physics. Quantum mechanics and band theory of semiconductors. Charge carrier distributions, generation/recombination, transport properties. Physical and electrical properties and fabrication of semiconductor devices such as MOSFETs, bipolar transistors, laser diodes and LED's. Nonmajor graduate credit.

Mat E 334. Electronic Properties of Materials. (2-2) Cr. 3. S. *Prereq: 317.* Electronic properties of conductors, semiconductors and dielectric materials. Quantum mechanical description of electron wave-particle duality and solutions of Shrodinger equation for free and bound electrons. Development of band theory of electron states in solids. Statistical mechanics and the density-of-states in energy bands. Thermal properties of lattices. Quantum model for metallic conduction. Semiconductor theory and semiconductor device physics. Polarization phenomena and dielectric properties of materials. Superconductivity and BCS Theory. Nonmajor graduate credit.

Mat E 342. Structure/Property Relations in Nonferrous Metals. (2-3) Cr. 3. S. *Prereq: 216.* Processing of metals and alloys to obtain desired mechanical properties by manipulation of their microstructure and composition of constituent phase(s). Relevance of defects to mechanical properties, plastic flow. Strengthening mechanisms in metals and alloys. Microstructure, heat treatment and mechanical properties of engineering alloys. Metal-matrix composites. Nonmajor graduate credit.

Mat E 351. Introduction to Polymeric Materials. (3-0) Cr. 3. F. *Prereq: 216.* Introduction to polymeric materials, synthesis, structure and properties. Relationship between polymer composition, processing and properties. Nonmajor graduate credit.

Mat E 362. Principles of Nondestructive Testing. (Cross-listed with E M). (3-0) Cr. 3. S. *Prereq: Phys 112 or 222.* Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection, and other techniques. Physical bases of tests; materials to which applicable; types of defects detectable; calibration standards, and reliability safety precautions. Nonmajor graduate credit.

Mat E 362L. Nondestructive Testing Laboratory. (Cross-listed with E M). (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 362.* Application of nondestructive testing techniques to the detection and sizing of flaws in materials and to the characterization of material's microstructure. Included are experiments in hardness, dye penetrant, magnetic particle, x-ray, ultrasonic and eddy current testing. Field trips to industrial laboratories. Nonmajor graduate credit.

Mat E 370. Toying with Technology. (Cross-listed with Cpr E). (2-2) Cr. 3. F.S. *Prereq: C I 201, junior standing in non-engineering major.* A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on laboratory experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Future K-12 teachers will leave the course with complete lesson plans for use in their upcoming careers.

Mat E 388. Sustainable Engineering and International Development. (Cross-listed with A E, C E, E E, M E). (2-2) Cr. 3. F. *Prereq: Junior classification in engineering.* Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as nongovernment organizations (NGOs). Course readings, final project/design report.

Mat E 391. Introduction to US Women's roles in Industry and Preparation for Summer Study. (3-0) Cr. 3. S. Introduction to the historical role of women as related to US industry, family and community with emphasis on the years 1830 - 1945, but also related to the current climate. Topics completed in 392 with arranged lectures at Brunel University. Orientation for Brunel summer study program. Credit for graduation allowable only upon completion of Mat E 392. Satisfactory-fail only.

Mat E 392. Principles of Materials Science and Engineering. (3-0) Cr. 3. SS. *Prereq: 391, Chem 167 or 177.* Structure and properties of ceramic, electronic, polymeric and metallic materials, emphasizing differences based on structure and bonding. Phase equilibria and phase transformations. Taught on Brunel University campus. Only one of Mat E 215, 272, or 392 may count toward graduation. Satisfactory-fail only.

Mat E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period.

Mat E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services; junior classification.* Professional work period, one semester maximum per academic year.

Mat E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

Mat E 413. Materials Design and Professional Practice I. (2-2) Cr. 3. F. *Prereq: Senior Status in Mat E.* Fundamentals of materials engineering design, information sources, team behavior, professional preparation, quantitative design including finite-element analysis and computer aided design, materials selection, informatics and combinatorial methods. Analysis of design problems, development of solutions, selected case studies. Oral presentation skills. Preparations for spring project.

Mat E 414. Materials Design and Professional Practice II. (2-2) Cr. 3. S. *Prereq: Senior Status in Mat E.* Integration of materials processing, structure/composition, properties and performance principles in materials engineering problems. Multi-scale design of materials, materials processing, case studies including cost analysis, ethics, risk and safety. Team projects specified by either industry or academic partners. Written and oral final project reports.

Mat E 418. Mechanical Behavior of Materials. (2-3) Cr. 3. S. *Prereq: 216 and credit or enrollment in E M 324.* Mechanical behavior of ceramics, metals, polymers, and composites. Relationships between materials processing and atomic aspects of elasticity, plasticity, fracture, and fatigue. Life prediction, stress- and failure analysis. Nonmajor graduate credit.

Mat E 425. Glasses and Advanced Ceramics. (2-3) Cr. 3. F. *Prereq: 321.* Composition, structure, properties and manufacturing of inorganic glasses. Properties and applications of advanced ceramics. Structural, thermal, optical, electronic, magnetic and biological applications of ceramic materials. Contemporary topics in ceramic engineering. Laboratory exercises in preparation and characterization of glasses and advanced ceramics. Nonmajor graduate credit.

Mat E 432. Microelectronics Fabrication Techniques. (Cross-listed with E E). (2-4) Cr. 4. *Prereq: Phys 222, Math 267. E E 332 or Mat E 334 recommended.* Techniques used in modern integrated circuit fabrication, including diffusion, oxidation, ion implantation, lithography, evaporation, sputtering, chemical-vapor deposition, and etching. Process integration. Process evaluation and final device testing. Extensive laboratory exercises utilizing fabrication methods to build electronic devices. Use of computer simulation tools for predicting processing outcomes. Recent advances in processing CMOS, ICs and micromechanical systems (MEMS). Nonmajor graduate credit.

Mat E 433. Advanced Electronic Materials. (2-3) Cr. 3. F. *Prereq: 334.* Advanced concepts in band theory of solids including chemical bonding in solids and the linear combination of atomic orbitals, phase transitions in electronic, magnetic, and optical materials. Dielectric materials, ferroelectricity, piezoelectricity, sensors, and non-stoichiometric conductors. Optical properties, optical spectra of materials, optoelectronic devices. Magnetic and superconducting materials. Nonmajor graduate credit.

Mat E 442. Polymers and Polymer Engineering. (Cross-listed with Ch E). (3-0) Cr. 3. S. *Prereq: Ch E 382 and Chem 331 or Mat E 351.* Chemistry of polymers, addition and condensation polymerization. Physical and mechanical properties, polymer rheology, production methods. Applications of polymers in the chemical industry. Nonmajor graduate credit.

Mat E 443. Physical Metallurgy of Ferrous Alloys. (2-3) Cr. 3. F. *Prereq: 214, 216, 311.* Production and processing of ferrous metals. Extraction of pig iron from ore. Steelmaking processes. Equilibrium and nonequilibrium phases in the Fe-C system. Properties and processing of cast irons, plain carbon and alloy steels, stainless and specialty steels. Transformation diagrams, hardenability, and surface treatments. Continuous casting, forging, hot rolling, quenching, and tempering as they apply to ferrous materials. Cost and mechanical performance considerations in cast iron and steel selection and heat treatment. Nonmajor graduate credit.

Mat E 444. Corrosion and Failure Analysis. (2-2) Cr. 3. S. *Prereq: 216 and credit or enrollment in 418.* Corrosion and corrosion control of metallic systems. Corrosion fundamentals, classification of different types of metallic corrosion, corrosion properties of various engineering alloys, corrosion control. Failure analysis. Characteristics of common types of metallic failures, case studies of failures, designing to reduce failure risk. Nonmajor graduate credit.

Mat E 453. Physical and Mechanical Properties of Polymers. (Dual-listed with M S E 553). (2-3) Cr. 3. F. *Prereq: 351.* Overview of polymer chemical composition, microstructure, thermal and mechanical properties, rheology, and principles of polymer materials selection. Intensive laboratory experiments include chemical composition studies, microstructural characterization, thermal analysis, and mechanical testing. Nonmajor graduate credit.

Mat E 454. Polymer Composites and Processing. (Dual-listed with M S E 554). (3-0) Cr. 3. S. *Prereq: 351.* Basic concepts in polymer composites, blends, and block copolymers. Phase separation and miscibility, microstructures and mechanical behavior. Fiber reinforced and laminated composites. Viscosity, rheology, viscoelasticity of polymers. Polymer melt processing methods such as injection molding and extrusion; selection of suitable processing methods and their applications. Nonmajor graduate credit.

Mat E 456. Biomaterials. (Dual-listed with M S E 556). (3-0) Cr. 3. S. *Prereq: 216 or 272 or 392.* Presentation of the basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

Mat E 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Aer E, Cpr E, E E, Engr, I E, M E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of the instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

Mat E 488. Eddy Current Nondestructive Evaluation. (Dual-listed with M S E 588). (Cross-listed with E E). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Math 265 and (Mat E 216 or 272 or E E 311 or Phys 364).* Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

Mat E 490. Independent Study. Cr. arr. Repeatable. Investigation of individual research or special topics.

Mat E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Materials Science and Engineering

Richard Lesar, Chair of Department

Distinguished Professors: Gschneidner, Pecharsky, Thiel, Thompson, Trivedi

Distinguished Professor (Emeritus): Verhoeven

University Professor: S. Martin

Professors: Akinc, Chumbley, Genalo, Gleeson, King, Lesar, Levitas, Mallapragada, Rajan, Russell, Shechtman

Professors (Emeritus): , D. Martin, McGee, Patterson, J. Smith, Wechsler, Wilder

Professors (Adjunct): Anderson, McCallum

Professors (Collaborators): Jiles, Tsukruk

Associate Professors: Bowler, Constant, Napolitano, X. Tan, Ustundag

Associate Professors (Adjunct): Athreya, Biner, Kramer

Assistant Professors: Beckman, Chaudhary, Hong, Kessler, Lin

Assistant Professors (Adjunct): Selby

Lecturer: A. Constant, M. Martin

Graduate Study

The department offers work toward the following advanced degrees: Master of Science in Materials Science and Engineering and Doctor of Philosophy in Materials Science and Engineering.

Built on a foundation of thermodynamics, kinetics of phase transformations, mechanical behavior, physical properties, solid state science, and the structure and chemistry of materials, the graduate program offers advanced studies in many areas of materials science and engineering, including the design and control of materials for structural, electronic, photonic, magnetic, optical, and biological functionality. Graduates of the program have a fundamental understanding of the critical aspects of the field and how they are applied to real materials systems. The program is highly flexible and research-oriented, where students work carefully with their major professor in tailoring the various academic and research components to meet their interests.

With the ability to address complex problems in materials science while considering the various constraints inherent to both academic and industrial environments, our graduates are well prepared for a wide range of academic and research-related careers. They are skilled in carrying out independent and collaborative research, able to communicate effectively in formal and informal settings, and are proficient at writing persuasive technical articles and grant proposals.

The department boasts excellent facilities for academic materials research, maintaining a wide range of faculty laboratories across the ISU campus. In addition, departmental research is highly integrated with the operation of several Research Centers, such as the Ames Laboratory, the Center for Nondestructive Evaluation, the Microelectronics Research Center, and the Center for Advanced Technology Development. These laboratories offer excellent resources and opportunities for graduate student research.

Prerequisite to major graduate work is completion of an undergraduate curriculum in physical science, biological science, or engineering discipline. Graduate students from disciplines other than materials science and engineering may expect that supplemental coursework will be needed, in addition to the required graduate coursework. Well qualified students (juniors) enrolled in the undergraduate materials engineering program at Iowa State University can apply to the Graduate College for admission to the concurrent enrollment program, where students may simultaneously pursue both master of science and bachelor of sciences degrees.

The requirements for the M.S. and Ph.D. degrees are established by the student's program of study committee within the established guidelines of the Graduate College. Minimum requirements include coursework, research, proposal, preliminary oral examination (Ph.D. only), dissertation, and a final oral examination. Academic coursework requirements include 18 credits for the M.S. degree and 26 credits for the Ph.D., with additional specific rules for choices available from the department.

There are no foreign language requirements for either of the graduate degrees administered by the Department of Materials Science and Engineering. Graduate students wishing to declare a formal minor in materials science and engineering will have at least one materials science and engineering faculty member serving on their program of study committee. For the M.S. and Ph.D. degrees, they will take a minimum of 8 and 12 materials science and engineering course credits, respectively.

Courses primarily for graduate students, open to qualified undergraduate students

M S E 510. Fundamentals of Structure and Chemistry of Materials. (3-0) Cr. 3. F. *Prereq: Math 165, Phys 221, and Chem 167.* Geometric and algebraic representations of symmetry. Pair distribution function. Structure, chemistry, and basic properties of covalent, ionic, and metallic solids, glasses and liquids, and polymers. Interactions of materials with particles and waves. Relationships between direct and reciprocal spaces. The kinematical theory of diffraction, with an introduction to the dynamical theory.

M S E 520. Thermodynamics and Kinetics in Multicomponent Materials. (3-0) Cr. 3. F. *Prereq: Mat E 311 or Chem 321, Math 266 or Math 267.* A review of the fundamental principles of heat, work, basic thermodynamic relations, and criteria for equilibrium. Analytical treatments for the thermodynamic description of multicomponent chemical solutions and reacting systems are developed and employed to predict phase equilibria in materials systems. Builds on the thermodynamic construction to treat the kinetics of chemical reactions and phase transformations. Topics include general first order and second order transitions, along with chemical diffusion. Detailed examples involving nucleation and diffusion limited growth, spinodal decomposition, martensitic transformations, magnetic and electric transitions, and glass formation will be considered.

M S E 521. Mechanical Behavior and Manufacturing of Polymers and Composites. (Cross-listed with M E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: ME 324 or Mat E 272 and E M 324.* Effect of chemical structure and morphology on properties. Linear viscoelasticity, damping and stress relaxation phenomena. Structure and mechanics of filler and fiber reinforced composites. Mechanical properties and failure mechanisms. Material selection and designing with polymers. Processing of polymer and composite parts.

M S E 530. Solid State Science. (3-0) Cr. 3. S. *Prereq: Mat E 334 or E E 332 or Phys 322.* Development of a quantitative description of the electronic structure of solids starting with fundamentals of atoms, atomic bonding, basic crystallography, and band theory of solids. Continuum properties of solids in response to electromagnetic fields and thermal gradients. Quantitative description of the atomistic properties of solids through electron-electron interactions, electron-phonon interactions, and dipole interactions.

M S E 540. Mechanical Behavior of Materials. (3-0) Cr. 3. F. *Prereq: Mat E 418, Math 266 or Math 267.* Mechanical behavior of materials with emphasis on micromechanics of deformation in three generic regimes: elasticity, plasticity, and fracture. A materials science approach is followed to understand and model the mechanical behavior that combines continuum mechanics, thermodynamics, kinetics, and microstructure. Some topics include elastic properties of materials, permanent deformation mechanisms at different temperatures (e.g., via dislocation motion and creep), and fracture in ductile and brittle materials. Specific classes of materials that are studied: metals, ceramics, polymers, glasses and composites.

M S E 550. Fundamentals of Nondestructive Evaluation. (Cross-listed with E M). (3-2) Cr. 4. S. *Prereq: E M 324, Math 385.* Principles of five basic NDE methods and their application in engineering inspections. Materials behavior and simple failure analysis. NDE reliability, and damage-tolerant design. Advanced methods such as acoustic microscopy, laser ultrasonics, thermal waves, computed tomography, and thermoelectrics are analyzed. Laboratory experiments on all basic methods: ultrasonics, eddy currents, x-ray, liquid penetrants, magnetic testing, and visual inspection are performed.

M S E 551. Characterization Methods in Materials Science. (2-3) Cr. 3. *Prereq: Mat E 214.* Characterization of ceramic, metal, polymer and glassy materials using modern analytical techniques. Spectroscopic (IR, Raman, UV/VIS/NIR, and NMR), thermal (DSC, DTA/TGA, and DMA) methods, mechanical and rheological testing, magnetic and electrical characterization, and powder characterization.

M S E 552. Scanning and Auger Electron Microscopy. (2-3) Cr. 3. *Prereq: Phys 222.* Characterization of materials using scanning electron microscope (SEM), electron microprobe, and auger spectrometer. Compositional determination using energy and wavelength dispersive x-ray and Auger spectroscopies. Specimen preparation. Laboratory covers SEM operation.

M S E 553. Physical and Mechanical Properties of Polymers. (Dual-listed with Mat E 453). (2-3) Cr. 3. F. *Prereq: Mat E 351.* Overview of polymer chemical composition, microstructure, thermal and mechanical properties, rheology, and principles of polymer materials selection. Intensive laboratory experiments include chemical composition studies, microstructural characterization, thermal analysis, and mechanical testing.

M S E 554. Polymer Composites and Processing. (Dual-listed with Mat E 454). (3-0) Cr. 3. S. *Prereq: Mat E 351.* Basic concepts in polymer composites, blends, and block copolymers. Phase separation and miscibility, microstructures and mechanical behavior. Fiber reinforced and laminated composites. Viscosity, rheology, viscoelasticity of polymers. Polymer melt processing methods such as injection molding and extrusion; selection of suitable processing methods and their applications.

M S E 555. Advanced Polymer Materials. (3-0) Cr. 3. *Prereq: Mat E 351.* Overview of basic principles of polymeric materials and the latest developments. Recently introduced polymeric materials (functional block-copolymers, biomedical, conductive, nanocomposites, electrooptical, non-linear optical polymers) and prospective applications in functional coatings, artificial implants, microelectronics, nanodevices, chemo/bio-sensors, and optical computing.

M S E 556. Biomaterials. (Dual-listed with Mat E 456). (3-0) Cr. 3. S. *Prereq: Mat E 216 or 272 or 392.* Presentation of the basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

M S E 564. Fracture and Fatigue. (Cross-listed with E M, M E). (3-0) Cr. 3. F. *Prereq: E M 324 and either Mat E 216 or 272 or 392. Undergraduates: Permission of instructor.* Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

M S E 569. Mechanics of Composite and Combined Materials. (Cross-listed with E M). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: E M 324.* Mechanics of fiber-reinforced materials. Micromechanics of lamina. Macromechanical behavior of lamina and laminates. Strength and interlaminar stresses of laminates. Failure criteria. Stress analysis of laminates. Thermal moisture and residual stresses. Joints in composites.

M S E 570. Toying With Technology for Practicing Teachers. (Cross-listed with C I). (2-0) Cr. 2. SS. *Prereq: C I 201, non-engineering major.* A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Other technological advances with K-12 applications will be explored. K-12 teachers will leave the course with complete lesson plans for use in their classrooms.

M S E 588. Eddy Current Nondestructive Evaluation. (Dual-listed with Mat E 488). (Cross-listed with E E). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Math 265 and (Mat E 216 or 272 or E E 311 or Phys 364).* Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

M S E 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

M S E 599. Creative Component. Cr. arr. Repeatable.

Courses primarily for graduate students

M S E 610. Academic Teaching Practices. (2-0) Cr. 2. Repeatable. F.S. *Prereq: Permission of instructor.* Provides instruction and directed experience in undergraduate level teaching practices. Students engage in lesson planning, classroom/laboratory teaching, student and course assessment, web-based lessons, and other aspects of academic course delivery.

M S E 620. Fundamentals of Phase Transformations. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: M S E 520.* Explores various advanced theoretical treatments of the energetics and kinetics of multi-component materials. Topics include analytical and computational descriptions of thermodynamic quantities, experimental measurement of essential physical properties, analytical and computational treatments of kinetic processes, and the use of theoretical predictions of phase equilibria and evolution in materials systems.

M S E 630. Physical Properties of Solids. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: M S E 530.* Advanced course in the behavior of solids within the framework of solid state physics and chemistry. Includes magnetic, dielectric, transport, and optical phenomena in solids. Influence of phase transformations and crystal symmetry on the physical properties.

M S E 651. Powder Diffraction Methods. (3-0) Cr. 3. S. *Prereq: M S E 510.* Advanced structural characterization of materials using powder diffraction. Production of X-ray and neutron radiation. Review of symmetry, group and kinematical theories of diffraction. Mathematical and computational backgrounds of powder diffraction data. Introduction to single crystal diffraction methods, origin of powder diffraction pattern, history of the technique. Modern powder diffraction methods. Indexing of powder diffraction patterns, figures of merit, precise lattice parameters. Phase problem, determining crystal structures from symmetry and geometry, Patterson, direct and Fourier methods. Rietveled method, precise crystal structures: atomic parameters, qualitative and quantitative phase identification, preferred orientation, grain size, strain, residual stress, order-disorder. Powder diffraction at non-ambient conditions. Applications of powder diffraction: data bases, phase transformations, phase diagrams, local structures, magnetism.

M S E 652. Transmission Electron Microscopy. (3-3) Cr. 4. S. *Prereq: 534.* Characterization of inorganic materials using TEM. Selected area and convergent beam electron diffraction, bright field/dark field/high resolution imaging. Compositional analysis using x-ray and electron energy loss spectroscopy.

M S E 690. Advanced Topics in Materials Science. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

M S E 697. Engineering Internship. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of department, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

M S E 699. Research. Cr. arr. Repeatable.

Mathematics

www. math.iastate.edu

Wolfgang Kliemann, Chair of Department

Distinguished Professors: Athreya, Levine

Distinguished Professors (Emeritus): R. Miller, Vinograde

University Professor (Emeritus): Cornette

Professors: Bergman, Dahiya, Evans, Hentzel, Hogben, Hou, E. Johnston, Kliemann, Lieberman, Liu, Luecke, J. Lutz, Maddux, Murdock, Peters, Rothmayer, Sacks, Sethuraman, Smiley, J. Smith, Tesfatsion, Weerasinghe, Willson, Wu

Professors (Emeritus): Barnes, Cain, Carlson, Colwell, Fink, Gautesen, Homer, Mathews, Pigozzi, Rudolph, Sanderson, Seifert, A. Steiner, E. Steiner, Tondra, Weiss, Wright

Professor (Collaborator): Driessel

Associate Professors: Alexander, Axenovich, D'Alessandro, Davidson, Hansen, Keinert, Ng, Poon, S. Song, Tidriri, J. Wilson

Associate Professor (Emeritus): Heimes

Associate Professor (Collaborators): Ashlock

Assistant Professors: Boushaba, Long, R. Martin, Matzavinos, Su, Weber, Yan

Assistant Professor (Emeritus): Peake

Senior Lecturers: Bolles, G. Johnston

Lecturers: Allen, Chan, Diesslin, Ellis, Gaalswyk, B. Hall, Kramer, Pan, Roettger, Schultz, Wagner

Undergraduate Study

For the undergraduate curriculum in liberal arts and sciences, major in mathematics, leading to the degree bachelor of science, see Liberal Arts and Sciences, Curriculum.

The program in mathematics offers training suitable for students planning to enter secondary school teaching, to work in mathematics and computation for industry or government, or to continue their studies in graduate school. The requirements for an undergraduate major in mathematics are designed so that the student may have opportunity for appropriate specialization to meet one or more of the foregoing objectives and, at the same time, obtain a thorough introduction to the mathematics underlying all of them.

Graduates understand a broad range of mathematical topics and are familiar with a broad range of mathematical models. They have skills for solving problems in diverse situations. They can construct rigorous arguments to demonstrate mathematical facts. They can communicate their mathematical methods to others and can justify their assumptions.

The requirements for an undergraduate major include:

(a) Math 165, 166, 201, 265, 317, 301, 414, and either 266 or 267.

(b) 15 additional credits in mathematics courses at the 300 level or above.

(c) The courses used to satisfy a) and b) above must include one of the sequences 301, 302; 414, 415; 435, 436.

(d) In addition to the credits in (b), either Math 492 or 2 credits of C I/LAS 480C. (C I/LAS 480C is available only for students seeking secondary school certification).

(e) Communication Proficiency requirement: The department requires a grade of C– or better in each of English 150 and 250 (or 250H) and an upper-level communication skills requirement that may be met by writing an acceptable undergraduate thesis (Math 491) or by taking at least one of Engl 302, 305, 314 or JI MC 201. A grade of C- or better is required.

The department strongly recommends that each student majoring in mathematics include in the program substantial supporting work beyond the minimum general education requirement of the college in one or more areas of application of mathematics, such as other mathematical sciences, engineering, natural science, or social science. In particular, it recommends that each student take Com S 207, 208; Phys 221, 222; and Stat 341, 342 (or Math 304). It also recommends that students contemplating graduate study in mathematics acquire a reading knowledge of French, German, or Russian. Credits earned in Math 104, 105, 140, 141, 142, 150, 151, 160, 181, 182, 195, 196, cannot be counted toward graduation by mathematics majors.

The department offers a minor in mathematics which may be earned by credit in Math 201, 265, (266 or 267), (307 or 317), and 301.

Graduate Study

The department offers programs leading to a master of science or doctor of philosophy degree in mathematics or applied mathematics, as well as minor work for students whose major is in another department. The department also offers a program leading to the degree of master of school mathematics (M.S.M.).

Students desiring to undertake graduate work leading to the M.S. or Ph.D. degree should have at least 12 semester credits of work in mathematics beyond calculus. It is desirable that these credits include advanced calculus and abstract algebra.

The M.S. degree requires at least 30 credits and students must write a creative component or thesis and pass a comprehensive oral examination over their coursework and their creative component or thesis. See the department handbook for specific requirements.

The Ph.D. degree requires a student to take 54 hours of coursework in addition to research hours, pass written qualifying examinations, pass an oral preliminary exam, and perform an original research project culminating in a dissertation

which is defended by an oral exam. Ph.D. candidates must have at least one year of supervised teaching experience. See the on-line Mathematics Graduate Handbook for specific requirements.

The M.S.M. degree is primarily for inservice secondary mathematics teachers. Students desiring to pursue the M.S.M degree should present some undergraduate work in mathematics beyond calculus. Candidates for the M.S.M. degree must write an approved creative component and pass a comprehensive oral examination over their course work and their creative component.

Courses primarily for undergraduate students

Math 010. High School Algebra. (4-0) F.S.SS. For students who do not have adequate facility with topics from high school algebra or do not meet the algebra admission requirement. The course is divided into tracks of one- and two-semester lengths. For most students a diagnostic exam will determine which track must be taken. Students will receive a grade in Math 25 or 30 respectively depending on the level of material covered. Satisfactory completion of Math 30 is recommended for students planning to take Math 140 or 151, while Math 25 is sufficient for Math 104, 105, 150, 195, Stat 101 or 105. Students must complete Math 30 to remove a deficiency in the algebra admission requirement. Topics include signed numbers, polynomials, rational and radical expressions, exponential and logarithmic expressions, and equations. Satisfactory-fail only.

Math 025. High School Algebra. (4-0) F.S.SS. Students should initially enroll in Math 10. See description of Math 10. Satisfactory-fail only.

Math 030. High School Algebra. (4-0) F.S.SS. Students should initially enroll in Math 10. See description of Math 10. Satisfactory-fail only.

Math 101. Orientation in Mathematics. Cr. R. F. For new majors. Issues to consider in planning a program of study. Sources of general information and perspectives concerning mathematics. Discussion of possible areas of study and careers. Satisfactory-fail only.

Math 104. Introduction to Probability and Matrices. (3-0) Cr. 3. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Permutations, combinations, probability, binomial and multinomial theorems, matrices, expected value. Either Math 104 or 150 may be counted toward graduation, but not both.

Math 105. Introduction to Mathematical Ideas. (3-0) Cr. 3. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Topics from mathematics and mathematical applications with emphasis on their nontechnical content.

Math 140. College Algebra. (3-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra; 1 year of high school geometry.* Coordinate geometry, complex numbers, quadratic and polynomial equations, functions, graphing, linear, polynomial and rational functions, exponential and logarithmic functions, inverse functions, linear inequalities, systems of equations. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, or 195 toward Group III of the General Education Requirements.

Math 141. Trigonometry. (2-0) Cr. 2. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra; 1 year of high school geometry, or enrollment in 140.* May be taken concurrently with 140. Trigonometric functions and their inverses, solving triangles, trigonometric identities and equations, graphing. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, or 195 toward Group III of the General Education Requirements. Only one of Math 141, 142 may count toward graduation.

Math 142. Trigonometry and Analytic Geometry. (2-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry, or enrollment in 140.* May be taken concurrently with 140. Trigonometric functions and their inverses, solving triangles, trigonometric identities and equations, graphing, polar coordinates, complex numbers, standard equations of lines and conic sections, parametric equations. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, or 195 toward Group III of the General Education Requirements. Only one of Math 141, 142 may count toward graduation.

Math 150. Discrete Mathematics for Business and Social Sciences. (2-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Linear equations and inequalities, matrix algebra, linear programming, discrete probability. Either Math 104 or 150 may be counted toward graduation, but not both.

Math 151. Calculus for Business and Social Sciences. (2-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Differential calculus, applications to max-min problems, integral calculus and applications. Will not serve as prerequisite for 265 or 266. Only one of Math 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 160. Survey of Calculus. (4-0) Cr. 4. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of geometry.* Analytic geometry, derivatives and integrals of elementary functions, partial derivatives, and applications. Will not serve as a prerequisite for 265 or 266. Only one of Math 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 165. Calculus I. (4-0) Cr. 4. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry or enrollment in 141 or 142.* Differential calculus, applications of the derivative, introduction to integral calculus. Only one of Math 151 or 160 or the sequence 165-166, or the sequence 181-182 may be counted towards graduation. **Math 166. Calculus II.** (4-0) Cr. 4. F.S.SS. *Prereq: Grade of C- or better in 165 or high math placement scores.* Integral calculus, applications of the integral, infinite series. Only one of Math 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 166H. Honors Calculus II. (4-0) Cr. 4. F.S. *Prereq: Permission of instructor and 165 or high math placement scores.* Integral calculus, applications of the integral, infinite series. Additional material of a theoretical, conceptual, computational, or modeling nature. Some of the work may require more ingenuity than is required for Math 166. Preference will be given to students in the University Honors Program. Only one of Math 151 or 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 181. Calculus and Mathematical Modeling for the Life Sciences I. (4-0) Cr. 4. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry, 1 semester of trigonometry or enrollment in 141 or 142.* Exponential and logarithm functions, difference equations, derivatives, and applications of the derivative. Examples taken from biology. Only one of Math 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 182. Calculus and Mathematical Modeling for the Life Sciences II. (4-0) Cr. 4. S. *Prereq: 181.* Integration, differentiation and integration of transcendental functions, first and second order differential equations, applications of the definite integral. Examples taken from biology. Only one of 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Math 195. Mathematics for Elementary Education I. (2-2) Cr. 3. F.S. *Prereq: Satisfactory performance on placement exam, 2 years high school algebra, 1 year of high school geometry, enrollment in elementary education or early childhood education.* Theoretical and hands-on models; standard and non-standard algorithms and properties related to whole numbers and whole number operations. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, or 195 toward Group III of the General Education Requirements.

Math 196. Mathematics for Elementary Education II. (2-2) Cr. 3. F.S. *Prereq: Grade of C- or better in 195 and enrollment in elementary education.* Two-and three-dimensional measurement, probability, data fitting, statistics, operations and algorithms for computing with integers, fractions, and decimals.

Math 201. Introduction to Proofs. (3-0) Cr. 3. F.S. *Prereq: 166 or 166H.* Reading and writing simple proofs, using logical reasoning, including quantifiers and truth tables. Proof Techniques. Mathematical induction. Proofs in set theory, number theory, and calculus.

Math 265. Calculus III. (4-0) Cr. 4. F.S.SS. *Prereq: Grade of C- or better in 166 or 166H.* Analytic geometry and vectors, differential calculus of functions of several variables, multiple integrals, vector calculus.

Math 265H. Honors Calculus III. (4-0) Cr. 4. F.S. *Prereq: Permission of the instructor; and 166 or 166H.* Analytic geometry and vectors, differential calculus of functions of several variables, multiple integrals, vector calculus. Additional material of a theoretical, conceptual, computational, or modeling nature. Some of the work may require more ingenuity than is required in Math 265. Preference will be given to students in the University Honors Program.

Math 266. Elementary Differential Equations. (3-0) Cr. 3. F.S.SS. *Prereq: Grade of C- or better in 166 or 166H.* Solution methods for ordinary differential equations. First order equations, linear equations, constant coefficient equations. Eigenvalue methods for systems of first order linear equations. Introduction to stability and phase plane analysis.

Math 267. Elementary Differential Equations and Laplace Transforms. (4-0) Cr. 4. F.S.SS. *Prereq: Grade of C- or better in 166 or 166H.* Same as 266 but also including Laplace transforms and series solutions to ordinary differential equations.

Math 268. Laplace Transforms. (1-0) Cr. 1. Alt. F., offered 2009. *Prereq: 266.* Laplace transforms and series solutions to ordinary differential equations. Together, Math 266 and 268 are the same as 267.

Math 290. Independent Study. Cr. arr. Repeatable. H. Honors

Math 297. Intermediate Topics for School Mathematics. (2-2) Cr. 3. F.S. *Prereq: Enrollment in elementary education and grade of C- or better in 196.* Mathematical reasoning, data fitting, and topics in Euclidean and non-Euclidean geometry. Discrete mathematics topics selected from graphs, networks, recurrence relations, probability, Markov chains. Use of technology to learn and teach mathematics.

Math 298. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Math 301. Abstract Algebra I. (3-0) Cr. 3. F.S. *Prereq: 166 or 166H, 307 or 317, and 201.* Theory of groups. Homomorphisms. Quotient groups. Introduction to rings. Emphasis on writing proofs. Nonmajor graduate credit.

Math 302. Abstract Algebra II. (3-0) Cr. 3. S. *Prereq: 301.* Theory of rings and fields. Introduction to Galois theory. Emphasis on writing proofs. Nonmajor graduate credit.

Math 304. Introductory Combinatorics. (3-0) Cr. 3. F. *Prereq: 166 or 166H; 201 or experience with proofs.* Permutations, combinations, binomial coefficients, inclusion-exclusion principle, recurrence relations, generating functions. Additional topics selected from probability, random walks, and Markov chains. Nonmajor graduate credit.

Math 307. Matrices and Linear Algebra. (3-0) Cr. 3. F.S.SS. *Prereq: 2 semesters of calculus.* Systems of linear equations, determinants, vector spaces, linear transformations, orthogonality, least-squares methods, eigenvalues and eigenvectors. Emphasis on methods and techniques. Only one of Math 307, 317 may be counted toward graduation. Nonmajor graduate credit.

Math 314. Graphs and Networks. (3-0) Cr. 3. S. *Prereq: 166 or 166H; 201 or experience with proofs.* Structure and extremal properties of graphs. Topics are selected from: trees, networks, colorings, paths and cycles, connectivity, planarity, Ramsey theory, forbidden structures, enumeration, applications. Nonmajor graduate credit.

Math 317. Theory of Linear Algebra. (4-0) Cr. 4. F.S. *Prereq: 166; credit or enrollment in 201.* Systems of linear equations, determinants, vector spaces, inner product spaces, linear transformations, eigenvalues and eigenvectors. Emphasis on writing proofs and results. Only one of Math 307, 317 may be counted toward graduation. Nonmajor graduate credit.

Math 331. Topology. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 307 or 317.* Topological properties of metric spaces, including Euclidean n-space, continuous functions, homeomorphisms, and topological invariants. Examples from surfaces, knots, links, and three-dimensional manifolds. Nonmajor graduate credit.

Math 341. Introduction to the Theory of Probability and Statistics I. (Cross-listed with Stat). (3-0) Cr. 3. F.S. *Prereq: Math 265 (or 265H).* Probability; distribution functions and their properties; classical discrete and continuous distribution functions; multivariate probability distributions and their properties; moment generating functions; simulation of random variables and use of the R statistical package.

Math 342. Introduction to the Theory of Probability and Statistics II. (Cross-listed with Stat). (3-0) Cr. 3. S. *Prereq: Stat 341; Math 307 or 317.* Transformations of random variables; sampling distributions; confidence intervals and hypothesis testing; theory of estimation and hypothesis tests; linear model theory, enumerative data; use of the R statistical package for simulation and data analysis.

Math 350. Number Theory. (Cross-listed with Com S). (3-0) Cr. 3. S. *Prereq: 166.* Divisibility, integer representations, primes and divisors, linear diophantine equations, congruences, and multiplicative functions. Applications to cryptography. Nonmajor graduate credit.

Math 365. Complex Variables with Applications. (3-0) Cr. 3. S. *Prereq: 265.* Functions of a complex variable, including differentiation, integration and series expansions, residues, evaluation of integrals, conformal mapping. Nonmajor graduate credit.

Math 373. Introduction to Scientific Computation. (3-0) Cr. 3. S. *Prereq: 265.* Vector, matrix and graphics programming in MATLAB for scientific applications. Algorithms for interpolation, systems of linear equations, least squares, nonlinear equations and optimization in one and several variables. Additional topics may include ordinary differential equations, symbolic calculation and the Fast Fourier Transform. Emphasis on effective use of mathematical software, and understanding of its strengths and limitations. Nonmajor graduate credit.

Math 385. Introduction to Partial Differential Equations. (3-0) Cr. 3. F.S. *Prereq: 265 and one of 266, 267.* Separation of variables methods for elliptic, parabolic, and hyperbolic partial differential equations. Fourier series, Sturm-Liouville theory, Bessel functions, and spherical harmonics. Nonmajor graduate credit.

Math 397. Teaching Secondary Mathematics Using University Mathematics. (2-2) Cr. 3. S. *Prereq: 201, 301.* Coursework in university mathematics including calculus, abstract algebra, discrete mathematics, geometry, and other topics as it relates to teaching mathematics in grades 7-12.

Math 398. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Math 414. Analysis I. (3-0) Cr. 3. F.S.SS. *Prereq: 201; 265; and 307 or 317.* A careful development of calculus of functions of a real variable: limits, continuity, differentiation, integration, series. Nonmajor graduate credit.

Math 415. Analysis II. (3-0) Cr. 3. S. *Prereq: 414.* Sequences and series of functions of a real variable, uniform convergence, power series and Taylor series, Fourier series, topology of n-dimensional space, implicit function theorem, calculus of the plane and 3-dimensional space. Additional topics may include metric spaces or Stieltjes or Lebesgue integration. Nonmajor graduate credit.

Math 421. Logic for Mathematics and Computer Science. (Cross-listed with Com S). (3-0) Cr. 3. S. *Prereq: Math 301 or 307 or 317 or Com S 330.* Propositional and predicate logic. Topics selected from Horn logic, equational logic, resolution and unification, foundations of logic programming, reasoning about programs, program specification and verification, model checking and binary decision diagrams, temporal logic and modal logic. Nonmajor graduate credit.

Math 426. Mathematical Methods for the Physical Sciences. (3-0) Cr. 3. F. *Prereq: 266 or 267.* A fast-paced course primarily for first-year graduate students in physics and chemistry. Emphasis on techniques needed for quantum mechanics and electrodynamics. Functions of a complex variable and contour integration, integral transforms and applications, series methods for ordinary differential equations, Green's functions, Sturm-Liouville problems and orthogonal functions, boundary-value problems for partial differential equations. Nonmajor graduate credit.

Math 435. Geometry I. (3-0) Cr. 3. F. *Prereq: 307 or 317.* Euclidean geometry. Points, lines, circles, triangles, congruence, similarity, properties invariant under rigid motions. Synthetic, analytic, and axiomatic methods. Nonmajor graduate credit.

Math 436. Geometry II. (3-0) Cr. 3. S. *Prereq: 435.* Continuation of Euclidean geometry with topics from elliptic, projective, or hyperbolic geometry. Emphasis on analytic methods. Nonmajor graduate credit.

Math 439. Mathematics of Fractals and Chaos. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 265.* Iterated function systems; periodic points; algorithms for generation of fractals; fractal dimension; Julia sets and the Mandelbrot set; chaos. Nonmajor graduate credit.

Math 471. Computational Linear Algebra and Fixed Point Iteration. (Cross-listed with Com S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Math 265 and either Math 266, or 267; knowledge of a programming language.* Computational error, solutions of linear systems, least squares, similarity methods for eigenvalues, solution of nonlinear equations in one and several variables. Nonmajor graduate credit.

Math 481. Numerical Solution of Differential Equations and Interpolation. (Cross-listed with Com S). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Math 265 and either Math 266 or 267; knowledge of a programming language.* Polynomial and spline interpolation, orthogonal polynomials, least squares, numerical differentiation and integration, numerical solution of ordinary differential equations. Nonmajor graduate credit.

Math 489. History of Mathematics. (3-0) Cr. 3. S. *Prereq: 6 credits in mathematics at the 300 level or above. Recommended credit or enrollment in 301, 414 or 435.* History of mathematical ideas found in the undergraduate curriculum. It includes a discussion of the historical and cultural settings in which these ideas arose, and the influence of the culture on the type of mathematical ideas that developed. Some of the particular cultures and their mathematics that are studied include: Babylonian and Ancient Egyptian. Ancient Greek, Arabic, Indian, Western European and Chinese. Nonmajor graduate credit.

Math 490. Independent Study. Cr. arr. Repeatable. *Prereq: 301 or 317; 6 credits in mathematics.* No more than 9 credits of Math 490 may be counted toward graduation.
H. Honors

Math 491. Undergraduate Thesis. Cr. arr. Writing a formal mathematics paper. Upon approval by the department, the paper will satisfy the departmental advanced English requirement.

Math 492. Undergraduate Seminar. (2-0) Cr. 2. S. *Prereq: Consent of instructor.* Introduction to mathematics research, a participating seminar on advanced topics in mathematics. Mathematical literature search, reading a mathematical article with the guidance of the instructor, mathematical presentation. Seminar content varies.

Math 497. Teaching Secondary School Mathematics. (Cross-listed with C I). (3-0) Cr. 3. F. *Prereq: 15 credits in college mathematics; if in a teacher licensure program, concurrent enrollment in C I 426 or 526.* Theory and methods for teaching mathematics in grades 7-12. Includes critical examination of instructional strategies, curriculum materials, learning tools, assessment methods, National Standards in Mathematics Education, and equity issues.

Math 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

Math 501. Introduction to Real Analysis. (3-0) Cr. 3. F. *Prereq: 265 and 307 or 317.* A development of the real numbers. Study of metric spaces, completeness, compactness, sequences, and continuity of functions. Differentiation and integration of real-valued functions, sequences of functions, limits and convergence, equicontinuity.

Math 504. Abstract Algebra I. (3-0) Cr. 3. F. *Prereq: 302.* Algebraic systems and their morphisms, including groups, rings, modules, and fields.

Math 505. Abstract Algebra II. (3-0) Cr. 3. S. *Prereq: 504.* Continuation of Math 504.

Math 510. Linear Algebra. (3-0) Cr. 3. F. *Prereq: 307 or 317.* Advanced topics in linear algebra including canonical forms; unitary, normal, Hermitian and positive-definite matrices; variational characterizations of eigenvalues, and applications to other branches of mathematics.

Math 511. Functions of a Single Complex Variable. (3-0) Cr. 3. S. *Prereq: 414 or 465 or 501.* Theory of analytic functions, integration, topology of the extended complex plane, singularities and residue theory, maximum principle.

Math 515. Real Analysis I. (3-0) Cr. 3. F. *Prereq: 414 or 501.* Lebesque measure and Lebesgue integral, one variable differentiation theory, product integration, Lp spaces.

Math 516. Real Analysis II. (3-0) Cr. 3. S. *Prereq: 515.* Metric spaces, topological spaces, compactness, abstract theory of measure and integral, differentiation of measures, Banach spaces.

Math 517. Finite Difference Methods. (3-0) Cr. 3. S. *Prereq: 481 or 503.* Finite difference methods for partial differential equations, with emphasis on parabolic and hyperbolic equations, and other partial differential equations from application areas. Topics include convergence, stability and implementation issues.

Math 519. Methods of Applied Mathematics I. (3-0) Cr. 3. F. *Prereq: 414 or 465 or 501.* Techniques of classical and functional analysis with applications to partial differential equations, integral equations. Vector spaces, metric spaces, Hilbert and Banach spaces, Sobolev spaces and other function spaces, contraction mapping theorem, distributions, Fourier series and Fourier transform, linear operators, spectral theory of differential and integral operators, Green s functions and boundary value problems, weak solutions of partial differential equations and variational methods, calculus in Banach spaces and applications.

Math 520. Methods of Applied Mathematics II. (3-0) Cr. 3. S. *Prereq: 519.* Continuation of Math 519.

Math 525. Numerical Analysis of High Performance Computing. (Cross-listed with Com S, Cpr E). (3-0) Cr. 3. S. *Prereq: Cpr E 308, or one of Math 471, 481; experience in scientific programming; knowledge of FORTRAN or C.* Development, analysis, and testing of efficient numerical methods for use on current state-of-the-art high performance computers. Applications of the methods to the students' areas of research.

Math 533. Cryptography. (Cross-listed with Cpr E, InfAs). (3-0) Cr. 3. S. *Prereq: Math 301 or Cpr E 310 or Com S 330.* Basic concepts of secure communication, DES and AES, public-key cryptosystems, elliptic curves, hash algorithms, digital signatures, applications. Relevant material on number theory and finite fields.

Math 535. Steganography and Watermarking. (Cross-listed with Cpr E, InfAs). (3-0) Cr. 3. S. *Prereq: Cpr E 531 or E E 524 or Math 533/Cpr E 533/InfAs 533.* Basic principles of steganography and watermarking. Algorithms based on spatial domain approaches, transformations of data, statistical approaches. Techniques for images, video, and audio data. Communications models for data hiding. Analysis, detection and recovery of hidden data. Military, commercial and e-commerce applications. Known theoretical results. Software packages for data hiding. Social and legal issues, case studies, and digital rights management issues that affect technological development of steganography and watermarking. Current developments in the area.

Math 540. Seminar in Mathematics Education. (1-0) Cr. 1. SS. *Prereq: Enrollment in the Master of School Mathematics program or professional studies in education.* Research studies in mathematics learning and teaching, exemplary practices in mathematics education, and current state and national trends in the mathematics curriculum in grades K-12.
A. Assessment, equity, and teaching of statistics.
B. Geometry and discrete mathematics, and problem solving.
C. Teaching of analysis, algebra, and the use of technology.

Math 542. Investigating the Teaching and Learning of Secondary Mathematics. (1-0) Cr. 1. Repeatable. Alt. F., offered 2010. *Prereq: Enrollment in master of school mathematics program, professional studies in education or by permission for secondary mathematics education majors.* Research, discussion and evaluation of efforts to improve instruction in the mathematics classroom.

Math 543. Topics in Mathematics Education. (1-0) Cr. 1. F. *Prereq: Teaching a mathematics course.* Selected topics in collegiate mathematics education including cooperative learning, instructional use of technology, writing in mathematics, and cognitive learning theories. Research studies, exemplar practices, and trends in mathematics education.

Math 545. Intermediate Calculus. (4-0) Cr. 4. *Prereq: 3 semesters of calculus and enrollment in the master of school mathematics program.* Offered on a 3-year cycle, offered SS. 2010. Further development of the fundamental concepts of calculus and their applications with an emphasis on a constructivist approach to learning, cooperative groups, problem solving, the use of technology.

Math 546. Algorithms in Analysis and Their Computer Implementation. (2-2) Cr. 3. *Prereq: 3 semesters in calculus or concurrent enrollment in 545 and enrollment in the master of school mathematics program.* Offered on a 3- year cycle, offered SS. 2010. The use of technology in secondary mathematics with an emphasis on the exploration and implementation of algorithms.

Math 547. Discrete Mathematics and Applications. (4-0) Cr. 4. *Prereq: Enrollment in the master of school mathematics program.* Offered on a 3-year cycle, offered SS. 2009. Applications of graph theory, game theory, linear programming, recursion, combinatorics and algebraic structures. Issues in integrating discrete topics into the secondary curriculum. Use of the computer to explore discrete mathematics.

Math 549. Intermediate Geometry. (3-0) Cr. 3. *Prereq: 435 or equivalent and enrollment in the master of school mathematics program.* Offered on a 3-year cycle, offered SS. 2009. A study of geometry with emphasis on metrics, the group of isometries, the group of similarities, and the affine group. Specific spaces studied normally include the Euclidean plane, the 2-sphere, and projective 2-space. Emphasis on analytical methods.

Math 554. Introduction to Stochastic Processes. (Cross-listed with Stat). (3-0) Cr. 3. F. *Prereq: Stat 542.* Markov chains on discrete spaces in discrete and continuous time (random walks, Poisson processes, birth and death processes) and their long-term behavior. Optional topics may include branching processes, renewal theory, introduction to Brownian motion.

Math 557. Ordinary Differential Equations I. (3-0) Cr. 3. F. *Prereq: 415 or 465 or 501.* The initial-value problem, existence and uniqueness theorems, continuous dependence on parameters, linear systems, stability and asymptotic behavior of solutions, linearization, topics from dynamical systems and two-point boundary-value problems.

Math 561. Numerical Analysis I. (3-0) Cr. 3. S. *Prereq: 414 or 501.* Approximation theory, including polynomial spline interpolation and best approximation; numerical differentiation and integration; numerical methods for ordinary differential equations.

Math 562. Numerical Analysis II. (3-0) Cr. 3. F. *Prereq: 414 or 501.* Numerical linear algebra including eigenvalue problems; numerical solution of nonlinear equations and optimization problems.

Math 569. Bioinformatics III (Structural Genome Informatics). (Cross-listed with BCB, Com S, BBMB, Cpr E). (3-0) Cr. 3. F. *Prereq: BCB 567, Gen 411, Stat 430.* Algorithmic and statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

Math 573. Random Signal Analysis and Kalman Filtering. (Cross-listed with Aer E, E E, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 370 or M E 411 or Math 341 or 395.* Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

Math 574. Optimal Control. (Cross-listed with Aer E, E E, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* The optimal control problem. Variational approach. Pontryagin's principle. Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

Math 575. Introduction to Robust Control. (Cross-listed with E E, M E, Aer E). (3-0) Cr. 3. *Prereq: E E 577.* Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H2, Hoo, and l1 control problems. Tools for robustness analysis and synthesis.

Math 576. Digital Feedback Control Systems. (Cross-listed with Aer E, E E, M E). (3-0) Cr. 3. F. *Prereq: E E 475 or Aer E 432 or M E 411 or 414 or Math 415; and Math 267.* Sampled-data, discrete data, and the z-transform. Design of digital control systems using transform methods: root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

Math 577. Linear Systems. (Cross-listed with Aer E, E E, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 414 or Math 415; and Math 307.* State variable and input-output descriptions of linear continuous-time and discrete-time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by state feedback. Design of feedback systems. Stability of linear dynamical systems.

Math 578. Nonlinear Systems. (Cross-listed with Aer E, E E, M E). (3-0) Cr. 3. S. *Prereq: E E 577.* Classification of nonlinear control systems. Existence and uniqueness of solutions. Approximate analysis methods. Periodic orbits. Concept of stability and Lyapunove stability theory. Absolute stability of feedback systems. Input-and output stability. Passivity.

Math 590. Special Topics. Cr. arr. Repeatable.

Math 597. Introductory Computational Structural Biology. (Cross-listed with BCB). (3-0) Cr. 3. S. *Prereq: 561 and 562.* Mathematical and computational approaches to protein structure prediction and determination. Topics include molecular distance geometry, potential energy minimization, and molecular dynamics simulation.

Math 599. Creative Component. Cr. arr.

Courses for graduate students

Math 601. Mathematical Logic I. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 504.* First semester of full-year course. Completeness and compactness of propositional and predicate logic, incompleteness and undecidability of set theory and arithmetic, Goedel's theorems, recursive functions, computability, models, ultraproducts, and ultralimits.

Math 602. Mathematical Logic II. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 601.* Continuation of Math 601.

Math 605. Design Theory and Association Schemes. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 504.* Combinatorial designs and Latin squares. Construction methods including finite fields. Error-correcting codes. Adjacency matrices and algebraic combinatorics.

Math 606. Enumerative Combinatorics and Ordered Sets. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 504 or permission of instructor.* Ordered sets and lattices. Generating functions. Moebius inversion and other enumeration methods.

Math 607. Modern (Structural) Graph Theory. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 504 or permission of instructor.* Structural and extremal theory of graphs. Topics include basic structures (trees, paths and cycles), networks, colorings, connectivity, topological graph theory, Ramsey theory, forbidden graphs and minors, introduction to random graphs, applications.

Math 610. Seminar. Cr. arr.

Math 615. General Theory of Algebraic Structures I. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 504.* First semester of full-year course. Subalgebras, homomorphisms, congruence relations, and direct products. Lattices and closure operators. Varieties and quasivarieties of algebras, free algebras, Birkhoff's theorems, clones, Mal'cev conditions. Advanced topics.

Math 616. General Theory of Algebraic Structures II. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 615.* Continuation of Math 615.

Math 617. Category Theory. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 504.* Categories and functors and their applications.

Math 618. Representation Theory. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 504.* Representations of algebraic structures. Content varies by semester.

Math 621. Topology. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Permission of instructor.* Introduction to general topology. Topological spaces, continuous functions, connectedness, compactness. Topics selected from countability and separation axioms, metrization, and complete metric spaces.

Math 622. Algebraic Topology. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 504.* Foundations of algebraic topology. The fundamental group, simplicial homology groups, and singular homology groups.

Math 624. Manifolds, Tensors and Differential Geometry. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 501 or 515.* Topics selected from: Geometry of curves and surfaces. Manifolds, coordinate systems. Tensors, differential forms, Riemannian metrics. Connections, covariant differentiation, curvature tensors.

Math 633. Functional Analysis I. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Permission of instructor.* Fundamental theory of normed linear spaces and algebras emphasizing aspects that provide a framework for the study of boundary-value problems, eigenvalue problems, harmonic analysis, analytic function theory, and modern operator theory.

Math 634. Functional Analysis II. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 633.* Continuation of Math 633.

Math 642. Advanced Probability Theory. (Cross-listed with Stat). (4-0) Cr. 4. F. *Prereq: Stat 542.* Measure spaces, extension theorem and construction of Lebesgue-Stieljes measures on Euclidean spaces, Lebesgue integration and the basic convergence theorems, Lp-spaces, absolute continuity of measures and the Radon Nikodym theorem, absolute continuity of functions on R and the fundamental theorem of Lebesgue integration, product spaces and Fubini-Tonelli Theorems, convolutions. Fourier series and transforms, probability spaces; Kolmogorov's existence theorem for stochastic processes; expectation; Jensen's inequality and applications, independence, Borel-Cantelli lemmas; weak and strong laws of large numbers and applications, renewal theory.

Math 645. Advanced Stochastic Processes. (Cross-listed with Stat). (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Weak convergence. Random walks and Brownian motion. Martingales. Stochastic integration and Ito's Formula. Stochastic differential equations and applications.

Math 646. Mathematical Modeling of Complex Physical Systems. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Modeling of the dynamics of complex systems on multiple scales: Classical and dissipative molecular dynamics, stochastic modeling and Monte-Carlo simulation; macroscale non-linear dynamics and pattern formation.

Math 655. Partial Differential Equations I. (3-0) Cr. 3. F. *Prereq: 515 or 519.* First order equations and systems, conservation laws, general theory of linear partial differential equations of elliptic, parabolic and hyperbolic types, maximum principles, fundamental solutions, Sobolev spaces, variational and Hilbert space methods.

Math 656. Partial Differential Equations II. (3-0) Cr. 3. S. *Prereq: 655.* Continuation of Math 655.

Math 658. Dynamical Systems. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 501 or 515.* Smooth mappings and flows. Fixed points, stable, unstable and center manifolds, normal forms. Structural stability, bifurcations. Horseshoe maps, introduction to chaotic behavior.

Math 666. Finite Element Methods. (3-0) Cr. 3. F. *Prereq: 503 or 516 or 520 or 656.* Elements of functional analysis; Sobolev spaces; variational principles and weak formulations; approximation theory in finite element spaces; analysis of finite element methods; implementation issues; applications.

Math 690. Advanced Topics. Cr. 3. Repeatable.
A. Algebra
B. Functional Analysis
C. Control Theory
D. Approximation Theory
E. Linear Algebra
G. Number Theory
H. Harmonic Analysis
I. Combinatorics and Graph Theory
J. Mathematical Biology and Bioinformatics
K. Mathematics Education
L. Logic and Foundations
M. Complex Analysis
N. Numerical Analysis
O. Ordinary Differential Equations
P. Partial Differential Equations
Q. Group Theory
R. Applied Mathematics
S. Set Theory
T. Topology
U. Automata Theory
V. Optimization Theory
W. Probability and Stochastic Processes
Y. Special Functions
Z. Ring Theory

Math 699. Research. Cr. arr. Repeatable.

Mechanical Engineering

Jonathan Wickert, Chair of Department

Distinguished Professors: Bernard, R. Brown

Distinguished Professor (Emeritus): Serovy

University Professor (Emeritus): Bahadur

Professors: Chandra, Heindel, Kelkar, Levitas, Molian, Nelson, Oliver, Vance, Wickert

Professors (Emeritus): Bathie, Baumgarten, Colver, Cook, Danofsky, Dejong, Eide, Hall, Hendrickson, Henkin, Junkhan, Kavanagh, Mischke, Okiishi, Pate, Peters, Pletcher, Roberts, Shapiro, Spinrad, Wechsle

Associate Professors: Anex, Bastawros, Bryden, Luecke, Mann, Maxwell, Olsen, Subramaniam, Sundararajan, Wang

Associate Professors (Emeritus): Joensen, Vanmeter

Associate Professor (Adjunct): Gray

Assistant Professors: Bigelow, Faidley, Ganapathysubramanian, Kim, Kong, Meyer, Shrotriya, Stone, Winer, Zhang, Zou

Senior Lecturer: Starns

Lecturer: Feve, Heise

Undergraduate Study

For the undergraduate curriculum in mechanical engineering leading to the degree bachelor of science, see College of Engineering, Curricula. This curriculum is accredited by the Engineering Accreditation Commission of ABET.

Mechanical engineers are typically involved with such activities as

•generation, distribution, and use of energy

•development and application of manufacturing systems and processes

•automation and control of mechanical and thermal systems

•design of various products for consumer and commercial markets

About one-fifth of all engineers practicing today have been educated as mechanical engineers. Their activities include research, development, design, testing, production, technical sales, and technical management.

Mechanical engineers are characterized by personal creativity, breadth of knowledge, and versatility. For these reasons they are found to function and thrive as valuable members and leaders of multidisciplinary teams. Through clever use of analysis, modeling, design, synthesis, and interpersonal skills they solve important problems to improve our world.

To ensure the success of students completing the curriculum in mechanical engineering, the department has established the following educational objectives:
1. The department provides a sound foundation for graduates to pursue a variety of careers. Most graduates will find immediate employment in industry, government laboratories or consulting, but some will pursue graduate or professional studies in such fields as engineering, business, law or medicine.
2. Graduates will apply the problem solving skills they have learned at Iowa State University to meet the challenging demands and increasing responsibilities of a successful career.
3. Graduates will continue to learn as they grow in their profession, using modern technology and communication skills to contribute as team members or leaders in solving important problems for their employers and for society.

The mechanical engineering curriculum is organized to provide students with a broad foundation in mathematics and the sciences of physics and chemistry.

•Through courses in these subjects, students will attain the basic knowledge required to understand and analyze mechanical engineering systems. This background is extended and organized through studies in mechanics, dynamics, thermo-fluids, materials, manufacturing, and design.

•Upon completion of courses in these areas of the curriculum, students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives. A major focus throughout the mechanical engineering curriculum is a series of experiences that emphasize engineering design.

•Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.

In addition, a sequence of courses emphasizing engineering design begins in the first year and culminates with a capstone design experience.

•Students will not only be able to apply their engineering knowledge to real-life design problems but also to critically evaluate the solutions.

Development of skills needed to be independent, creative thinkers, effective communicators, and contributing team members is emphasized throughout the curriculum.

•Students will learn to effectively work in multidisciplinary teams to solve engineering problems subject to technical and business constraints through critical thinking that crosses content boundaries.

•Students will develop an understanding of the societal context in which they will practice engineering. They will include ethical, legal, and

aesthetic considerations in design of engineering components and systems. The curriculum provides flexibility to allow students to broaden their perspectives or to focus in more depth in areas of particular interest. Organized sequences of technical electives can be chosen from areas which represent major concentrations in the field of mechanical engineering. Optional areas of specialization include energy conversion and utilization, thermal system design, mechanical system design, materials and manufacturing, nuclear engineering, thermal and environmental engineering, and vehicle propulsion.

•Elective courses provide additional emphasis in terms of the student's unique educational goals, whether they include immediate entry into industry or further study at the graduate level. In addition, students elect courses in the humanities, social sciences, U.S. diversity and international perspectives.

•Through these courses, students develop an understanding of the societal context in which they will practice engineering, including environmental, legal, aesthetic, and human aspects. Students in mechanical engineering are encouraged to participate in the cooperative education program or to obtain engineering internships, both domestically and abroad. Study abroad is encouraged, and the department has exchange programs with several universities around the world. These experiences help students to round out their education and to better prepare for careers in the increasingly global practice of engineering.

Nuclear Engineering Minor

The nuclear engineering minor is multidisciplinary and open to undergraduates in the College of Engineering. The minor may be earned by completing 15 credits from a list of courses available through the Mechanical Engineering Advising Center.

The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

Graduate Study

The department offers work for the degrees of master of science and doctor of philosophy with a major in mechanical engineering. The master of science degree may be earned with or without a thesis. Although co-major and formal minor programs are not offered in mechanical engineering, courses may be used for minor work by students taking major work in other departments.

The graduate program offers advanced study in a variety of thrust areas, including biological and nanoscale sciences, clean energy technologies, complex fluid systems, design and manufacturing innovation, and simulation and visualization.

The department offers students the opportunity to broaden their education by participating in minor programs in established departments, interdepartmental programs, or other experiences as approved by their program of study committees.

The requirements for advanced degrees are established by the student's program of study committee within established guidelines of the Graduate College. Graduate students who have not completed an undergraduate program of study substantially equivalent to that required of undergraduate students in the department can expect that additional supporting coursework will be required. A foreign language requirement exists for the degree of doctor of philosophy only if the student's program of study committee deems it appropriate to a specific program of study.

Courses primarily for undergraduate students

M E 102. Mechanical Engineering Orientation. Cr. R. F.S. (1-0) Information concerning university, college, and departmental policies and procedures. Information on cooperative, intern, summer and career placement. Review of degree audit and registration.

M E 190. Learning Communities. (1-0) Cr. 1. Repeatable. F.S. Enrollment in M E learning communities.

M E 202. Mechanical Engineering - Professional Planning. (1-0) Cr. R. F.S. *Prereq: Sophomore classification.* Preparation for a career in mechanical engineering; discussion of opportunities for leadership, undergraduate research, experiential learning.

M E 231. Engineering Thermodynamics I. (3-0) Cr. 3. F.S. *Prereq: Math 265, Chem 167, Phys 222.* Fundamental concepts based on zeroth, first and second laws of thermodynamics. Properties and processes for ideal gases and solid-liquid-vapor phases of pure substances. Applications to vapor power cycles. Credit for either M E 231 or 330, but not both, may be applied toward graduation.

M E 270. Introduction to Mechanical Engineering Design. (1-6) Cr. 3. F.S. *Prereq: Engr 170, Phys 221.* Introduction to fundamentals of mechanical engineering design with applications to thermal and mechanical systems. Examination of existing machines and systems. Team-based projects, open-ended problems and prototyping. Application of engineering tools. Oral and written reports required.

M E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

M E 324. Manufacturing Engineering. (3-2) Cr. 4. F.S. *Prereq: 270, E M 324, Mat E 272.* Plastic deformation and work hardening. Manufacturing processes including forming, machining, casting and welding with emphasis on manufacturing considerations in design. Modern manufacturing practices. Laboratory exercises will be an integral component of the course. Nonmajor graduate credit.

M E 325. Machine Design. (3-0) Cr. 3. F.S. *Prereq: Engr 170, E M 324, Stat 305.* Philosophy of design and design methodology. Consideration of stresses and failure models useful for static and fatigue loading. Analysis, selection and synthesis of machine elements. Nonmajor graduate credit.

M E 330. Thermodynamics. (3-0) Cr. 3. F.S. *Prereq: Phys 222.* For students electing one course in engineering thermodynamics. First and second laws of thermodynamics. Properties and processes for pure substances. Selected applications including cycles for power and refrigeration. Psychrometrics. Credit for either M E 231 or 330, but not both, may be applied toward graduation. Majors in mechanical engineering may not apply M E 330 toward a degree in mechanical engineering.

M E 332. Engineering Thermodynamics II. (3-0) Cr. 3. F.S. *Prereq: 231.* Gas power cycles. Fundamentals of gas mixtures, psychrometry, and thermochemistry. Applications to one-dimensional compressible flow, refrigeration, air conditioning and combustion processes. Nonmajor graduate credit.

M E 335. Fluid Flow. (3-2) Cr. 4. F.S. *Prereq: Credit or enrollment in 332 and 370, E M 345, Math 266 or 267.* Incompressible and compressible fluid flow fundamentals. Dimensional analysis and similitude. Internal and external flow applications. Lab experiments emphasizing concepts in thermodynamics and fluid flow. Written reports are required. Nonmajor graduate credit.

M E 370. Engineering Measurements and Instrumentation. (2-3) Cr. 3. F.S. *Prereq: E E 442, Stat 305.* Fundamentals of design, selection, and operation of components of measuring systems. Measurement processes, data acquisition systems, analysis of data, and propagation of measurement uncertainty. Nonmajor graduate credit.

M E 388. Sustainable Engineering and International Development. (Cross-listed with A E, C E, E E, Mat E). (2-2) Cr. 3. F. *Prereq: Junior classification in engineering.* Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as non-government organizations (NGOs). Course readings, final project/design report.

M E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services.* Summer professional work period.

M E 397. Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services.* Professional work period, one semester maximum per academic year.

M E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

M E 410. Mechanical Engineering Applications of Mechatronics. (2-2) Cr. 3. S. *Prereq: E E 442, 448, credit or enrollment in 421.* Fundamentals of sensor characterization, signal conditioning and motion control, coupled with concepts of embedded computer control. Digital and analog components used for interfacing with computer controlled systems. Mechanical system analysis combined with various control approaches. Focus on automation of hydraulic actuation processes. Laboratory experiences provide hands-on development of mechanical systems. Nonmajor graduate credit.

M E 411. Automatic Controls. (2-2) Cr. 3. F. *Prereq: 421.* Methods and principles of automatic control. Pneumatic, hydraulic, and electrical systems. Representative applications of automatic control systems. Mathematical analysis of control systems. Nonmajor graduate credit.

M E 412. Ethical Responsibilities of a Practicing Engineer. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 325, senior classification in engineering.* Failure modes associated with product environment. Interaction between the legal profession, legislative bodies, standards and the design engineer, using a case study approach in design applications. Litigation involving designs, standards, and laws applicable to specific designs surveyed. The influence of laws and standards upon design. Nonmajor graduate credit.

M E 413. Fluid Power Engineering. (Cross-listed with A E). (2-2) Cr. 3. F. *Prereq: Credit or enrollment in 335 or E M 378, A E 216 or M E 270.* Properties of hydraulic fluids. Performance parameters of fixed and variable displacement pumps and motors. Hydraulic circuits and systems. Hydrostatic transmissions. Characteristics of control valves. Analysis and design of hydraulic systems for power and control functions. Nonmajor graduate credit.

M E 414. Hydraulic Systems and Control. (3-0) Cr. 3. F. *Prereq: 421, 335.* Characteristics of hydraulic motors and pumps, system components, system analysis, feedback control and stability, control circuits, computer simulation. Nonmajor graduate credit.

M E 415. Mechanical Systems Design. (0-6) Cr. 3. F.S. *Prereq: 324, 325.* Solution of a total design problem involving a mechanical system, documenting decisions concerning form and function, material specification, manufacturing methods, safety, cost, and conformance with codes and standards. Solution description includes oral and written reports. Nonmajor graduate credit.

M E 417. Advanced Machine Design. (Dual-listed with 517). (3-0) Cr. 3. S. *Prereq: 325, Mat E 272.* Stress life, strain life, and linear elastic fracture mechanics approaches to fatigue life and design. Material processing to mitigate crack growth in the initiation and propagation stages of the fatigue process. Variable amplitude and multi-axial loadings, stress-strain response to cyclical loadings, and notch effects. Software development required for graduate credit. Nonmajor graduate credit.

M E 418. Mechanical Considerations in Robotics. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 421.* Three dimensional kinematics, dynamics, and control of robot manipulators, hardware elements and sensors. Laboratory experiments using industrial robots. Nonmajor graduate credit.

M E 419. Computer-Aided Design. (3-0) Cr. 3. F. *Prereq: 325.* Theory and applications of computer-aided design. Design theory, solid modeling and finite element modeling in CAD. Assembly modeling, rapid prototyping and mechanism analysis. Curves and surfaces and CAD/CAM data exchange. Nonmajor graduate credit.

M E 421. Mechanical Systems and Control. (3-2) Cr. 4. F.S. *Prereq: E E 442, E E 448, E M 345, Math 267.* Modeling and simulation of mechanical systems. Development of equations of motion and dynamic response characteristics. Fundamentals of classical control applications, including mathematical analysis and design for closed loop control systems. Introduction to computer interfacing for data acquisition and control. Laboratory exercises for hands-on motion and control implementation. Nonmajor graduate credit.

M E 423. Creativity and Imagination for Engineering and Design. (3-0) Cr. 3. *Prereq: Junior classification in mechanical engineering.* Historical examples of technical innovations based on creativity and imagination. Introduction to the psychology and theory of creativity and imagination. Background and simplified exercises in the creative arts, including poetry (both free verse and prose) and the visual arts (both two and three dimensional), for skill strengthening. Additional exercises in creative and imaginative thinking. Application of creative and imaginative skills for formulating conceptual design solutions. Additional applications related to technology including problem solving and inventing.

M E 425. Optimization Methods for Complex Designs. (Dual-listed with 525). (3-0) Cr. 3. S. *Prereq: Engr 160, Math 265.* Optimization techniques including unconstrained and constrained minimization, linear programming, and particle swarm optimization. Both the theory and methods and the application to complex designs will be presented. Nonmajor graduate credit.

M E 433. Alternative Energy Conversion. (3-0) Cr. 3. F. *Prereq: Phys 221/222 and Chem 167.* Basic principles, thermodynamics, and performance of alternative energy conversion technologies such as direct energy conversion (fuel cells, photovoltaics, magnetohydrodynamics), wind energy, biomass energy, non-combustion thermal sources (ocean gradients, geothermal and nuclear fusion), non-conventional environmental energy sources (ocean tides and currents), and finally other alternative approaches (molecular motors, cryo-engines, and solar sailing). Performance analysis and operating principles of systems and components, economic analysis for system design and operation. Nonmajor graduate credit.

M E 436. Heat Transfer. (3-2) Cr. 4. F.S. *Prereq: 335.* Heat transfer by conduction, convection, and radiation. Similarity concepts in heat, mass, and momentum transfer. Methods for determination of heat transfer coefficients. Combined modes of heat transfer. Heat exchangers. Lab experiments emphasizing concepts in thermodynamics and heat transfer. Written reports are required. Nonmajor graduate credit.

M E 441. Fundamentals of Heating, Ventilating, and Air Conditioning. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 436.* Space conditioning and moist air processes. Application of thermodynamics, heat transfer, and fluid flow principles to the analysis of heating, ventilating, and air conditioning components and systems. Performance and specification of components and systems. Nonmajor graduate credit.

M E 442. Heating and Air Conditioning Design. (1-5) Cr. 3. S. *Prereq: 441.* Design criteria and assessment of building environment and energy requirements. Design of heating, ventilating, and air conditioning systems. System control and economic analysis. Oral and written reports required. Nonmajor graduate credit.

M E 444. Elements and Performance of Power Plants. (3-0) Cr. 3. S. *Prereq: 332, credit or enrollment in 335.* Basic principles, thermodynamics, engineering analysis of power plant systems. Topics include existing power plant technologies, the advanced energyplex systems of the future, societal impacts of power production, and environmental and regulatory concerns. Nonmajor graduate credit.

M E 446. Power Plant Design. (2-2) Cr. 3. F. *Prereq: 332, credit or enrollment in 335.* Design of a power plant to meet regulatory, cost, fuel, and output needs. Selection and synthesis of principal components. Oral and written reports required. Nonmajor graduate credit.

M E 448. Fluid Dynamics of Turbomachinery. (Cross-listed with Aer E). (3-0) Cr. 3. *Prereq: M E 335 or equivalent.* Applications of principles of fluid mechanics and thermodynamics in performance analysis and design of turbomachines and related fluid system components. Nonmajor graduate credit.

M E 449. Internal Combustion Engine Design. (3-1) Cr. 3. F. *Prereq: 335.* Basic principles, thermodynamics, combustion, and exhaust emissions of spark-ignition and compression-ignition engines. Laboratory determination of fuel properties and engine performance. Thermodynamic and mechanical design of engine components to meet specified performance, fuel economy, and air pollution requirements. Oral and written reports required. Nonmajor graduate credit.

M E 450. Engineering Vibrations. (Cross-listed with E M). (3-0) Cr. 3. F. *Prereq: E M 324 and 345.* Elementary vibration analysis, single and multiple degrees of freedom, energy methods, free and forced vibrations, viscous and other forms of damping transform methods and response to periodic and random force inputs, numerical methods of solution, eigenvalues and modal analysis, energy methods, vibration isolation and suppression, string or cable dynamics, beam bending dynamics, application problems in aerospace and mechanical engineering (as relevant). Nonmajor graduate credit.

M E 451. Engineering Acoustics. (Cross-listed with E M). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: Phys 221 and Math 266 or 267.* Sound sources and propagation. Noise standards and effects of noise on people. Principles of noise and vibration control used in architectural and engineering design. Characteristics of basic noise measurement equipment. Experience in use of noise measuring equipment, sound power measurements, techniques for performing noise surveys, evaluation of various noise abatement techniques applied to common noise sources. Selected laboratory experiments. Nonmajor graduate credit.

M E 466. Multidisciplinary Engineering Design. (Cross-listed with A E, Aer E, Cpr E, E E, Engr, I E, Mat E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

M E 475. Modeling and Simulation. (3-0) Cr. 3. S. *Prereq: 421, credit or enrollment in 436.* Introduction to computer solution techniques required to simulate flow, thermal, and mechanical systems. Methods of solving ordinary and partial differential equations and systems of algebraic equations; interpolation, numerical integration; finite difference and finite element methods. Nonmajor graduate credit.

M E 484. Technology, Globalization and Culture. (Dual-listed with 584). (Cross-listed with WLC). (3-0) Cr. 3. F. *Prereq: senior classification for 484; graduate classification for 584.* Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

M E 486. Appropriate Technology Design. (3-0) Cr. 3. F. *Prereq: 231, current enrollment in 335.* Hands-on design experience utilizing knowledge acquired in core mechanical engineering courses. Emphasis with engineering problem formulation and solution, oral and written communication, team decision-making and ethical conduct. Design projects include engineering considerations in appropriate technology which have multidisciplinary components in economics and sociology.

M E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Senior classification.* Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.
C. Engineering Measurements and Instrumentation
D. Heat Transfer
E. Fluid Power and Controls
F. Machines and Systems
G. Materials and Manufacturing Processes
H. Honors
J. Thermodynamics and Energy Utilization
K. Fluid Mechanics
L. Turbomachinery
M. Nuclear Engineering
N. CAD/CAM

M E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 298, permission of department and Engineering Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduate students

M E 511. Advanced Control Design. (3-0) Cr. 3. S. *Prereq: 411.* Application of control design methods using continuous, discrete, and frequency-based models. Approaches include classical, pole assignment, model reference, internal model, and adaptive control methods. Mechanical design projects.

M E 517. Advanced Machine Design. (Dual-listed with 417). (3-0) Cr. 3. S. *Prereq: 325, Mat E 272.* Stress life, strain life, and linear elastic fracture mechanics approaches to fatigue life and design. Material processing to mitigate crack growth in the initiation and propagation stages of the fatigue process. Variable amplitude and multi-axial loadings, stress-strain response to cyclical loadings, and notch effects. Software development required for graduate credit.

M E 520. Material and Manufacturing Considerations in Design. (3-0) Cr. 3. F. *Prereq: 324, 325.* Advanced treatment of materials and manufacturing. Applications to design. Design and redesign to facilitate cost-effective manufacturing. Qualitative and quantitative comparisons of designs. Economic considerations.

M E 521. Mechanical Behavior and Manufacturing of Polymers and Composites. (Cross-listed with M S E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 324 or Mat E 272 and E M 324.* Effect of chemical structure and morphology on properties. Linear viscoelasticity, damping and stress relaxation phenomena. Structure

and mechanics of filler and fiber reinforced composites. Mechanical properties and failure mechanisms. Material selection and designing with polymers. Processing of polymer and composite parts.

M E 525. Optimization Methods for Complex Designs. (Dual-listed with 425). (Cross-listed with HCI). (3-0) Cr. 3. S. *Prereq: Engr 160, Math 265.* Optimization techniques including unconstrained and constrained minimization, linear programming, and particle swarm optimization. Both the theory and methods and the application to complex designs will be presented.

M E 527. Mechanics of Machining and Finishing Processes. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 324.* Mechanics of material removal for ductile materials. Shear zone theory. Oblique cutting. Heat transfer in machining. Milling and grinding. Mechanics of material removal for brittle materials. Optimal selection and design of cutting parameters. Control of machining processes. Principles of precision finishing. Design considerations for machining and finishing processes.

M E 528. Micro/Nanomanufacturing. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 324.* Introduction and scaling laws; SEM/SPM/AFM microscopes; top-down-beam machining; top-down-mechanical and electrical machining; synthesis of powders, tubes, and wires; bottom-up molecular manufacturing; applications of molecular manufacturing.

M E 530. Advanced Thermodynamics. (3-0) Cr. 3. F. *Prereq: 332.* Fundamentals of thermodynamics from the classical viewpoint with emphasis on the use of the first and second laws for analysis of thermal systems. Generalized thermodynamic relationships. Computer applications of thermodynamic properties and system analysis. Selected topics.

M E 532. Compressible Fluid Flow. (Cross-listed with Aer E). (3-0) Cr. 3. S. *Prereq: M E 335 or Aer E 541.* Thermodynamics of compressible flow. Viscous and inviscid compressible flow equations. One dimensional steady flow; isentropic flow, normal shock waves oblique and curved shocks, constant area flow with friction and heat transfer. Linear theory and Prandtl-Glauert similarity. Method of characteristics. Subsonic, transonic, supersonic and hypersonic flows.

M E 535. Thermochemical Processing of Biomass. (Cross-listed with BRT). (3-0) Cr. 3. S. *Prereq: Undergraduate course work in thermodynamics and transport phenomena..* Introduction to thermal and catalytic processes for the conversion of biomass to biofuels and other biobased products. Topics include gasification, fast pyrolysis, hydrothermal processing, syngas to synfuels, and bio-oil upgrading. Application of thermodynamics, heat transfer, and fluid dynamics to bioenergy and biofuels.

M E 536. Advanced Heat Transfer. (3-0) Cr. 3. S. *Prereq: 436.* Advanced treatment of heat transmission by conduction, convection, and radiation.

M E 538. Advanced Fluid Flow. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 436.* Detailed analysis of incompressible/compressible, viscous/inviscid, laminar/turbulent, and developing fluid flows on a particle/point control volume basis.

M E 540. Solar Energy Systems. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 436.* Application of heat transfer, thermodynamics and photovoltaics to the design and analysis of solar energy collectors and systems.

M E 542. Advanced Combustion. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 332 or Ch E 381.* Thermochemistry and transport theory applied to combustion. Gas phase equilibrium. Energy balances. Reaction kinetics. Flame temperatures, speed, ignition, and extinction. Premixed and diffusion flames. Combustion aerodynamics. Mechanisms of air pollution.

M E 543. Introduction to Random Vibrations and Nonlinear Dynamics. (Cross-listed with E M). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: E M 444.* Vibrations of continuous systems. Nonlinear vibration phenomena, perturbation expansions; methods of multiple time scales and slowly-varying amplitude and phase. Characteristics of random vibrations; random processes, probability distributions, spectral density and its significance, the normal or Gaussian random process. Transmission of random vibration, response of simple single and two-degree-of-freedom systems to stationary random excitation. Fatigue failure due to random excitation.

M E 545. Thermal Systems Design. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 436.* Integrating thermodynamics, fluid mechanics, and heat transfer to model thermal equipment and to simulate thermal systems. Second law and parametric analysis; cost estimation, life cycle analysis and optimization.

M E 546. Computational Fluid Mechanics and Heat Transfer I. (Cross-listed with Aer E). (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 538 or Aer E 541.* Introduction to finite difference and finite volume methods used in modern engineering. Basic concepts of discretization, consistency, and stability. Applications of numerical methods to selected model partial differential equations.

M E 547. Computational Fluid Mechanics and Heat Transfer II. (Cross-listed with Aer E). (3-0) Cr. 3. S. *Prereq: M E 546.* Application of computational methods to current problems in fluid mechanics and heat transfer. Methods for solving the Navier-Stokes and reduced equation sets such as the Euler, boundary layer, and parabolized forms of the conservation equations. Introduction to relevant aspects of grid generation and turbulence modeling.

M E 549. Vehicle Dynamics. (3-0) Cr. 3. F. *Prereq: E M 345, Math 266 or 267.* Analysis and evaluation of the performance of cars and trucks. Computer simulation of ride, braking, and directional response.

M E 552. Advanced Acoustics. (Cross-listed with E M). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 451.* Theoretical acoustics: wave propagation in fluids; acoustic radiation, diffraction and scattering; and architectural acoustics. Applications of basic acoustic theory in noise control and acoustic radiation. Introduction to selected numerical methods in acoustics.

M E 557. Computer Graphics and Geometric Modeling. (Cross-listed with Cpr E, Com S). (3-0) Cr. 3. F.S. *Prereq: 421, programming experience in C.* Fundamentals of computer graphics technology. Data structures. Parametric curve and surface modeling. Solid model representations. Applications in engineering design, analysis, and manufacturing.

M E 561. Scanning Probe Microscopy. (2-1) Cr. 3. Alt. F., offered 2010. *Prereq: First year physics, chemistry.* Introduction to the scanning probe microscope (SPM, also known as atomic force microscope or AFM) and associated measurement techniques. Overview or instrumentation system, basic principles of operation, probe-sample interaction and various operational modes to obtain micro/nanoscale structure and force spectroscopy of material surfaces. Examples of SPM significance and applications in science and engineering research, nanotechnology and other industries. Laboratory work involving use of a scanning probe microscope system is an integral part of the course.

M E 563. Micro and Nanoscale Mechanics. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: E M 324 and M E 325.* Review of Fundamentals: (Elasticity, Electromagnetism, Mechanical response), Mechanics of thermally, electrostatically and magnetically actuated microsystems, Mechanics and design of nanostructured materials, mechanics of surface stress engineering and its implications to sensors and thin film structures.

M E 564. Fracture and Fatigue. (Cross-listed with E M, M S E). (3-0) Cr. 3. F. *Prereq: E M 324 and either Mat E 216 or 272 or 392. Undergraduates: Permission of instructor.* Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

M E 573. Random Signal Analysis and Kalman Filtering. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 370 or 411 or Math 341 or 395.* Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

M E 574. Optimal Control. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. S. *Prereq: E E 577.* The optimal control problem. Variational approach. Pontryagin's principle. Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

M E 575. Introduction to Robust Control. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. *Prereq: E E 577.* Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H2, Hoo, and I1 control problems. Tools for robustness analysis and synthesis.

M E 576. Digital Feedback Control Systems. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. F. *Prereq: E E 475 or Aer E 432 or M E 411 or 414 or Math 415; and Math 267.* Sampled data, discrete data, and the z-transform. Design of digital control systems using transform methods; root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

M E 577. Linear Systems. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. F. *Prereq: E E 324 or Aer E 331 or M E 414 or Math 415; and Math 307.* State variable and input-output descriptions of linear continuous-time and discrete-time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by state feedback. Design of feedback systems. Stability of linear dynamical systems.

M E 578. Nonlinear Systems. (Cross-listed with Aer E, E E, Math). (3-0) Cr. 3. S. *Prereq: E E 577.* Classification of nonlinear control systems. Existence and uniqueness of solutions. Approximate analysis methods. Periodic orbits. Concept of stability and Lyapunov stability theory. Absolute stability of feedback systems. Input-output stability. Passivity.

M E 584. Technology, Globalization and Culture. (Dual-listed with 484). (Cross-listed with WLC). (3-0) Cr. 3. F. *Prereq: senior classification for 484; graduate classification for 584.* Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

M E 590. Special Topics. Cr. arr. Repeatable.
A. Experimental Gas Dynamics
B. Fluid Mechanics
C. Heat Transfer
D. Thermodynamics and Energy Utilization
E. Turbomachinery
F. Vehicular Propulsion Systems
G. Advanced Machine Design
I. Automatic Controls
J. Operating and Environmental Considerations in Design
K. Mechanical Behavior of Materials
L. Manufacturing Processes
M. Tribology
N. Sensitivity Methods
O. Engineering Computation
P. Engineering Measurements and Instrumentation
Q. Independent Literature Investigation
R. Nuclear Engineering
S. CAD/CAM

M E 599. Creative Component. Cr. arr. Repeatable.

Courses primarily for graduate students

M E 600. Seminar. Cr. R. Repeatable. (1-0)

M E 625. Surface Modeling. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 557, programming experience in C.* Theory and implementation of contemporary parametric sculptured surface modeling technology. Non-uniform rational B-spline (NURBS) curves and surfaces. Fundamental computational algorithms. Construction techniques. Advanced modeling topics. Computer projects.

M E 632. Multiphase Flow. (Cross-listed with Ch E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 538.* Single particle, mutliparticle and two-phase fluid flow phenomena (gas-solid, liquid-solid and gas-liquid mixtures); particle interactions, transport phenomena, wall effects; bubbles, equations of multiphase flow. Dense phase (fluidized and packed beds) and ducted flows; momentum, heat and mass transfer. Computer solutions.

M E 636. Conduction Heat Transfer. (3-0) Cr. 3. Alt. F, offered 2010. *Prereq: 436.* Techniques for analysis of problems involving steady-state and transient heat conduction in solids.

M E 637. Convection Heat Transfer. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 436.* Heat transfer to internal or external forced convection flows under laminar or turbulent conditions. Free convection. Heat exchanger design considerations, including augmentation.

M E 638. Radiation Heat Transfer. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 436.* Techniques for analysis of radiation in enclosures. Radiative properties of surfaces. Radiative transfer in participating media. Combined modes of transfer. Approximate methods of analysis.

M E 639. Two-Phase Flow and Heat Transfer. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 436.* Hydrodynamics of adiabatic two-phase flow. Pool boiling. Forced convection, boiling, and condensation. Dynamic behavior of two-phase systems. Augmentation of boiling and condensing heat transfer. Applications in the power and process industries.

M E 647. Advanced High Speed Computational Fluid Dynamics. (Cross-listed with Aer E). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 547.* An examination of current methods in computational fluid dynamics. Differencing strategies. Advanced solution algorithms. Grid generation. Construction of complex CFD algorithms. Current applications. Use of state of the art CFD codes.

M E 690. Advanced Topics. Cr. arr. Repeatable. Investigation of advanced topics of special interest to graduate students in mechanical engineering.
A. Experimental Gas Dynamics
B. Fluid Mechanics
C. Heat Transfer
D. Thermodynamics and Energy Utilization
E. Turbomachinery
F. Vehicular Propulsion Systems
G. Advanced Machine Design
I. Automatic Controls
J. Operating and Environmental Considerations in Design
K. Mechanical Behavior of Materials
L. Manufacturing Processes
M. Tribology
N. Sensitivity Methods
O. Engineering Computation
P. Engineering Measurements and Instrumentation
Q. Independent Literature Investigation
R. Nuclear Engineering
S. CAD/CAM

M E 697. Engineering Internship. Cr. R. Repeatable. *Prereq: Permission of Director of Graduate Education, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

M E 699. Research. Cr. arr. Repeatable. Satisfactory-fail only.

Microbiology

www.micro.iastate.edu

(Interdepartmental Undergraduate Major)

Supervisory Committee: J. Cunnick, Professor-in-Charge, J. Beetham, N. Boury, J. Dickson, E. Braun, M. Gleason, G. Phillips

(Interdepartmental Graduate Major)

Supervisory Committee: A. Bogdanove, Chair, Halverson, Vice Chair, N. Cornick, L. Bartholamy, B. Brehm-Stecher

Participating faculty: M. Allison, L. Bartholomay, G. Beattie, S. Beattie, J. Beetham, B. Bellaire, J. Blanchong, B. Blitvich, T. Bobik, A. Bogdanove, B. Bonning, T. Boylston, B. Brehm-Stecher, N. Cornick, J. Cunnick, J. Dickson, T. Ellis, M. Gleason, R. Griffith, L. Halverson, T. Harrington, D. H. Harris, J. Hill, K. Hofmockel, T. Loynachan, A. Mendonca, C. Miller, W. A. Miller, F. C. Minion, T. Moorman, G. Munkvold, L. Nolan, F. Nutter, E. Nystrom, S. Ong, T. Opriessnig, T. Parkin, G. Phillips, R. Rosenbusch, J. Roth, A. Scupham, J. Sebranek, V. Sharma, B. Sponseller, T. Stanton, E. Vaughn, D. Voytas, M. Wannemuehler, I. Wesley, S. Whitham, B. Yang, Q. Zhang, C. Ziemer, J. Zimmerman, R. Zuerner

Undergraduate Study

Undergraduate study for the bachelor of science degree with a major in microbiology. For the curriculum in microbiology, see Agriculture, Curricula. In this curriculum, principal emphasis is placed on understanding microorganisms and their interrelationships with other organisms in nature, the application of microbiology in medicine, agriculture and industry, and the study of fundamental life processes as exemplified by microorganisms. Some fields of microbiology, especially advanced research, may require further training. Undergraduate work in the program is designed to provide sound preparation for graduate study, training for bachelors-level employment, and admission to professional programs such as medicine, veterinary medicine and dentistry.

Graduates of the Interdepartmental Undergraduate Microbiology Program will learn about the diversity and complexity of microbial life represented by procaryotes, eucaryotes and viruses. In addition to being able to explain fundamental principles of microbial growth, physiology, genetics, biochemistry, and ecology, students will be able to evaluate the impact that the microbial world has on human, animal and plant health, as well as on environmental quality, industry and biotechnology. Graduates are able to design and implement experimental approaches to address specific questions. In addition, graduates are able to communicate scientifically, using a variety of media.

Students graduating in microbiology find career opportunities in a wide variety of areas including: hospital and clinical laboratories; federal, state, and local government agencies; research and development; dairy and food processing industries; and the pharmaceutical and fermentation industries.

The undergraduate program for the major in microbiology requires the following basic courses: 110, 302, 310, 320, 430 or 477, 450, 451, and labs including 302L, 310L, and 440. In addition, students must take 9 credits of elective microbiology courses from an approved list. Aspects of these courses emphasize communication skills, environmental issues, problem solving, and laboratory techniques. Courses in the following areas are required as supporting work: biology, chemistry, biochemistry, genetics, mathematics and physics. For additional details on the undergraduate curriculum in Microbiology see College of Agriculture, Curricula. Students are encouraged to participate in independent studies, internship opportunities, and international experiences.

Preveterinary preparation may be accomplished through the curriculum major in this program (see College of Veterinary Medicine, Admission Requirements).

The program offers a minor in microbiology which may be earned by accumulating a minimum of 15 credits of microbiology courses.

Graduate Study

The program offers work for the degrees master of science and doctor of philosophy in microbiology and for a minor for students majoring in other programs. The interdepartmental microbiology major is offered through faculty housed in twelve departments, including Agronomy; Animal Science; Biochemistry, Biophysics and Molecular Biology; Civil, Construction and Environmental Engineering; Entomology; Food Science and Human Nutrition; Genetics, Developmental and Cell Biology; Geological and Atmospheric Sciences; Plant Pathology; Veterinary Diagnostic and Production Animal Medicine; Veterinary Microbiology and Preventive Medicine; and Veterinary Pathology. Faculty coordinate graduate education and research in a wide range of topics fundamental to the discipline of microbiology. Specific information about individual faculty and their research areas is available at www.micro.iastate.edu.

Prerequisites to graduate study include a sound undergraduate background in chemistry, mathematics and biology, including microbiology and genetics.

All M.S. and Ph.D. students complete coursework that is comprised of one year of modular courses in microbiology (Micro 551, 552, 553, 554, 555, 556). Students also take at least 3 credits (M.S.) or 9 credits (Ph.D.) of coursework from an approved list of microbiology courses, one year of biochemistry (BBMB 404 and 405, or the equivalent), one course (0.5) credits in ethics (Micro 565A), and 3 credits (M.S.) or 5 credits (Ph.D.) of seminar (Micro 604).

Graduates in the Microbiology Graduate program have a broad-based knowledge in the fundamentals of microbiology as well as advanced knowledge in specific areas as determined by their areas of research focus. Students completing the thesis have the technical, research, critical-thinking, problem-solving, and computer skills to design, implement, and conduct research using a variety of current techniques and equipment. They are also able to communicate research results effectively with scientific peer groups in both oral and written formats.

Courses primarily for undergraduate students

Micro 110. Orientation in Microbiology. (1-0) Cr. 0.5. F. Orientation to the discipline of microbiology, the curriculum in microbiology, and educational research opportunities within the department. Satisfactory-fail only.

Micro 201. Introduction to Microbiology. (2-0) Cr. 2. F.S. *Prereq: One semester of college-level biology.* Selected topics in microbiology with emphasis on the relationship of microorganisms to human and animal health, agricultural technology, and the environment. With written petition to the chair of the supervisory committee, students who obtain a grade of B or better may substitute 201 for 302 in advanced courses.

Micro 201L. Introductory Microbiology Laboratory. (0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in 201 or 302.* Basic microbiology laboratory techniques for non-microbiology majors. Credit for either Micro 201L or 302L, but not both, may be applied toward graduation.

Micro 302. Biology of Microorganisms. (3-0) Cr. 3. F.S. *Prereq: Biol 211, credit or enrollment in Biol 212; 1 semester of chemistry.* Basic cell biology, physiology, metabolism, genetics and ecology of microorganisms, with an emphasis on procaryotes and viruses, as well as the roles of microorganisms in the environment, disease, agriculture, and industry.

Micro 302L. Microbiology Laboratory. (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in 302.* Basic microbiology laboratory techniques for majors in microbiology, biological sciences and related fields. Credit for either Micro 201L or 302L, but not both, may be applied toward graduation.

Micro 310. Medical Microbiology. (3-0) Cr. 3. F. *Prereq: 302 (or 201 if a B or better was obtained).* Study of infection and immunity by bacterial and viral pathogenic agents of humans. Nonmajor graduate credit.

Micro 310L. Medical Microbiology Laboratory. (0-3) Cr. 1. F. *Prereq: 201 or 302; 201L or 302L, credit or enrollment in 310.* Isolation and identification of human bacterial pathogens using basic staining techniques and biochemical tests. Brief introduction to techniques in cell culture and virology.

Micro 320. Microbial Physiology and Genetics. (4-0) Cr. 4. S. *Prereq: 302, Biol 313, credit or enrollment in Chem 332.* Introductory course in microbial physiology and genetics with special emphasis on prokaryotes. Topics include the structure, function, and assembly of cell components, bioenergetics, metabolic diversity, environmental stress tolerance, regulation of gene expression, genetic adaptation, and growth and cellular differentiation.

Micro 353. Introductory Parasitology. (Cross-listed with Biol). (3-3) Cr. 4. F. *Prereq: Biol 212.* Biology and host-parasite relationships of major groups of animal parasites, and techniques of diagnosing and studying parasites.

Micro 374. Insects and Our Health. (Cross-listed with Ent). (3-0) Cr. 3. S. *Prereq: 3 credits in biological sciences.* Bartholomay. Identification, biology, and significance of insects and arthropods that affect the health of humans and animals, particularly those that are vectors of disease. Nonmajor graduate credit.

Micro 374L. Insects and Our Health Laboratory. (Cross-listed with Ent). (0-3) Cr. 1. Alt. S., offered 2010. *Prereq: Credit or enrollment in Ent 374.* Bartholomay. Laboratory and field techniques for studying medical or public health entomology, including: collection, identification and maintenance of medically significant arthropods and experimental design and execution related to the biology of arthropods or arthropod-pathogen interactions.

Micro 381. Environmental Systems I: Introduction to Environmental Systems. (Cross-listed with Biol, EnSci, Env S). (2-4) Cr. 4. F. *Prereq: 12 credits of natural science including Biology and chemistry.* Introduction to the structure and function of natural environmental systems. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems. Nonmajor graduate credit.

Micro 402. Microbial Genetics. (Dual-listed with 502). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 302, Biol 313.* The fundamental concepts of bacterial and bacteriophage genetics including mutagenesis, mechanisms of both vertical and horizontal genetic information transfer, gene regulation, and genetic approaches to study complex cellular processes. Review and discussion of research literature to examine experimental design, methodology, and interpretation of both historical and contemporary relevance to microbial genetics.

Micro 407. Microbiological Safety of Foods of Animal Origins. (Dual-listed with 507). (Cross-listed with FS HN). (3-0) Cr. 3. S. *Prereq: 420.* Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

Micro 408. Virology. (Dual-listed with 508). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 313 or BBMB 301, Biol 314 recommended.* The molecular virology and epidemiology of human, animal, plant and insect viruses.

Micro 410. Insect-Virus Interactions: a Molecular Perspective. (Dual-listed with 510). (Cross-listed with Ent). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Permission of an instructor.* Bonning, Bartholomay. Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

Micro 419. Foodborne Hazards. (Cross-listed with FS HN, Tox). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Micro 201 or 302, a course in biochemistry.* Pathogenesis of human microbiological foodborne infections and intoxications, principles of toxicology, major classes of toxicants in the food supply, governmental regulation of foodborne hazards. Nonmajor graduate credit.

Micro 420. Food Microbiology. (Cross-listed with FS HN, Tox). (3-0) Cr. 3. F. *Prereq: 201 or 302.* Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications. Nonmajor graduate credit.

Micro 421. Food Microbiology Laboratory. (Cross-listed with FS HN). (0-6) Cr. 3. F. *Prereq: Micro 201 or 302; 201L. Credit or enrollment in Micro 420, FS HN 203.* Standard techniques used for the microbiological examination of foods. Independent and group projects on student-generated questions in food microbiology. Emphasis on oral and written communication and group interaction. Nonmajor graduate credit.

Micro 430. Procaryotic Diversity and Ecology. (Dual-listed with 530). (Cross-listed with BBMB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 302, 302L.* Survey of the diverse groups of procaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

Micro 440. Laboratory in Microbial Physiology, Diversity, and Genetics. (Cross-listed with BBMB). (1-7) Cr. 3. F. *Prereq: 302, 302L, Chem 332, Biol 313L.* Study of the fundamental techniques and theory of studying the diversity of microbial life. Experimental techniques will include isolation and physiological characterization of bacteria that inhabit different environments. Also included are techniques for the phylogenetic characterization, and genetic manipulation of diverse species of bacteria.

Micro 450. Undergraduate Seminar. Cr. 1. S. *Prereq: Sp Cm 212 and senior standing in Microbiology.* Required of all undergraduate majors in microbiology. Discussion of current papers in microbiology and immunology, issues in scientific conduct, and bioethics in microbiology. Students present current papers in a journal club format.

Micro 451. Senior Survey in Microbiology. Cr. R. F. *Prereq: Junior or Senior standing in Microbiology.* Preparations for graduation. Topics include job search strategies, career information, mock interviews, graduate and professional school application processes and guidelines as well as outcomes assessment activities.

Micro 456. Principles of Mycology. (Cross-listed with Biol). (2-3) Cr. 3. F. *Prereq: 10 credits in biological sciences.* Morphology, diversity, and ecology of fungi; their relation to agriculture, industry, and human health. Nonmajor graduate credit.

Micro 475. Immunology. (Dual-listed with 575). (3-0) Cr. 3. S. *Prereq: 310.* An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either Micro 475 or V MPM 520, but not both, may be applied to graduation.

Micro 475L. Immunology Laboratory. (1-4) Cr. 1. S. *Prereq: Credit or enrollment in 475 or 575.* Techniques in primary culture and tumor cell growth, measures of lymphocyte function, and flow cytometry. Half semester course.

Micro 477. Bacterial-Plant Interactions. (Dual-listed with 577). (Cross-listed with Pl P). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interaction with plants; covers symbiotic nitrogen fixation, plant pathogenesis, plant growth promotion, and biological control.

Micro 485. Soil and Environmental Microbiology. (Dual-listed with 585). (Cross-listed with Agron, EnSci). (2-3) Cr. 3. F. *Prereq: Agron 154 or EnSci 402, Micro 201 (Micro 302 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues. Nonmajor graduate credit.

Micro 487. Microbial Ecology. (Dual-listed with 587) (Cross-listed with Biol, EnSci). (3-0) Cr. 3. F. *Prereq: Six credits in biology and 6 credits in chemistry.* Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems. Nonmajor graduate credit.

Micro 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor.* **A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.**
H. Honors

Micro 495. Internship. Cr. arr. F.S. *Prereq: At least 6 credits of 300-level or above coursework in microbiology, approval of academic adviser.* Participation in the Cooperative Extension Intern Program or an equivalent work experience. Written report of activities required. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Micro 502. Microbial Genetics. (Dual-listed with 402). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 302, Biol 313.* The fundamental concepts of bacterial and bacteriophage genetics including mutagenesis, mechanisms of both vertical and horizontal genetic information transfer, gene regulation, and genetic approaches to study complex cellular processes. Review and discussion of research literature to examine experimental design, methodology, and interpretation of both historical and contemporary relevance to microbial genetics.

Micro 507. Microbiological Safety of Foods of Animal Origins. (Dual-listed with 407). (Cross-listed with FS HN). (3-0) Cr. 3. S. *Prereq: 420.* Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

Micro 508. Virology. (Dual-listed with 408). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 313 or BBMB 301, Biol 314 recommended.* The molecular virology and epidemiology of human, animal, plant, and insect viruses.

Micro 509. Plant Virology. (Cross-listed with Pl P). (2-6) Cr. 4. Alt. S., offered 2011. *Prereq: Pl P 408, Biol 454, BBMB 405, Chem 211.* Hill. Plant viruses and the diseases they cause. Emphasis on epidemiology and control. Structure, function, and biochemical-biophysical properties of plant viruses.

Micro 510. Insect-Virus Interactions: a Molecular Perspective. (Dual-listed with 410). (Cross-listed with Ent). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Permission of an instructor.* Bonning, Bartholomay. Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

Micro 530. Procaryotic Diversity and Ecology. (Dual-listed with 430). (Cross-listed with BBMB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 302, 302L.* Survey of the diverse groups of procaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

Micro 540. Livestock Immunogenetics. (Cross-listed with An S, V MPM). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: An S 561 or Micro 575 or V MPM 520.* Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

Micro 551. Microbial Diversity and Phylogeny. (1-0) Cr. 1. F. *Prereq: 302, Biol 313.* Comparisons among the three kingdoms of life (Bacterica, Archaea, and Eukarya). Topics will include metabolism, adaptation, methods of phylogenetic analysis, and comparative genomics.

Micro 552. Bacterial Molecular Genetics and Physiology. (1-0) Cr. 1. F. *Prereq: 302, Biol 313.* Review of the molecular genetics and physiology of model organisms.

Micro 553. Pathogenic Microorganisms. (1-0) Cr. 1. F. *Prereq: 302, Biol 313.* Review and contrast/comparison of common bacterial pathogens of plants and animals and their mechanisms of virulence, including toxins, protein secretion, host invasion and iron acquisition strategies. An overview of eukaryotic cell biology that is relevant to pathogenesis will also be included.

Micro 554. Virology. (1-0) Cr. 1. S. *Prereq: 302, Biol 313.* Review and contrast/comparison of insect, animal and plant viruses and bacteriophage. Growth dynamics, replication of model viruses, and the role of specific viruses in disease will also be included.

Micro 555. Fungal Biology. (1-0) Cr. 1. S. *Prereq: 302, Biol 313.* Review of the biology, reproduction, genetics, physiology, and diversity of yeast and other fungi.

Micro 556. Microbial Ecology and Environmental Monitoring. (1-0) Cr. 1. S. *Prereq: 302, Biol 313.* Examination of microorganisms in their natural habitats, including aquatic, terrestrial and extreme environments, community and biofilm development, microbe-microbe interactions, and current and traditional methods of microbial analysis in natural environments.

Micro 565. Professional Practice in the Life Sciences. (Cross-listed with Pl P, Agron, An S, BCB, Hort, V MPM). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.
A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

Micro 575. Immunology. (Dual-listed with 475). (Cross-listed with V MPM). (3-0) Cr. 3. S. *Prereq: 310.* An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either Micro 575 or V MPM 520, but not both, may be applied toward graduation.

Micro 577. Bacterial-Plant Interactions. (Dual-listed with 477). (Cross-listed with Pl P). (3-1) Cr. 3. Alt. S., offered 2010. *Prereq: 3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interaction with plants; covers symbiotic nitrogen fixation, plant pathogenesis, plant growth and biological control.

Micro 585. Soil and Environmental Microbiology. (Dual-listed with 485). (Cross-listed with Agron, EnSci). (2-3) Cr. 3. F. *Prereq: Agron 154 or 402, Micro 201 (Micro 302 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

Micro 586. Medical Bacteriology. (Cross-listed with V MPM). (4-0) Cr. 4. F. *Prereq: 310.* Bacteria associated with diseases of vertebrates, including virulence factors and interaction of host responses.

Micro 587. Microbial Ecology. (Dual-listed with 487). (Cross-listed with EEOB, EnSci). (3-0) Cr. 3. F. *Prereq: Six credits in biology and 6 credits in chemistry.* Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

Micro 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*

Courses for graduate students

Micro 604. Seminar. (1-0) Cr. 1. Repeatable. F.S. Course will expose students to the breadth of subdisciplines within microbiology, offer opportunities for direct interaction between the students and the faculty members within the Interdepartmental Microbiology Graduate Program, and promote interactions among the students within the program. Satisfactory-fail only.

Micro 608. Molecular Virology. (Cross-listed with V MPM, Pl P). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: BBMB 405 or GDCB 511.* C. Miller, Blitvich, A. Miller. Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

Micro 615. Molecular Immunology. (Cross-listed with BBMB, V MPM). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: BBMB 405 or 502.* Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signalling pathways leading to expression of genes that control and activate immune function.

Micro 625. Mechanisms of Bacterial Pathogenesis. (Cross-listed with V MPM). (4-0) Cr. 4. Alt. S., offered 2011. *Prereq: Credit in Biochemistry and Microbiology.* Review of current concepts in specific areas of microbial pathogenesis including the genetic basis for bacterial disease, genetic regulation and control of virulence factors and their mechanisms of action, and host-pathogen interactions at the cellular and molecular levels. The application of microbial genetics to understanding pathogenesis will be included.

Micro 626. Advanced Food Microbiology. (Cross-listed with FS HN, Tox). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: FS HN 420 or 421 or 504.* Topics of current interest in food microbiology, including new foodborne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials.

Micro 627. Rapid Methods in Food Microbiology. (Cross-listed with FS HN, Tox). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: FS HN 420 or 421 or 504.* Provides an overview of rapid microbial detection methods for use in foods. Topics include historical aspects of rapid microbial detection, basic categories of rapid tests (phenotypic, genotypic, whole cell, etc.), existing commercial test formats and kits, automation in testing, sample preparation and "next generation" testing formats now in development.

Micro 679. Light Microscopy. (Cross-listed with GDCB, EEOB). (2-9) Cr. 5. Alt. F., offered 2010. *Prereq: Permission of instructor.* Current theories encompassing light optics and their applications for specimen preservation, paraffin and resin sectioning, general staining, histochemistry, cytophotometry, immunocytochemistry, autoradiography, image digitization, processing and presentation, and digital macro- and micrography. Limit of 10 students.

Micro 680. Scanning Electron Microscopy. (Cross-listed with GDCB, EEOB). (2-9) Cr. 5. Alt. F., offered 2009. *Prereq: Permission of instructor.* Current theories encompassing scanning electron optics and their applications for high and low vacuum microscopy, specimen chemical and cryopreservation methods, x-ray microanalysis, backscattered and topographic imaging, image digitization, processing and presentation. Limit of 10 students.

Micro 681. Transmission Electron Microscopy. (Cross-listed with GDCB, EEOB). (2-9) Cr. 5. Alt. S., offered 2011. *Prereq: GDCB 679 and permission of instructor.* Current theories encompassing electron optics and their applications for chemical and physical specimen preservation, ultramicrotomy, general staining and cytochemistry, immunocytochemistry, autoradiography, negative staining and shadowing, x-ray microanalysis, image digitization, processing and presentation.

Micro 685. Advanced Soil Biochemistry. (Cross-listed with Agron, EnSci). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Agron 585.* Tabatabai. Chemistry of soil organic matter and biochemical transformations brought about by microorganisms and enzymes in soils.

Micro 690. Current Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Colloquia or advanced study of specific topics in a specialized field.
A. Microbiology
B. Immunology
C. Infectious Diseases

Micro 692. Molecular Biology of Plant-Pathogen Interactions. (Cross-listed with Pl P). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Pl P 506 or BBMB 405 or Gen 411 or Micro 402 or course in molecular biology.* Bogdanove, Whitham. Seminal and current research in molecular and physiological aspects of plant interactions with pathogens, including mechanisms of pathogenesis, host-pathogen recognition and host defense, with an emphasis on critical evaluation of primary literature. Students also complete an interinstitutional research proposal writing and peer review exercise.

Micro 697. Graduate Research Rotation. Cr. arr. Repeatable. F.S. Graduate research projects performed under the supervision of selected faculty members in the Interdepartmental Microbiology major.

Micro 698. Seminar in Molecular, Cellular, and Developmental Biology. (Cross-listed with MCDB, GDCB, BBMB, V MPM). (2-0) Cr. arr. Repeatable. F.S. Student and faculty presentations.

MICRO 699. Research. Cr. arr. Repeatable.

Military Science

www.public.iastate.edu/~armyrotc/

Lt. Col. John Soupene, Chair of Department

Professor: Soupene

Assistant Professor (Adjunct): Meyer

Instructors (Adjunct): Bower, Gledhill, Porter, Scott, Stephenson, Taylor, White

The Military Science Department does not offer an academic degree and is embedded within the College of Liberal Arts and Sciences as an interdisciplinary program. The mission of the department is derived directly from regulations governing Army Reserve Officers' Training Corps (AROTC), which are issued by the Army Cadet Command and Army Training and Doctrine Command and cannot be modifiable by this department.

Freshmen Year Learning Outcomes: The student will have a working knowledge of the following areas: The Role of the Army, Roles and Origins of the Army, Army Customs and Traditions, Branches (Jobs) in the Army and Military Operations and Tactics.

Sophomore Year Learning Outcomes: The student will have a working knowledge of the following areas: The Role of an Officer, Role of the Officer and Noncommissioned Officer, communications, code of conduct, first aid, principles of war and military operations and tactics.

Junior Year Learning Outcomes: The student will have a working knowledge of the following areas: Small Unit Training, Command and Staff Functions, Nuclear, Biological and Chemical Warfare, Law of War, Weapons, Human Behavior, Math Reasoning, Computer Science and Military Operations and Tactics.

Senior Year Learning Outcomes: The student will have a working knowledge of the following areas: Transition to Becoming an Officer, Military Justice, Intelligence and Electronic Warfare, Army Personnel Management, Army Logistics, Post and Installation Support and Military Operations and Tactics.

The mission of the Army Reserve Officers' Training Corps (AROTC) is to commission the future leaders of the United States Army. Since ROTC produces over 65 percent of the Army's Officer Corps, our task is one of the most important undertakings in the Army and our country today. We seek top quality college students. We train these potential leaders, assess their abilities, and challenge them with the highest standards of profession/professionalism. Those who successfully complete the program, receive a commission as a second lieutenant in the U.S. Army. A commission as an Army officer affords the opportunity to pursue a profession in one or several of the 300 different jobs held by Army officers. Students may request to serve as an officer in either the active army, or part time in the Army Reserve or National Guard. Regardless of the method of service, officers in today's Army can be proud to know that they are doing their share in the defense of the United States of America.

The ISU Military Science program is divided into two segments, the basic program and the advanced program. The basic program (courses numbered 101-290) is designed primarily for freshmen and sophomores. No military obligation is incurred by a person participating in the basic program. The basic program is designed to be informative and to acquaint students with the military as a profession. The basic program or an allowed substitute is a prerequisite for the advanced program. Financial assistance is available on a competitive basis.

Persons interested in Military Science should visit the department located on the second floor of the Armory (east side).

Basic Program

These courses are primarily for freshmen and sophomore students and, except for persons with prior military service and basic training graduates, are required for entry into the advanced program. No more than 10 credits in 100- and 200-level courses may be applied toward graduation. Each scholarship cadet in the Basic Program receives a monthly allowance (freshmen $300; sophomore $350) for up to 10 months. The curriculum is designed to train freshmen and sophomores in individual and team skills. It also helps the Professor of Military Science identify individual leader developmental needs.

Advanced Program

These courses are for students who have completed the basic program (or received equivalent credit) and are mandatory for potential commissioning upon contracting at the beginning of their junior year. Each cadet receives a monthly allowance (junior $450; senior $500) for up to 10 months. This stipend is given during the junior and senior years. These courses are primarily taught to academic juniors and seniors.

Successful completion normally obligates the student to military service on active or reserve duty. In addition to the advanced program of study, a student (cadet) will be expected to pass the Army Physical Fitness Test (precondition for commissioning) each semester and continually maintain military appearance standards in both personal grooming and uniform. Physical fitness training is regularly conducted outside of class and laboratory hours in a separate course, M S 150 "Army Physical Readiness". Students are encouraged to attend and participate in this class.

Professional Military Science Education (PME) coursework outside of the military science curriculum is also a precondition to commissioning. The PME component consists of Basic Academic proficiency standards. These standards are explained to prospective students as they consider enrollment in the advanced program. Army Uniforms will be worn at least once a week. The 300-level courses are designed to prepare cadets for the Leader Development and Assessment Course, which is a 32 day summer internship/training program where cadets are trained to Army standards, develop leadership skills, and have their officer potential evaluated. The 400-level courses are the final preparation for commissioning as a second lieutenant in the United States Army. Students must meet academic alignment criteria and receive basic program credit before entering the advanced program.

The College of Liberal Arts and Science offers a minor in Military Studies. Requirements for the minor include taking a minimum of 15 credits of ROTC instruction, which may be taken from one or a number of the ROTC programs. At least 6 credits must be in courses numbered 300 or above.

Courses primarily for undergraduate students

Basic Program

M S 101. Introduction to Military Science. (1-0) Cr. 1. F. *Prereq: Concurrent enrollment in M S 101L required.* Examines the role of a Cadet in the Army Reserve Officer Training Corps and a Lieutenant in the United States Army. The course explores a military culture whose ultimate success is determined by the character and proficiency of its' leaders. Instruction introduces students to the cultural heritage and history of the U.S. Army. Students will begin to understand the structure of the U.S. Army and how it functions as an organization and institution. The curriculum promotes the development of students' communication skills to enhance their ability to transmit ideas. The class examines how the Army's cultural values drive the development of leadership in the Officer Corps. Hands-on activities enable students to gain insight on the skills and abilities required of cadets and officers interacting with civilians and soldiers.

M S 101L. Basic Leadership Laboratory I. (0-2) Cr. 1. F. *Prereq: Concurrent enrollment in M S 101 required.* Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Students observe and participate in the rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. This concept provides a constant learning environment as they learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Marching, rifle firing, and tactical patrolling; students gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 102. Structure and Function of the U.S. Army. (1-0) Cr. 1. S. *Prereq: Concurrent enrollment in M S 102L required.* Instructs students on the fundamental skills and proficiencies required of Cadets in the Army Reserve Officer Training Corps and Officers in the United States Army. Allows students to explore the Army culture whose ultimate success is determined by the character and proficiency of its' leaders. Students will gain an insight to the effects of human behavior and communication on the function of the Army's basic unit structures. Special focus is given to the emphasis the Army puts on the development and character of the leader and how that affects the culture and operation of the Army as an institution. Students will develop an understanding of the role that morals and ethics play in becoming an Army Officer and leading American Soldiers. Introduction to basic officer/soldier skills will elucidate the complex role of the Officer in the modern Army.

M S 102L. Basic Leadership Laboratory II. (0-2) Cr. 1. S. *Prereq: Concurrent enrollment in M S 102 required.* Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. Provides a constant learning environment as they learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Students also learn various military tasks such as marching, rifle firing, and tactical patrolling; gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 150. Army Physical Readiness. (0-3) Cr. 1. Repeatable. F.S. *Prereq: None.* This lab is designed to use basic military skills and instruction to develop confidence, leadership, and physical fitness. The team approach is utilized in the instruction and application of Army physical fitness requirements. Students will learn various Army physical fitness techniques as well as how to conduct physical fitness sessions. Teaching locations include Lied Recreation Center, Beyer Hall, State Gym as well as around campus. Full participation in all events will be determined based on

students physical and medical eligibility. No more than 10 credits in MS 100 and 200- level courses may be applied toward graduation. Satisfactory-fail only.

M S 201. Principles of Leadership and Communication Skills. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in M S 201L required.* Explores the development of leadership and communication skills by understanding and studying the principles, traits, and dynamics of leadership and effective communication techniques. These include; leadership dimensions, human behavior, time management skills, stress management, values and ethics, decision making process, problem solving skills, team building exercises, communication techniques, briefing skills, delegating, nutrition, fitness, and counseling. Leadership assessment programs, role playing, active class participation, speeches, country briefs, and video clips are used to enhance and reinforce the instruction.

M S 201L. Basic Leadership Laboratory III. (0-2) Cr. 1. F. *Prereq: Concurrent enrollment in M S 201 required.* Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Students observe and participate in the rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. Learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Students also learn various military tasks such as marching, rifle firing, and tactical patrolling; gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 202. Map Reading and Land Navigation. (2-0) Cr. 2. S. *Prereq: Concurrent enrollment in M S 202L required.* Class focuses on the characteristics and features of the earth's land mass and how to apply different methods of conducting navigation on land. These methods include; by use of topographical maps, compasses, aerial photographs, military maps, symbols, and all their practical application. These navigation techniques are used in class in conjunction with patrolling techniques and squad movement exercises. Students will utilize verbal and non-verbal communication, communication techniques, and briefing techniques during this class. Students are also assigned to read one professional book from the Army Reading List and complete a written review of the book in the Army writing style.

M S 202L. Basic Leadership Laboratory IV. (0-2) Cr. 1. S. *Prereq: Concurrent enrollment in M S 202 required.* Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Students observe and participate in the rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. Learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Students also learn various military tasks such as marching, rifle firing, and tactical patrolling; gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 290. Independent Study: Basic Military Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of the Chair of Military Science Department.* Investigation of an approved topic. Must result in a professional journal-worthy paper on ethics, current military issues, interpersonal communications, or leadership development. No more than 10 credits in MS 100- and 200-level courses may be applied toward graduation.

M S 301. Methods of Instructing Military Skills. (3-0) Cr. 3. F. *Prereq: Completion of the basic Military Science program, concurrent enrollment in MS 301L, and permission of the Chair of the Military Science Department.* Develops student's proficiency in analyzing, planning, and executing complex operations within a military organizational structure. Students are given situational opportunities and then measured on their leadership abilities through systematic feedback. Student's evaluations are based on sixteen leadership dimensions within the realms of values, attributes, skills, and actions. Students develop an understanding of human cultural heritage and history, as it pertains to the armed forces.

M S 301L. Advanced Leadership Laboratory I. (0-4) Cr. 1. F. *Prereq: Completion of the basic program, concurrent enrollment in MS 301 and permission of the Chair of the Military Science Department.* The lab compliments M S 301 by providing opportunities to practice the lessons from class. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs. Participating in the Water Survival test, Army Physical Fitness test and the Land Navigation test are required.

M S 302. Applied Leadership. (3-0) Cr. 3. S. *Prereq: Completion of the basic Military Science program, concurrent enrollment in MS 302L and permission of the Chair of the Military Science Department.* Prepares students to attend the Leadership Develop and Assessment Course at Fort Lewis, Washington in which they will be assigned specific and situational tasks to accomplish by providing purpose, motivation, and direction to fellow students across the nation. Students will learn how to identify sixteen leadership dimensions in the under classmen and provide specific feedback on their leadership behaviors. Students will develop their oral communication skills about the plans developed by the class, through small group presentation settings. Students will develop methods of studying human behavior.

M S 302L. Advanced Leadership Laboratory II. (0-4) Cr. 1. S. *Prereq: Completion of the basic program, concurrent enrollment in MS 302 and permission of the Chair of the Military Science Department.* The lab compliments M S 302 by providing opportunities to practice the lessons from class. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs. Participating in the Water Survial Test, Army Physical Fitness Test and the Land Navigation test required.

M S 310. Practicum: Advanced Military Skills. (0-3) Cr. 1. Repeatable. S. *Prereq: Permission of the Chair of the Military Science Department.* An annual 72-hour military field training exercise that requires weeks of planning, participation, plus senior ROTC cadet evaluation. Designed to prepare basic cadets for military field training and MS III cadets for the Leadership Development and Assessment Course, held during the summer at Fort Lewis, Washington. Actual military conditions are simulated; detailed instruction in weapons training and execution of a simulated Operation Order in accomplishing a specific military mission. Conducted as a weekend exercise at Camp Dodge (National Guard Facility). Satisfactory-fail only.

M S 401. Seminar: The Military Team. (3-0) Cr. 3. F. *Prereq: Completion of the basic program, concurrent enrollment in MS 401L and permission of the Chair of the Military Science Department.* Develops student proficiency in analyzing and evaluating leadership behaviors, such as values, attributes, skills, and actions. Students are given situational opportunities to assess leadership and provide feedback to other students placed in leadership roles. Students will be measured by their ability to both give and receive systematic and specific feedback on leadership behaviors. Students will develop their ability to communicate thoughts and ideas orally through small group presentations and group discussions. Students will supervise and evaluate the planning and execution of complex operations within a military organizational structure.

M S 401L. Advanced Leadership Laboratory III. (0-4) Cr. 1. F. *Prereq: Completion of the basic program, concurrent enrollment in MS 401 and permission of the Chair of the Military Science Department.* The lab compliments the instruction from class by demonstrating the indelible link between personal values and successful leadership. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs.

M S 402. Seminar: The Professional Military Officer. (3-0) Cr. 3. S. *Prereq: Completion of the basic program, concurrent enrollment in M S 402L and permission of the Chair of the Military Science Department.* Explores the dynamics of leading in the complex situations of current military operations in a contemporary world. Students will examine the differences in customs, courtesies and operational principles in the face of international terrorism. Students will also explore aspects of interaction with nongovernmental organizations, civilians and media in a war zone and foreign national governments. The course uses case studies, scenarios, and practical exercises, which prepare the student to face complex ethical and practical demands of leading soldiers within a multifaceted military organizational structure.

M S 402L. Advanced Leadership Laboratory IV. (0-4) Cr. 1. S. *Prereq: Completion of the basic program, concurrent enrollment in MS 402 and permission of the Chair of the Military Science Department.* The lab compliments the instruction from class by demonstrating the indelible link between personal values and successful leadership. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs.

M S 410. Practicum: Military Skills Leadership. (0-3) Cr. 1. S. *Prereq: Permission of the Chair of the Military Science Department.* An annual 72-hour military field training exercise that requires weeks of planning, participation, and ROTC cadre evaluation. Designed for the advanced ROTC cadet in preparation for being commissioned as officers in the U.S. Army. Actual military conditions are simulated; detailed instruction in weapons training and execution of a simulated operation order in accomplishing a specific military mission. Conducted as a weekend exercise at Camp Dodge (National Guard Facility). Satisfactory-fail only.

M S 490. Independent Study: Advanced Military Study. (1-0) Cr. 1. Repeatable. F.S.SS. *Prereq: M S 301, 302, 401 and 402 and permission of the Chair of the Military Science Department.* Investigation of an approved topic. Must result in a professional journal-worthy paper on ethics, current military issues, interpersonal communications, or leadership development.

Military Studies

(Interdepartmental Minor)

Advisory Committee: Lieutenant Colonel Soupene, Captain Waring, Colonel Cramp

The Military Studies program is designed for students interested in learning about military skills and careers. The mission of the Reserve Officers' Training Corps (ROTC) programs is threefold. First, students are developed mentally, morally, and physically in order to make them strong leaders. Second, a desire for development in mind and character is instilled in students so they may assume the highest responsibilities of command, citizenship, and government. Finally, students are imbued with the highest ideals of duty, honor, and

loyalty in order to graduate with a basic professional background and motivation toward their careers.

The Military Science, Naval Science and Air Force Aerospace departments accomplish this mission through detailed courses of instruction occurring throughout a typical student's college career. All academic courses offered by these departments focus on the development of professional military skills and their application. Each department offers courses unique to its branch of the military. Students in Army ROTC classes gain an appreciation for ground warfare and doctrine, while the Naval Science program develops basic seamanship skills such as navigation and marine propulsion. The Air Force Aerospace Studies curriculum familiarizes students with Air Force structure and doctrine. On a broader scale, all three departments offer courses promoting leadership and sound management practices that investigate the military's role in American domestic and foreign policy, and can be employed in any career path.

Military Science, Naval Science and Air Force Aerospace courses are offered in the interdepartmental Military Studies program in the following participating departments: Military Science, Naval Science and Air Force Aerospace.

Undergraduate Study

Undergraduate study in this program provides the student with an opportunity to develop a minor in Military Studies. The three Iowa State University ROTC programs offer over 64 credits of specialized coursework. The minor in Military Studies is open to any Iowa State University student.

Undergraduate students may minor in Military Studies by taking 15 credits of coursework from a combination of any of the three ROTC programs - regardless of whether or not a commission in the Armed Forces is tendered. At least 6 of the 15 credits must be in courses numbered 300 or above.

Courses primarily for undergraduate students

Air Force Aerospace Studies - See Air Force Aerospace Studies.

AFAS 141. Foundations of the United States Air Force.
AFAS 142. Foundations of the United States Air Force.
AFAS 241. The Evolution of Air and Space Power.
AFAS 242. The Evolution of Air and Space Power.
AFAS 341. Air Force Leadership Studies.
AFAS 342. Air Force Leadership Studies.
AFAS 441. National Security Affairs and Preparation for Active Duty.
AFAS 442. National Security Affairs and Preparation for Active Duty.

Military Science - See Military Science.

M S 101. Introduction to Military Science
M S 102. Structure and Function of the U.S. Army
M S 201. Principles of Leadership and Communication Skills
M S 202. Map Reading and Land Navigation
M S 301. Methods of Instructing Military Skills
M S 302. Applied Leadership
M S 401. Seminar: The Military Team.
M S 290. Independent Study: Basic Military Study
M S 490. Independent Study: Advanced Military Study

Naval Science - See Naval Science.

N S 111. Introduction to Naval Science
N S 212. Seapower and Maritime Affairs
N S 220. Leadership and Management
N S 230. Navigation
N S 320. Naval Ship Systems I
N S 321. Evolution of Warfare
N S 330. Naval Ship Systems II
N S 410. Naval Operations and Seamanship
N S 412. Leadership and Ethics
N S 421. Evolution of Amphibious Warfare

Molecular, Cellular, and Developmental Biology

www.mcdb.iastate.edu

(Interdepartmental Graduate Major)

Program Executive Committee: Jeff Beetham, Chair; F. C. Minion Associate Chair; W. A. Miller, and James Reecy

Participating Faculty: J. Beetham, Chair; Ambrosio, Linda Anderson, Lloyd Andreotti, Amy Bartholomay, Lyric Bassham, Diane Bhattacharyya, Madan Baum, Thomas Beattie, Gwyn Becraft, Phil Beitz, Donald Bellaire, Bryan Birt, Diane Blitvich, Bradley Bogdanove, Adam Bonning, Bryony Brehm-Stecher, Byron Coffman, Clark Dobbs, Drena Ellinwood, Matthew Essner, Jeffrey Ford, Clark Hannapel, David Henderson, Eric Huiatt, Ted Johansen, Jorgen Johansen, Kristen Jones, Doug Jurenka, Russell Kanthasamy, Anumantha Lee, Michael Link, Charles Macintosh, Gustavo Martin, Richard McGrail, Maura Miller, Cathy Miller, W. Allen Minion, F. Chris Myers, Alan Nikolau, Basil Nilsen-Hamilton, Marit Nolan, Lisa K. Ourednik, Jitka Ourednik, Vaclav Peters, Reuben Petersen, Christine Phillips, Greg Powell-Coffman, Jo Anne Reecy, Jim Robson, Richard Ross, Jason Rowling, Matthew Sakaguchi, Donald Selsby, Joshua Schalinske, Kevin Schnable, Patrick Shin, Yeon-Kyun Shogren-Knaak, Michael Singh, Ravindra Spalding, Martin Tabatabai, Louisa Thornburg, Robert Tuggle, Christopher Vollbrecht, Erik Wang, Kan Whitham, Steve Wurtele, Eve Yang, Bing Yin, Yanhai Yu, Edward Zabotina, Olga Zhang, Qijing

Undergraduate Study

A special program in molecular, cellular, and developmental biology is not offered for the baccalaureate. Undergraduates wishing to prepare for graduate study in molecular, cellular, and developmental biology should elect courses in biochemistry, biology, genetics, microbiology; and mathematics through calculus; chemistry through organic; and one year of physics. Biol 313, 313L, 314, and 314L are recommended to undergraduates desiring an introduction to this area.

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in molecular, cellular, and developmental biology in several cooperating departments: Agronomy; Animal Science; Biochemistry, Biophysics & Molecular Biology; Biomedical Sciences; Entomology; Food Science and Human Nutrition; Genetics, Development and Cell Biology; Horticulture; Physics & Astronomy; Plant Pathology; Veterinary Microbiology & Preventive Medicine; Veterinary Pathology. Facilities and qualified faculty are available in these departments for conducting fundamental research in the various aspects of molecular, cellular, and developmental biology. Ongoing research projects include molecular and cellular studies of viral, prokaryotic, plant, and animal systems.

Students may enter the MCDB major in one of two ways: they may apply to and be accepted into the major directly or they may formally apply to the major after being accepted by a participating department. Students admitted into MCDB will take MCDB 697 (Graduate Research Rotations) in their first two semesters and choose a major professor from the participating faculty by the end of their second semester. Students admitted by a department will choose a major professor from the participating faculty in that department. All Ph.D. students take a core curriculum consisting of the following courses: Molecular biology (MCDB 511, 520, or 545 or Micro 502 or MCDB 676 or V MPM 608). In seminar, students will make journal and research presentations and attend MCDB seminars. M.S. students take the above core but may delete either the molecular genetics, cell biology, or developmental biology component. Additional coursework is selected to meet departmental requirements and to satisfy individual student research interests. All graduate students are required to teach as part of their training for an advanced degree.

Students minoring in molecular, cellular, and developmental biology at the Ph.D. level must meet the following requirements: one year of biochemistry (BBMB 404, 405, or BBMB 501, 502; one course in each of two of the above three areas molecular biology (MCDB 511, 520, or 545 or Micro 502 or MCDB 676 or V MPM 608).

Courses primarily for graduate students

MCDB 511. Molecular Genetics. (Cross-listed with GDCB). (3-0) Cr. 3. S. *Prereq: Biol 313 and BBMB 405.* The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes.

MCDB 512. Plant Growth and Development. (Cross-listed with GDCB, PlBio). (2-0) Cr. 2. S. *Prereq: Biol 330 or a course in developmental biology; GDCB 545 or BBMB 404, 405 or GDCB 520.* Plant growth and development and its molecular genetic regulation. Hormone biosynthesis, metabolism, and action. Signal transduction in plants.

MCDB 520. Genetic Engineering. (Cross-listed with GDCB, BBMB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Gen 411 or BBMB 405.* Strategies and methods of gene cloning, restriction endonuclease mapping, southern hybridization, isolation and manipulation of plasmid DNA, and detection of specific genes in bacteria.

MCDB 528. Cellular Growth and Regulation. (Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Courses in cell biology and BBMB 404, 405.* Cell cycle, regulation of cell growth, cell division, membranes, transport processes, and regulation of cellular activities.

MCDB 529. Plant Cell Biology. (Cross-listed with GDCB). (2-0) Cr. 2. F. *Prereq: Biol 313, 314, 330 or BBMB 405.* Organization, function, and development of plant cells and subcellular structures.

MCDB 533. Principles of Developmental Biology. (Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Biol 314.* Fundamental principles in multicellular development. Emphasis on cellular and molecular regulation of developmental processes, and experimental approaches as illustrated in classical studies and current literature.

MCDB 545. Plant Molecular Biology. (Cross-listed with GDCB, PlBio). (3-0) Cr. 3. F. *Prereq: Biol 314, 330.* Organization and function of plant nuclear and organelle DNA; regulation of gene expression. Methods of generating novel genetic variation. Impact of plant biotechnology on agriculture.

MCDB 590. Special Topics. Cr. arr. Repeatable.

MCDB 640. Signal Transduction. (Cross-listed with GDCB, BBMB). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: GDCB 528, BBMB 404.* Mechanisms and components of cellular signal transduction including receptors, G-proteins, second messengers, protein phosphorylation, other post-translational protein modifications, and transcriptional regulation.

MCDB 676. Biochemistry of Gene Expression in Eucaryotes. (Cross-listed with BBMB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: BBMB 404 or 501, 405 or 502 or GDCB 511.* Analysis of the biochemical processes involved in expression of eucaryotic genes and the regulation thereof, including RNA polymerase, transcriptional regulatory proteins, enhancers and silencers, chromosome structure, termination, RNA processing, RNA transport, RNA turnover, translational regulation, protein turnover.

MCDB 697. Graduate Research Rotation. Cr. arr. Repeatable. F.S. Graduate research projects performed under the supervision of selected faculty members in the molecular, cellular, and developmental biology program.

MCDB 698. Seminar in Molecular, Cellular, and Developmental Biology. (Cross-listed with BBMB, GDCB, Micro, V MPM). (2-0) Cr. arr. Repeatable. F.S. Student and faculty presentations.

MCDB 699. Research. Cr. arr. Repeatable.

Music

www.music.iastate.edu

Michael Golemo, Chair of Department

Distinguished Professor (Emeritus): White

University Professor: David

Professors: Cox, Darlington, Prater, Rodde, Simonson, Stuart, Work, Zeigler

Professors (Emeritus): Bleyle, Brandt, Burkhalter, Drexler, Haug, Messenger, Molison, Swift, Vongrabow

Professor (Adjunct): Estes

Associate Professors: Bovinette, Creswell, Golemo, Larkin, Munsen, Schilling, Sturm, Sunderman, Tam

Associate Professors (Emeritus): Alcorn, Bjurstrom

Assistant Professors: Baker, Giles, Hopkins, Oakes

Assistant Professor (Emeritus): Waggoner

Assistant Professors (Adjunct): Bryden, Trenberth

Instructor (Collaborator): Foss

Senior Lecturers: Rodde, Smith, Tener

Lecturers: Conklin, Dell, Duckett, Foss, Giles, Grunmann, Heffernan, Kortenkamp, Lin, Schumacher, Steele, Zwick-Tapley

Undergraduate Study

The Department of Music offers a strong undergraduate music program, where students study with full-time faculty professionals in a supportive environment that encourages students to become their best.

The curriculum of the music department provides:

1. A comprehensive program of professional studies for students who wish to prepare for careers in music, including teaching, performance, and composition, and for students who plan to pursue graduate studies in music.

2. Courses in music literature, theory and areas of performance for all students, regardless of major.

The department embodies the land-grant philosophy of service to the people of the state with a faculty of active scholars, teachers, and artists committed to excellence in teaching, creative/scholarly work, and arts outreach. The department is an accredited institutional member of the National Association of Schools of Music (NASM).

The Theatre Program is administered by the Department of Music (see *Index, Theatre Courses*.)

Minor in Music. Candidates for the minor in music will complete 19 credits in music including:
a. 221 and 231
b. two of the following: 102, 120 or 302, 304, 383
c. four credits chosen from the following ensembles and applied music: 111, 113, 115, 141, 151, 161, 181, 321, 118, 318, 290F

At least 6 of the 19 credits must be in courses numbered 300 and above taken at ISU with a grade of C or better. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

Students pursuing a music minor must meet the audition requirements and/or prerequisites for all courses they wish to take.

Minor in Music Technology. Candidates for the minor in music technology will complete 15 credits including:
a. eight credits: Music Technology Core—Music 246 (2 cr.), 346 (3 cr.), 446 (3 cr.)
b. seven credits from the following technology and music electives: Com S 107, 207, 208, 227, 228, 229, 309; Cpr E 329; E E 201, 224, 324, 424; M E 451; Phys 198; S E 319; Music 101 or 105, 102, 118, 120 or 302, 221, 222, 231, 232, 304, 318, 331, 332, 337, 338, 383, 384, 472, 490I, 593I.

Music majors may use the following music courses toward the music technology minor: 246, 346, 446, 490I, 590I.

Bachelor of Music students may not count Phys 198 in the Music Technology minor.

At least six of the fifteen credits must be taken at Iowa State University in courses numbered 300 or above with a grade of C or higher. The minor must include at least nine credits not used to meet any other department, college, or university requirement. Students pursuing a minor in music technology must meet the audition requirements and/or prerequisites for all music courses they wish to take.

Curricula Available to Music Majors

Students interested in pursuing an emphasis in music theater should see Index, Theater and Performing Arts.

Bachelor of Music

This curriculum leads to the degree bachelor of music. This degree is more specialized and contains fewer general education requirements than the bachelor of arts degree with a major in music. Students in this curriculum choose between options in education, performance, and composition. To obtain a bachelor of music degree, a student must earn a minimum of 124.5-146 credits (depending on the option chosen) including a minimum of 32 credits in residence at Iowa State University and a minimum of 45 advanced credits in courses numbered 300 or above and must meet all of the requirements specified below.

Courses taken on a pass/not pass basis may be counted toward the required total credits, and may be used to meet the advanced credit requirement, if appropriate, but may not be used to satisfy any other graduation requirement.

Cr. Degree Requirements

32 General Education Requirements
(Students choosing the music education option should consult their advisers regarding general education requirements)
- 6 Social sciences
- 6 Humanities
- 6 Music 383, 384
- 3 Phys 198
- 6 Mathematical, physical, and biological sciences
- 5 Electives

6.5-14.5 Other Requirements
- 6 Engl 150, 250 (average grade C- or better required)
- 0.5 Library 160
- 0-8 World language (one)

47 Music core
- 22 Music 120, 221, 222, 231, 232, 331, 332, 337, 338, 361
- 12 Music 119, 219, 319, 419
- 3 One of the following: Music 471, 472, 473, 475, 476
- 3 One of the following: Music 440, 446
- 7 Ensembles
- R 420

31-52.5 Area of concentration
(select one of the following options)

51.5-52.5 Music education - See Teacher Education Section of this catalog.

52.5 Vocal K-12 option
Music 248, 266, 327, 358A, 360, 362A, 366, 367, 417K, 417L, 465, 466, 480K (3.5 cr.); one of the following: Music 301 (3 cr.), Thtre 354, 355, 359; C I 204, 406, 426; Sp Ed 450

51.5-52.5 Instrumental K-12 option
Music 248, 266, 350, 351, 352, 353, 354, 355, 358B, 362B, 366, 368 or 490A (String pedagogy), 464, 466, 417K, 417L, 480K (3.5 cr.); C I 204, 406, 426; Sp Ed 450

31 Voice
- 2 Music 327
- 2 Music 119B, 119C, or 119K
- 8 Music 319A, 419A
- 6 Music 324, 325, 360
- 3 Music 440, or 446
- 2 Music 415A
- 8 Second world language

31 Piano
- 12 Music 119, 219, 319, 419
- 5 Music 321
- 5 Music 415B
- 2 Music 327
- 3 Music 440 or 446
- 4 Electives

31 Organ
- 4 Music 119B, 219B
- 8 Music 319C, 419C
- 5 Music 415C
- 3 Music 471, 472, 473, 475, or 476
- 3 Music 440, or 446
- 8 Second world language

31 String instruments
- 12 Music 119, 219, 319, 419
- 6 Music 181, 321
- 3 Music 440 or 446
- 4 Music 415D
- 6 Electives

31 Wind or percussion instrument
- 12 Music 119, 219, 319, 419
- 1-3 Music 351-352 or 353-354 or 355
- 3 Music 321
- 3 Music 440 or 446
- 4 Music 415
- 6-8 Electives

31 Composition
- 4 Music 290C
- 12 Music 490C
- 2 Music 246
- 4 Music 362A, 362B
- 6 From: Music 346, 440, 446, 490B, 490I
- 3 Electives

124.5-146 Total credits

Bachelor of Arts—Music Major

A more general degree than the bachelor of music, the bachelor of arts degree requires no formal specialization. It includes more general education requirements and provides a broader course of academic study.

For the undergraduate curriculum in Liberal Arts and Sciences, major in music, leading to the degree bachelor of arts, see Liberal Arts and Sciences, Curriculum.

Candidates for the degree bachelor of arts with a music major will normally complete 48 credits of music including the following required courses: 119, 120, 219, 221, 222, 231, 232, 319, 331, 332, 337, 338, 383, 384, 4 credits from: 111, 113, 115, 141, 151, 161, 181, 321.

Bachelor of arts students whose chief professional interest lies in research are encouraged to minor in world languages and cultures, history, literature, or philosophy.

General Requirements

Prior to being accepted as a music major, students are required to audition for applied faculty in their performance area (piano, organ, woodwinds, strings, percussion, brass, or voice), and must successfully demonstrate performance skills appropriate for college level instruction. Once accepted, a student must complete a placement examination in keyboard skills. This examination will be given by members of the departmental faculty during summer orientation, the week preceding the opening of classes for fall semester, or by appointment.

Seminars and Recitals. All music majors enrolled for applied music courses will attend a weekly 1-hour seminar in their areas and departmental recitals each semester.

Ensemble Requirement. All bachelor of music students must register for an ensemble course (111, 115, 141, 151, 161, 181, 113, 301, 321) each semester of full-time enrollment (except during student teaching). Students in a music education option must register for six semesters of large ensemble (111, 115, 141, 151, 161, 181) and one semester of chamber music ensemble (113, 161, 301, 321). Instrumental music education students may count one semester of 114A as a large ensemble. All full-time Bachelor of Music students in options other than music education must include among their ensembles at least two semesters of large ensemble (111, 115, 141, 151, 161, 181) and one semester of chamber ensemble (113, 161, 301, 321).

Continuation Examination. To be approved for continuation as a music major on the junior level, a student must pass a continuation examination taken normally at the end of the fourth semester. Before taking this examination, the student must fill out the requisite forms as well as write an essay including: (1) his/her personal goals, (2) a self-assessment of his/her progress thus far, and (3) an assessment of what he/she expects to accomplish before graduation.

The student taking the Continuation Examination performs for a Continuation Examination Committee. Requirements include the performance of three works representing different periods or styles selected by and studied with the applied teacher, a self-prepared piece, and sight reading. The student must display acceptable solo ability and performance techniques in at least one of the applied areas. A written evaluation will be given each student following his/her performance. This evaluation will include a candid assessment of the student's potential to achieve his/her goals.

In addition, the student may arrange to meet with members of the Continuation Examination Committee at a later date to discuss the results of his/her Continuation Examination.

All music majors must demonstrate proficiency in piano as a part of the continuation examination. Proficiency will normally be demonstrated by completing Music 228 or, for keyboard majors, by completing Music 327. The student must pass all parts of the continuation examination in order to enroll in Music 319 or 419, Applied Music. Details and forms available at: www.music.iastate.edu.

Graduation Proficiency. To be recommended for graduation, a music student should demonstrate to the music faculty mature acquaintance with performance styles, technique, and repertoire. All music majors will participate in departmental recitals to the satisfaction of the department. Candidates for the bachelor of music degree will present a graduation recital.

Communication Proficiency requirement: The department requires a grade of C– or better in each of Engl 150 and 250 (or 250H). In addition the Communication Proficiency must be certified through one of the following options:

1. Certification of writing skills, by the instructor, after completion of Music 120, 383, 384, 472, 473, or 475. (Passing one of these courses does not automatically satisfy the requirements for Communication Proficiency.)

2. Satisfactory completion of an advanced writing course (e.g., English 302, 305, or 314.)

Learning Outcomes and Assessment
Music graduates will understand and demonstrate: (1) Knowledge of music cultural heritage and history, (2) Appreciation for musical creativity, reasoning, and the aesthetic value of music, (3) Knowledge of organization and structures of music, (4) Analytical skills necessary for listening, performing, and teaching, (5) Skills necessary to perform music from a variety of periods, styles, and genres, (6) Necessary abilities to communicate ideas musically, verbally, and in writing, (7) Awareness of the diversity of musical ideas throughout the world's cultures, and (8) For Music Education students: success in meeting the ISU Teaching Standards as outlined by the University Teacher Education Program. Assessment measures include the continuation examination, graduating senior surveys and exit interviews, public performances, senior projects, course grades, teacher certification (for music education students), and the National Association of Schools of Music accreditation review.

Courses primarily for undergraduate students

Music 101. Fundamentals of Music. (1-2) Cr. 2. F.S. *Prereq: Ability to read elementary musical notation.* Notation, recognition, execution and analysis of scales, intervals, triads, and rhythm; key signatures; time signatures; transposition. Open to non-majors only.

Music 102. Introduction to Music Listening. (3-0) Cr. 3. F.S.SS. Expansion of the music listening experiences for the general student through greater awareness of differences in techniques of listening, performance media, and materials of the art. The course focuses on the elements of music: rhythm, melody, harmony, form, and style, and how these elements are used in musics of different cultures and time periods. Ability to read or perform music not required.

Music 105. Basic Musicianship. (1-4) Cr. 3. S. *Prereq: Performing arts major classification.* Beginning keyboard techniques, sight-reading, and ear training. Basic materials of music: notation, scales, intervals, key signatures, time signatures, rhythm, and harmony.

Music 111. Wind Ensemble. (0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Emphasis on significant extended compositions for wind and percussion instruments. Performances include formal concerts on campus and the annual tour.

Music 112. Concert Band. (0-2) Cr. 1. Repeatable. F.S. *Prereq: Open to all students who have performed on a wind or percussion instrument in high school band or orchestra.* Repertoire includes the broad spectrum of band music. Two concerts are presented each semester.

Music 113. Jazz Ensemble. (0-2) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Designed to explore various styles and trends in contemporary jazz.

Music 114. Marching and Pep Bands. (0-5) Cr. 1. Repeatable.
A. Marching Band.
F. Membership determined by audition and band application. Auditions held for woodwind, brass, percussion, flag, and twirler positions. Presentation of pre-game and half time shows at each home football game; additional performances are also scheduled on and off campus. Audition information is listed on the band website (www.music.iastate.edu/org/marching).
B. Pep Band.
S. Prereq: Students selected by audition from current members of 114A. Performances at basketball games.

Music 115. Symphonic Band. (0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Stresses high quality wind literature. Performances include formal concerts on campus.

Music 118. Applied Music: Non-majors. (0.5-0) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor.* (.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 119. Applied Music: Majors. (0.5-2) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor; restricted to music majors.* (.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 120. Introduction to Music Literature and Styles. (3-0) Cr. 3. S. *Prereq: 221.* Directed studies via aural analysis for music majors with emphasis on the materials of music, form and aesthetic issues. Introduction to style and literature of the major performance media in context of historical chronology. Fundamentals of score reading and performance terminology. Only one of Music 120 and 302 can count toward graduation.

Music 127. Class Study in Piano I. (0-2) Cr. 1. F.S. *Prereq: 101 or audition, and permission of instructor.* Beginning keyboard technique, transposition, harmonization, ensemble and solo repertory, and sight-reading skills.

Music 128. Class Study in Piano II. (0-2) Cr. 1. F.S. *Prereq: 127 or audition, and permission of instructor.* Continuation of beginning keyboard technique, transposition, harmonization, ensemble and solo repertory, and sight-reading skills.

Music 131. Vocal Jazz Ensemble: "Off the Record". (0-2) Cr. 1. Repeatable. *Prereq: Open by audition and permission of instructor; concurrent enrollment in one of the following: 141, 151, 161.* Small mixed chorus specializing in advanced vocal jazz techniques. Performances on and off campus.

Music 133. Basic Voice Techniques. (0-2) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.* Class study in voice. Techniques of vocal production: respiration, phonation, resonation, articulation, and performance.

Music 141. Lyrica Women's Choir. (0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all female students by audition.* Large chorus; emphasis on fundamental vocal and choral skills, wide variety of literature. Campus concerts each semester.

Music 151. Oratorio Chorus. (0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Advanced skills required, high quality literature. Campus concerts each semester, some concerts in conjunction with orchestras. Men's and women's choirs separately and in combination.
A. Cantamus Women's Choir
B. Statesmen Men's Choir

Music 161. Iowa State Singers. (0-5) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Concert choir specializing in performance of advanced music literature, Renaissance through contemporary. Campus concerts, annual spring tour.

Music 181. Symphony Orchestra. (0-4) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition.* Reading, preparation, and performance of standard repertoire. Five or six concerts annually plus occasional off-campus appearances.

Music 219. Applied Music: Majors. (0.5-2) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor; restricted to music majors.* (.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 221. Introduction to Music Theory. (3-0) Cr. 3. F. *Prereq: Music major status or permission of instructor; concurrent enrollment in 222 recommended.* Fluent identification and application of the elements of music and music notation. The study of two-voice species counterpoint as an introduction to voice-leading principles in common practice period music.

Music 222. Introduction to Aural Theory and Music Technology. (0-4) Cr. 2. F. *Prereq: Music major status or permission of instructor; concurrent enrollment in 221 recommended.* Aural discrimination of musical elements and patterns as demonstrated by proficiency in ear training, sight singing, and related musicianship skills. Introduction to technological equipment and software used in the study of music.

Music 227. Class Study in Piano III. (0-2) Cr. 1. F.S. *Prereq: 128 or audition and permission of instructor.* Intermediate keyboard technique, transposition, harmonization, improvisation, repertory, and sight-reading skills. Introduction to score reading, hymn playing, and accompanying at the piano.

Music 228. Class Study in Piano IV. (0-2) Cr. 1. F.S. *Prereq: 227 or audition and permission of instructor.* Continuation of intermediate keyboard technique, transposition, harmonization, improvisation, repertory, score reading, hymn playing, and accompanying at the piano.

Music 231. Materials of Music I. (3-0) Cr. 3. S. *Prereq: 221.* Harmonic, melodic, and rhythmic materials of the common practice period. Application of these materials in analysis and writing. Techniques of melodic construction, formal design, and harmonization.

Music 232. Aural Theory I. (0-3) Cr. 1. S. *Prereq: 222.* Development of sight singing, ear training, and related musical skills with emphasis on melodic, harmonic and rhythmic materials from the common practice period.

Music 246. Introduction to Music Technology. (2-0) Cr. 2. F.S. *Prereq: 101, 105, or 221, or permission of instructor.* Introduction to audio and MIDI in music and media applications, fundamentals of digital audio editing and mixing, software-based musical arrangements and composition.

Music 248. Technology in Music Instruction. (2-0) Cr. 2. S. *Prereq: 221 and 222.* Introduction to computer software applications used in musical arrangements and presentations, practical introduction to audio and MIDI technologies in lab-based music instruction, basic recording/sound reinforcement and music website management. Intended for Music Education Majors

Music 265. Music in Elementary Education. (3-0) Cr. 3. F.S. *Prereq: HD FS 226 or Psych 230.* Experiencing and understanding the fundamentals of music through singing, playing classroom instruments, body movement, reading notation, listening, and creative activities. Developing lesson plan strategies and sequence, exploring multicultural musics, integrating music with other subjects in the elementary classroom, and evaluating aspects of musical learning.

Music 266. Introduction to Music Education. (1-2) Cr. 2. F. *Prereq: Concurrent enrollment (.5 cr.) in 480K.* Required for second-year majors in music education. Historical, philosophical, and social foundations of music education; music curricula overview including goals of the music program, and contemporary and international curriculum development; psychology of teaching music including discipline techniques. Preparation for required observations in area schools.

Music 290. Special Problems. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor; 12 credits in music, approval of department head.*
A. Education
B. Theory
C. Composition
D. History
E. Literature
F. Applied Music
G. Conducting
H. Honors

Music 301. Opera Studio. Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Study of selected opera scenes, chamber operas, and works from contemporary and classical music theater. Basic stagecraft, role interpretation, production.
A. Opera/Operetta
B. Music Theater

Music 302. The History of Music in Western Culture. (3-0) Cr. 3. S. *Prereq: 102.* Study of the evolution of music styles through history with emphasis on listening. Primarily European music with some non-Western music providing a global perspective. Individual composer's unique approaches to timbre, texture, rhythm and melody. General trends in the progress of style and form. Concert reports and papers in addition to examinations. Ability to read music recommended, but not required. Open to non-majors only. Only one of Music 120 and 302 can count toward graduation.

Music 304. History of Rock 'n' Roll. (3-0) Cr. 3. S. *Prereq: 101, 102, 221, or 222.* Rock 'n' Roll from the mid 1950s through the 1990s, focusing on the development of rock styles from its roots in blues, folk, country, and pop. Expansion of listening experience through study of song forms, musical instruments of rock, and the socio-political significance of song lyrics. Examinations, research paper or in class presentation required. Ability to read or perform music not required.

Music 318. Applied Music: Non-majors. (0.5-0) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor.* (.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 319. Applied Music: Majors. (0.5-2) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor; restricted to music majors.* (.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 321. Advanced Ensemble. (0-3) Cr. 1. Repeatable. F.S. *Prereq: Advanced proficiency and performing ability, permission of instructor.* Performance in ensembles that demand high proficiency. Open to a limited number of undergraduate and graduate students.
A. Voice
B. Piano
C. Organ
D. Strings
E. Musica Antiqua
F. Woodwinds
G. Brass
I. Percussion
J. Mixed

Music 324. English and Italian Diction for Singing. (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: Credit or enrollment in 118A or 119A.* The international phonetic alphabet and its application to correct pronunciation of English and Italian in singing.

Music 325. French and German Diction for Singing. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Credit or enrollment in 118A or 119A.* The international phonetic alphabet and its application to correct pronunciation of French and German in singing.

Music 327. Functional Piano. (0-3) Cr. 2. S. *Prereq: 228 or audition and permission of instructor.* Emphasis on sight reading, three and four-part score reading, improvisation, accompanying, and advanced harmonization.
A. Keyboard majors.
B. Vocal/choral majors.

Music 331. Materials of Music II. (3-0) Cr. 3. F. *Prereq: 231.* Harmonic, melodic, and rhythmic materials of the common practice period. Application of these materials in analysis and writing. Techniques of melodic construction, formal design, and harmonization.

Music 332. Aural Theory II. (0-2) Cr. 1. F. *Prereq: 232.* Development of sight singing, ear training, and related musical skills with emphasis on melodic, harmonic and rhythmic materials from the eighteenth and nineteenth centuries.

Music 337. Materials of Music III. (3-0) Cr. 3. S. *Prereq: 331.* Writing and analysis based on musical styles since 1900.

Music 338. Aural Theory III. (0-2) Cr. 1. S. *Prereq: 332.* Development of sight singing, ear training, and related musical skills with emphasis on melodic, harmonic and rhythmic materials from the nineteenth and twentieth centuries.

Music 346. MIDI and Digital Audio Techniques. (3-0) Cr. 3. S. *Prereq: 246 or permission of instructor.* MIDI theory and programming applications, sampling/synthesis control, digital signal processing techniques. Composition projects using integrated audio/MIDI sequencing applications. Nonmajor graduate credit.

Music 350. Instrumental Techniques: Strings. (0-2) Cr. 1. F. *Prereq: Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

Music 351. Instrumental Techniques: Clarinet, Flute, Saxophone. (1-2) Cr. 2. S. *Prereq: Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

Music 352. Instrumental Techniques: Oboe, Bassoon. (0-2) Cr. 1. F. *Prereq: 351 or permission of instructor. Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

Music 353. Instrumental Techniques: Trumpet, Horn. (0-2) Cr. 1. S. *Prereq: Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

Music 354. Instrumental Techniques: Trombone, Baritone, Tuba. (0-2) Cr. 1. F. *Prereq: 353 or permission of instructor. Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

Music 355. Instrumental Techniques: Percussion. (0-2) Cr. 1. S. *Prereq: Concurrent enrollment in 358B. Limited to music majors.* Techniques and skills required to teach percussion instruments in the schools. Techniques for performing and teaching snare drum, keyboard percussion instruments, timpani, band and orchestral hand instruments, drum set, and Latin percussion. Intended for instrumental music education students.

Music 356. Instrument Maintenance and Repair. (0-2) Cr. 1. *Prereq: Permission of instructor. Limited to music majors.* Techniques and skills required for basic maintenance and repair of wind and percussion instruments. Examination of commercial repair methods and facilities. Intended for instrumental music education students.

Music 358. Lab Ensemble. Cr. R. Repeatable. Review and selection of appropriate literature for ensembles of differing levels and abilities; conducting and rehearsal experience.
A. Choral. F., Alt. S., offered 2009. Sight singing, conducting, and accompanying experience in conjunction with 362
A. Required of all vocal music education majors in every semester offered.
B. Instrumental. F. S. Performance on secondary instruments. Includes experiences with singing and vocal techniques. Required of all instrumental music education majors in those semesters when enrolled in 350, 351, 352, 353, 354, 355, or 362B.

Music 360. Voice Pedagogy. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 319A or vocal proficiency examination.* Physical, acoustical, and musical properties of the vocal instrument, including a survey of important texts and articles on singing and voice production.

Music 361. Conducting I. (1-2) Cr. 2. F. *Prereq: 231, 232.* Introduction to conducting; score reading and analysis. Conveying musical ideas through appropriate gestures. Leadership role of the conductor.

Music 362. Conducting II. (1-2) Cr. 2.
A. Choral techniques. Alt. S., offered 2011. Prereq: Concurrent enrollment in 358A and 141, 151, or 161. Advanced baton technique, score preparation and interpretation of choral repertoire.
B. Instrumental techniques. S. Prereq: Concurrent enrollment in 358B. Advanced baton technique. Score preparation. Specific problems of large instrumental ensembles.

Music 366. Methods of Music Education. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 480K and Sp Ed 450; 266 and admission into teacher education..* Music education strategies and materials including development of appropriate objectives and plans for general music classes utilizing traditional and multicultural musics, evaluating musical learning; overview of Orff Schulwerk, Kodaly, and Dalcroze approaches; music in special education; required teaching in lab settings and observations in area schools.

Music 367. Choral Literature. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 361 recommended.* Overview of choral repertoire from the sixteenth century to the present, including accessible works for the young conductor.

Music 368. Marching Band and Jazz Ensemble Techniques. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Credit or enrollment in 362B recommended.* Techniques and materials for teaching marching band in the high school; philosophy, computer assisted drill design, music analysis, band set up, and other related skills. Jazz style, articulation, phrasing, materials and teaching techniques for secondary school jazz ensembles.

Music 383. History of Music I. (3-0) Cr. 3. F. *Prereq: 120.* History of the stylistic and cultural development of music: Middle Ages through Baroque.

Music 384. History of Music II. (3-0) Cr. 3. S. *Prereq: 383.* History of the stylistic and cultural development of music: Classical through contemporary music.

Music 415. Literature and Pedagogy in Applied Music. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Includes experience in technology relative to the particular discipline.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
J. Jazz Pedagogy and Performance

Music 417. Student Teaching. (Cross-listed with C I). Cr. arr. F.S. *Prereq: Admission to teacher education, approval of coordinator during semester before student teaching.* Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.
K. Music - Secondary
L. Music - Elementary

Music 419. Applied Music: Majors. (0.5-2) Cr. arr. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor; restricted to music majors.* (.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.
A. Voice
B. Piano
C. Organ
D. Strings
E. Carillon
F. Woodwinds
G. Brass
I. Percussion
K. Harpsichord

Music 420. Junior/Senior Recital. Cr. R. Repeatable. F.S.SS. *Prereq: Advanced performing ability, permission of instructor, concurrent registration in Music 319 or 419..* Performance of advanced repertory in a public concert. Preparation of program notes. Satisfactory-fail only.

Music 440. Seminar in Music Theory. (3-0) Cr. 3. Repeatable. S. *Prereq: 337, 338.* Various topics in music theory including analysis, counterpoint, arranging, pedagogy, and psychology of music. Content will vary. Contact the Department of Music for the current year offering. Nonmajor graduate credit.

Music 446. Electronic Music Synthesis. (3-0) Cr. 3. F. *Prereq: 246 or permission of instructor.* Techniques of digital sound synthesis, software synthesizer design, and electronic music composition. Nonmajor graduate credit.

Music 464. Instrumental Administration, Materials, and Methods. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Credit or enrollment in 362B recommended.* Instructional materials and methods appropriate for teaching instrumental music in elementary, middle school, and high school music programs. Required observations in area schools. Intended for instrumental music education students.

Music 465. Choral Materials and Methods. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 358A and 141, 151, or 161.* Instructional materials and methods appropriate for teaching choral music in the secondary school. Emphasis on pedagogy and rehearsal techniques. Required observations in area schools. Intended for vocal music education students.

Music 466. Program Development and Evaluation in Music Education. (2-1) Cr. 2. F. *Prereq: Continuation Examination passed; 362, 366, concurrent enrollment (1 cr.) in 480K..* Developing a rationale for music education; music program development; evaluation of music curricula, programs and facilities; professional growth of the teacher; preparation for student teaching and the job market. Required observations in area schools.

Music 471. The Tones of Florence - A Study of Humanism. Cr. 3. SS. *Prereq: Application through the Study Abroad Program; interview with instructor; sophomore classification.* A survey of the masterpieces of music, literature, painting, sculpture, architecture, mathematics and theology that made Florence the major European center of humanism in the Renaissance.

Music 472. History of American Music. (3-0) Cr. 3. *Prereq: Ability to read music; 9 credits from music, American literature, American history, art history.* Offered F. 2010. History and development of the sacred and secular music in North America from approximately 1600 to the present, exploring the diverse cultural backgrounds that have contributed to the variety of contemporary musical styles. Nonmajor graduate credit.

Music 473. Music of the Baroque and Classical Eras. (3-0) Cr. 3. *Prereq: 383, 384.* Detailed survey of instrumental, vocal, choral, and keyboard music from 1600 to 1825. Nonmajor graduate credit.

Music 475. Music of the Romantic Era. (3-0) Cr. 3. *Prereq: 383, 384.* Offered F. 2009. Detailed survey of instrumental, vocal, choral, and keyboard music from 1825 to 1910. Nonmajor graduate credit.

Music 476. Music of the Twentieth Century. (3-0) Cr. 3. *Prereq: 383, 384.* Offered S. 2010. Detailed survey of instrumental, vocal, choral, and keyboard music from 1900 to the present. Nonmajor graduate credit.

Music 480. Field Experience for Secondary Teaching Preparation. (Cross-listed with C I). Cr. arr. Repeatable. F.S. *Prereq: Permission of area coordinator required prior to enrollment.* Observation and participation in a variety of school settings after admission to the teacher preparation program. (S/F grading may be used in some offerings of some sections.)
K. Music

Music 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor; 12 credits in music, approval of department head.*
A. Education (Same as C I 490A)
B. Theory
C. Composition
D. History
E. Literature
F. Applied Music
G. Conducting
H. Honors
I. Electronic Music

Courses primarily for graduate students, open to qualified undergraduate students

Music 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor, approval of department head.*
A. Education
B. Theory
C. Composition
D. History
E. Literature
F. Applied Music
G. Conducting
I. Electronic Music

Music 593. Workshops. Cr. arr. Repeatable.
A. Foundations of Music Learning
B. Music in Early Childhood
C. Junior High School Music Programs
D. Instrumental Teaching Techniques
E. Research in Music Education
F. Vocal/Choral Teaching Techniques
G. General & Contemporary Music Methodologies
I. Music and Technology

Natural Resource Ecology and Management

Richard Hall, Interim Chair of Department

University Professors (Emeritus): Atchison, Hinz, McNabb

Professors: Colletti, Hall, Harrington, Jungst, Payne, Schultz

Professors (Emeritus): M. Bachmann, R. Bachmann, Best, Countryman, J. Dinsmore, Hart, Klaas, Manwiller, Menzel, Moorman, Prestemon, Summerfelt, Wray

Professors (Collaborators): Brandle, Burger, Engle, Isebrands, Otis

Associate Professors: Asbjornsen, S. Dinsmore, Fairbanks, Isenhart, Kuo, Morris, Rule, Thompson

Associate Professors (Emeritus): Pease

Associate Professors (Collaborators): Deutsch, Guntenspergen, Manson, Palik, Rickenbach, Tomer

Assistant Professors: Blanchong, Kim, Quist, Randall, Schulte, Stewart, Tyndall

Assistant Professors (Adjunct): Harris, McMullen, Merrick, Pritchard, Roe

Assistant Professors (Collaborators): Koford, Kolka, Miller, Negreros-Castillo, Pierce, Thogmartin, Westphal

Senior Lecturer: Stokke, Wiersema

Lecturer: O'Brien

The department addresses a broad spectrum of natural resource and environmental issues in a holistic approach to learning, discovery and engagement. Our vision of natural resources is that informed protection and management of natural resources involves an integration of biological, economic, and social considerations. Such an integrated and comprehensive approach to the education of future generations of natural resource managers and scientists is needed in order to sustain viable landscapes, facilitate strong communities, and produce desired goods, services, and functions from our natural resources.

Our educational mission for the undergraduate and graduate programs is to provide those learning experiences and opportunities that will ensure students can learn to function effectively in their chosen fields.

Central to that effective functioning are the abilities to:

Identify, explain and critically evaluate their own beliefs, values and actions in relation to professional and societal standards of ethics.

Anticipate, analyze and evaluate natural resource issues and opportunities, explaining the ecological, economic, and social consequences of natural resource actions at various scales and over time.

Actively seek the input and perspectives of diverse stakeholders regarding natural resource problems and issues.

Assess, analyze, synthesize, and evaluate information fairly and objectively.

Work effectively, both individually and with others, on complex, value-laden natural resource problems that require holistic problem solving approaches.

Formulate and evaluate alternative solutions to complex problems and recommend and defend best alternatives.

Communicate clearly and effectively with all audiences using appropriate oral, visual, electronic, and written techniques.

Recognize and interpret resource problems and opportunities across spatial scales from local to global.

Appreciate cultural diversity and understand the impact of the global distribution of people and wealth on natural resource use and valuation.

Exercise leadership skills as professionals and engaged citizens.

Demonstrate creativity and innovation in identifying and pursuing opportunities that produce environmental, social, or economic value.

Exercise life-long learning skills developed before graduation.

Undergraduate Study

The Department of Natural Resource Ecology and Management offers work for the bachelor of science degree with majors in animal ecology or forestry (see College of Agriculture and Life Sciences, Curricula). The department participates in interdisciplinary programs in biology, environmental studies, international studies, and pest management. By proper selection of free and restricted elective courses, students can obtain a minor or a second major in these programs or other disciplines.

The Department provides numerous scholarships; application information is available in the departmental Student Services Center.

Animal Ecology (A Ecl)

The animal ecology curriculum provides its majors with an understanding of ecological principles and processes and their applications to natural resource management. It is oriented toward students desiring a general and flexible program in environmental biology and for those planning graduate study. Students may select from five options: Aquatic Sciences, Fisheries, Interpretation of Natural Resources, Preveterinary and Wildlife Care, or Wildlife. Graduates find employment as aquaculturists, aquatic ecologists, wildlife biologists, fisheries biologists, resource managers, and ecologists for industry, environmental consulting firms, natural resource and environmental agencies and organizations, zoos, and as educators.

Graduates of the Animal Ecology major understand the basic principles of animal biology, ecology and management, and relevant aspects of scientific communication, basic mathematics and sciences, computing applications, and personal and professional development. Five specific options prepare students for careers in aquatic sciences, fisheries, wildlife, interpretation of natural resources, wildlife care and veterinary sciences. Each option has specific outcomes expectations that include (1) the scope of the specialization and its relationships to broader aspects of animal ecology, biotic resource management, and other allied scientific disciplines and professions, (2) career opportunities and requirements, and (3) knowledge and skills appropriate for employment at technical and practitioner levels in each discipline. Graduates are able to communicate and work effectively in the multidisciplinary arena of ecology and natural resource management.

All options require three months of relevant work experience or study at a biological station prior to graduation. The latter may be accomplished at the university's affiliate field stations: Iowa Lakeside Laboratory at West Lake Okoboji, and Gulf Coast Research Laboratory at Ocean Springs, Mississippi. Information on these laboratories is available from the department's Student Services Center.

Preveterinary medicine preparation may be achieved while satisfying degree requirements in animal ecology.

Additional education and training can lead to other opportunities in such areas as research and management, natural resources planning and administration, teaching, and environmental consulting, among others. Graduate training is necessary for many specialized positions within the fields of animal ecology. Majors preparing for graduate study should consult with their academic adviser concerning appropriate coursework.

Students seeking certification to teach biology in secondary schools must meet requirements of the College of Human Sciences as well as those of the Animal Ecology curriculum. In addition, they must apply formally for admission to the teacher education program (see Index, Teacher Education Program). Students with an interest in careers in outdoor writing are encouraged to obtain a minor or a second major in journalism (see Index, Journalism and Communication, Courses and Programs). Students who wish to pursue a job as a conservation officer may wish to minor in criminal justice (see Index, Criminal Justice Studies).

The department offers a minor in animal ecology that may be earned by taking 15 credits in the department including 312, 365, NREM 120, plus four additional credits of Animal Ecology courses at the 300 level or above.

Forestry (For)

The forestry curriculum offers courses dealing with the management of forest ecosystems for multiple benefits including wood and fiber products, biodiversity, recreation, water, wilderness, and wildlife. Conservation and preservation of natural resources are emphasized. The department offers work for the bachelor of science degree with a major in forestry and options in forest ecosystem management, interpretation of natural resources, urban and community forestry, natural resource conservation and restoration, or sustainable materials science and technology. All options lead to a professional degree in

forestry (Bachelor of Science). The forestry major has been accredited by the Society of American Foresters (SAF) since 1935. The Council for Higher Education Accreditation recognizes SAF as the specialized accrediting body for forestry education in the United States. The primary goal of the undergraduate curriculum in forestry is to educate foresters to be capable of scientifically managing the nation's forest lands and related ecosystems - private and public.

Graduates understand and can apply scientific principles associated with forests, forest ecosystem management, and wood and non-wood products. Graduates are able to communicate effectively and work well in teams. They are capable of preparing and delivering effective oral and written communication of scientific and technical decisions to professional and lay audiences. They are proficient in technical skills such as measurements, computer usage, inventory, economic analysis, data and situation analysis, and ecosystem assessment. They recognize the importance of ethics in forestry and are sensitive to cultural diversity and broad environmental concerns.

Graduates of the forest ecosystem management option are skilled at understanding how forests function and how forests can be managed to produce desired goods (wood, fiber, recreation, wildlife habitat) and services (clean water, carbon sequestration, wilderness) in the long-run. They are skilled at interpretation of interactions and effects of abiotic and biotic factors in forests and quantification of bio-physical, social, and economic outputs from forest ecosystems. They are skilled at complex decision-making involving private and public forest resources where ethical, legal, social, economic, and ecological dimensions are explicitly considered.

Graduates of the interpretation of natural resources option are skilled at communicating with the public about the values associated with forest ecosystems and providing educational programs for all ages.

Graduates of the urban and community forestry option are able to combine biological, social, legal, and economic expertise to effectively manage trees or forests in an urban setting. They are skilled at decision-making related to site assessment, and long-term management of urban trees and forests to achieve multiple goals.

Graduates of the natural resource conservation and restoration option are skilled at assessing the natural functions of the environment and human impacts. They are skilled at interpretation of forest and other natural environments and making decisions relating to their conservation and preservation.

Graduates of the sustainable materials science and technology option understand the anatomical, physical, and chemical properties of wood and other bio-renewable materials and know wood processing operations involved in drying, composite materials manufacturing, and chemical treatment.

Elective courses related to the forest ecosystem management option can be selected to emphasize forest ecology; wildlife, wilderness, and recreation management; water quality and erosion protection; quantitative-analytical techniques; business and marketing; and other areas related to natural resource management. Elective courses in the urban and community forestry option can be selected to emphasize plant health, policy and planning, ecology, hydrology, sociology, business administration, or horticulture/design. Elective courses related to the natural resource conservation and restoration option can be selected to emphasize, ecology, wildlife, recreation, nature interpretation, landscape design, sociology and ethics of conservation and preservation. Similarly, elective courses in the sustainable materials science and technology option can be selected to emphasize wood production, bio-renewable materials, wood fiber, business and marketing, and quality assurance. Elective courses in the interpretation of natural resources option can be selected to emphasize natural history, animal ecology, and environmental education.

Many private firms as well as national, regional, state, and local agencies seek forestry graduates to fill positions in management of natural resources for commodity and non-commodity multiple benefits. Graduates in forestry are prepared to be involved with evolving forestry systems, such as agroforestry and urban forestry. Wood processing industries, such as composite products, plywood, particle board, lumber, and pulp and paper offer professional opportunities in production, product development, quality control, and marketing.

With advanced graduate study, the range of professional job opportunities for a person with a B.S. in forestry is expanded. Opportunities include research and education as well as more specialized managerial and administrative positions with private firms and public agencies.

During fall semester of the second year of study (sophomore year, typically), forestry students are required to enroll in the department's integrated forestry modules consisting of 201, 202, 203, 204, 205, and 206. That semester, consisting entirely of forestry coursework, is designed to give students an early understanding of the many aspects of forestry and how they are interrelated. In addition to work in the classroom, students will spend time in laboratory and field work each week. A 3-week off-campus fall camp during the semester will reinforce concepts learned both in the classroom and during laboratory/field sessions. Transfer students should check with the department for counsel on timing their completion of the integrated forestry modules.

The department offers a minor in forestry which can be earned by completion of a minimum of 15 credits in forestry courses. Students wishing to emphasize management and environmental aspects of forestry must select at least 15 credits from the following courses: 302, 356, 451, NREM 120, 301, 345, 390, 407, and 472. Students wishing to emphasize wood products and wood utilization must complete 280 and an additional 12 credits from the following courses: 480, 481, 483, 485, 486, 487, and 490B.

Graduate Study

The Department of Natural Resource Ecology and Management offers work for the degrees master of science and doctor of philosophy with majors in fisheries biology, forestry, and wildlife ecology. A non-thesis masters degree is available for students desiring a general degree program without thesis research. Students may also major in interdepartmental graduate majors in biorenewable resources technology, ecology and evolutionary biology, environmental science, genetics, plant physiology, sustainable agriculture, or toxicology (see Index). All students are required to teach and conduct research as part of their training for the Ph.D. degree.

Fisheries Biology and Wildlife Ecology

Graduates have a broad understanding of the basic principles of animal biology, ecology and management, and relevant aspects of basic mathematics and natural sciences, computing applications, and personal and professional development. They are able to execute rigorous independent research, have developed problem-solving and critical-thinking skills, and can communicate effectively with scientific colleagues and the general public in both formal and informal settings.

Personnel of the U.S. Geological Survey's Iowa Cooperative Fish and Wildlife Research Unit contribute significantly to the graduate program of the department through teaching and research. Governmental agencies such as the U.S. Fish and Wildlife Service, Natural Resources Conservation Service and the Iowa Department of Natural Resources, and non-governmental agencies such as The Nature Conservancy and the Iowa Natural Heritage Foundation also contribute to the graduate program by funding research, providing in-kind support, and providing numerous formal and informal mentoring relationships.

No more than two dual-listed animal ecology courses may be applied for major graduate credit. Additional work is expected of students taking a dual-listed course for credit at the 500 level.

Forestry

The department offers programs leading to the degrees of master of science and doctor of philosophy with a major in forestry and minor work to students taking major work in other departments.

Graduates are skilled at defining a research problem in forestry, applying scientific principles and appropriate methods, and analyzing the results. They are capable of understanding the many facets of forest and wood science and are very knowledgeable in specific areas in forestry. They are able to deal with complex forestry problems, and where appropriate, they are capable of blending ecological, social, ethical, legal, and economic factors in the research process. They are very skilled at communicating, both in written and oral form, research results to professional and lay audiences. They are sensitive to cultural diversity and work effectively with peers, natural resource professionals, and the public.

The graduate program is open to, and suitable for, students who have majored in forestry or related natural resource fields. A non-thesis master's option is available.

The department participates in the Masters in Business Administration (M.B.A.), with specialization in the agriculture program administered by the College of Business, providing an opportunity to obtain an M.B.A. degree while taking advanced courses in forestry and maintaining contact with the profession of forestry.

Animal Ecology (A Ecl)

Courses primarily for undergraduate students

A Ecl 312. Ecology. (Cross-listed with Biol, EnSci). (3-3) Cr. 4. F.SS. *Prereq: Biol 211L and 212L.* Fundamental concepts and principles of ecology dealing with organisms, populations, communities and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats.

A Ecl 312l. Ecology. (Cross-listed with Ia LL, EnSci). Cr. 4. SS. An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

A Ecl 321. Fish Biology. (2-3) Cr. 3. S. *Prereq: 365.* Biology, ecology, and evolution of fishes. Emphasis on structure, physiology, and behavior, including a focus on the conservation and management of fishes and their habitats. Laboratory focus on fish morphology, survey methods, identification, distribution, habits, and habitats of fishes.

A Ecl 326l. Ornithology. (Cross-listed with Ia LL). Cr. 4. SS. The biology, ecology, and behavior of birds with emphasis on field studies of local avifauna. Group projects stress techniques of population analysis and methodology for population studies.

A Ecl 365. Vertebrate Biology. (Cross-listed with Biol). (3-2) Cr. 4. F. *Prereq: Biol 212, 212L.* Evolution, biology, and classification of fish, amphibians, reptiles, birds, and mammals. Emphasis on a comparative analysis of the structure and function of organ systems. Laboratory exercises concentrate on morphology and identification of orders of vertebrates.

A Ecl 366. Natural History of Iowa Vertebrates. (2-3) Cr. 3. S. *Prereq: Biol 211, 211L, 212, 212L.* Vertebrate fauna of Iowa, including fishes, amphibians, reptiles, birds, and mammals. Species identification, habitat requirements, community structure and assessment, conservation issues that include historical population changes and value of wild animals to the region's ecological and economic health.

A Ecl 371. Ecological Methods. (Cross-listed with Biol). (2-2) Cr. 3. F. *Prereq: 312; Stat 101 or 104.* Quantitative techniques used in management of natural resources with emphasis on inventory and manipulation of habitat and animal populations. Nonmajor graduate credit.

A Ecl 401. Introductory Aquatic Animal Health and Medicine. (Cross-listed with B M S). (1-2) Cr. 1. S. 8 weeks. Introductory course with focus on fin fish production, health and medicine. Course content will help define future roles for veterinarians, producers, and service providers. Emphasis will be placed on anatomy, pathology, infectious diseases, nutrition, regulatory constraints in production, food safety, and current research. Field trip to aquaculture facility.

A Ecl 404l. Behavioral Ecology. (Cross-listed with Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: Two semesters of biology.* Animal coloniality, courtship, territoriality, predator defense, habitat selection, foraging, mating systems, and parental care will be examined in the field in order to evaluate various ecological and evolutionary theories of animal behavior.

A Ecl 418. Stream Ecology. (Dual-listed with 518). (Cross-listed with EnSci). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 486.* Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

A Ecl 419l. Vertebrate Ecology and Evolution. (Cross-listed with Ia LL). Cr. 4. SS. Field and laboratory study of representative vertebrates of northwestern Iowa. Observations and experimentation emphasize ecological histories by integrating concepts of functional morphology, behavioral ecology, and evolutionary biology. Nonmajor graduate credit.

A Ecl 420l. Amphibians and Reptiles. (Cross-listed with Ia LL). Cr. 4. Alt. SS., offered 2010. *Prereq: Two semesters of biology.* Ecology, behavior, and conservation biology of amphibians and reptiles with emphasis on their anatomy and morphology; temperature and water regulation; locomotion; life history; reproduction; population and community ecology; and conservation.

A Ecl 425. Aquatic Insects. (Dual-listed with 525). (Cross-listed with Ent). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312 or equivalent.* Courtney. Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

A Ecl 440. Fishery Management. (Dual-listed with 540). (2-3) Cr. 3. F. *Prereq: 312, 321, Stat 101 or 104; credit or enrollment in 441 and 486.* Biological basis of fishery management, fishery problems, and management practices for freshwater, anadromous, and marine fisheries.

A Ecl 441. Fisheries Techniques. (Dual-listed with 541). (2-3) Cr. 3. F. *Prereq: 321 and Stat 104.* Overview of field, laboratory, and analytical techniques associated with managing fisheries and aquatic resources. Specific topics include sampling design, fish and habitat sampling techniques, structural indices, age and growth, and biotelemetry.

A Ecl 442. Aquaculture. (Dual-listed with 542). (2-3) Cr. 3. Alt. S., offered 2010. *Prereq: 486, credit or enrollment in 321.* Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetics, diseases, and marketing.

A Ecl 451. Wildlife Ecology and Management. (2-3) Cr. 3. F. *Prereq: 371.* Ecological theory and practice of wildlife management, including, population ecology, habitat management, and current issues in the field. Course involves a series of case studies addressing actual wildlife issues using field and quantitative methods. Nonmajor graduate credit.

A Ecl 455. International Wildlife Issues. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 365, 312 or graduate standing; NREM 120.* Biological, political, social, and economic factors affecting the management of international wildlife resources. Nonmajor graduate credit.

A Ecl 457. Herpetology. (Dual-listed with 557). (Cross-listed with Biol). (2-3) Cr. 3. F. *Prereq: A Ecl 365 or Biol 351.* Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodilians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

A Ecl 458. Ornithology. (Dual-listed with 558). (Cross-listed with Biol). (2-3) Cr. 3. S. *Prereq: A Ecl 365 or Biol 351.* Biology, evolution, ecology and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation. Laboratory exercises complement lecture topics, emphasize identification and distribution of Midwest birds, and include field trips.

A Ecl 459. Mammalogy. (Dual-listed with 559). (Cross-listed with Biol). (2-3) Cr. 3. S. *Prereq: Biol 351 or A Ecl 365.* Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. Laboratory focus on identification, distribution, habits, and habitats of mammals.

A Ecl 480. Studies in Marine Biology. Cr. arr. Repeatable. SS. Courses taken at Gulf Coast Research Laboratory and other marine biological stations are transferred to Iowa State University under this number.

A Ecl 486. Aquatic Ecology. (Cross-listed with Biol, EnSci). (3-0) Cr. 3. F. *Prereq: Biol 312 or EnSci 381 or EnSci 402 or NREM 301.* Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology. Nonmajor graduate credit.

A Ecl 486L. Aquatic Ecology Laboratory. (Cross-listed with Biol, EnSci). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in 486.* Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

A Ecl 515. Ecology of Freshwater Invertebrates, Plants, and Algae. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 312.* Identification, biology, and ecological requirements of freshwater invertebrates, plants and algae. Additional emphases on community sampling methods and analysis, and use of organisms as tools for aquatic ecosystem health assessment.

A Ecl 516. Avian Ecology. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 365, 312, or graduate standing.* Current topics and theories including avian breeding and foraging ecology, population biology, community structure, habitat selection, field methodologies, and data interpretation.

A Ecl 518. Stream Ecology. (Dual-listed with 418). (Cross-listed with EnSci). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 486.* Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

A Ecl 520. Fisheries Science. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 312, 321.* Concepts, approaches, and techniques for assessment of recreational and commercial fisheries. Scope will range from individual fish to entire ecosystems, both freshwater and marine.

A Ecl 523l. Fish Ecology. (Cross-listed with Ia LL). Cr. 4. Alt. SS., offered 2010. Basic principles of fish interaction with the biotic and abiotic environment. Field methods, taxonomy, and biology of fish with emphasis on the fish fauna of northwestern Iowa.

A Ecl 525. Aquatic Insects. (Dual-listed with 425). (Cross-listed with Ent). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: Biol 312 or equivalent.* Courtney. Morphology, ecology, diversity and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

A Ecl 526l. Advanced Field Ornithology. (Cross-listed with Ia LL). Cr. 2. SS. *Prereq: Concurrent registration in Ia LL 326l.* Field study of birds of the upper Midwest; extended field trip to Minnesota and Wisconsin; individual or group project.

A Ecl 531. Conservation Biology. (Cross-listed with EEOB). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 312; Biol 313 or graduate standing.* Examination of conservation issues from a population and a community perspective. Population-level analysis will focus on the role of genetics, demography, and environment in determining population viability. Community perspectives will focus on topics such as habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology.

A Ecl 531l. Conservation Biology. (Cross-listed with Ia LL, EEOB). Cr. 4. Alt. SS., offered 2010. *Prereq: Ia LL 312l.* Population-and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

A Ecl 535l. Restoration Ecology. (Cross-listed with Ia LL, EEOB, EnSci). Cr. 4. Alt. SS., offered 2010. *Prereq: A course in ecology.* Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

A Ecl 540. Fishery Management. (Dual-listed with 440). (2-3) Cr. 3. F. *Prereq: 312, 321; credit or enrollment in 541 and Biol 586; Stat 401.* Biological basis of fishery management, fishery problems, and practices for management of freshwater, anadromous, and marine fisheries.

A Ecl 541. Fisheries Techniques. (Dual-listed with 441). (2-3) Cr. 3. F. *Prereq: 321 and Stat 104.* Overview of field, laboratory, and analytical techniques associated with managing fisheries and aquatic resources. Specific topics include sampling design, fish and habitat sampling techniques, structural indices, age and growth, and biotelemetry.

A Ecl 542. Aquaculture. (Dual-listed with 442). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 485, credit or enrollment in 321.* Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetic, diseases, and marketing.

A Ecl 551. Wildlife Behavioral Ecology. (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: a course in ecology or animal behavior.* The study of how an animal's behavior affects its ability to survive and reproduce in its environment. Topics represent the interface of ecology, evolution, and behavior. Wildlife defined broadly.

A Ecl 557. Herpetology. (Dual-listed with 457). (Cross-listed with EEOB). (2-3) Cr. 3. F. *Prereq: A Ecl 365 or Biol 351.* Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodilians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

A Ecl 558. Ornithology. (Dual-listed with 458). (Cross-listed with EEOB). (2-3) Cr. 3. S. *Prereq: A Ecl 365 or Biol 351.* Biology, evolution, ecology and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation. Laboratory exercises complement lecture topics, emphasize identification and distribution of Midwest birds, and include field trips.

A Ecl 559. Mammalogy. (Dual-listed with 459). (Cross-listed with EEOB). (2-3) Cr. 3. S. *Prereq: Biol 351 or A Ecl 365.* Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. Laboratory focus on identification, distribution, habits, and habitats of mammals.

A Ecl 570. Landscape Ecology. (Cross-listed with EEOB). (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: Permission of instructor; EEOB 588; a course in calculus.* The study of ecological and evolutionary processes within a spatial context with emphasis on behavior, population, and community dynamics.

A Ecl 573. Techniques for Biology Teaching. (Cross-listed with Ia LL, EEOB). Cr. arr. Repeatable. SS. The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.
A. Animal Biology (Same as Ia LL 573A)
G. Limnology (Same as Ia LL 573G)
H. Animal Behavior (Same as Ia LL 573H)
W. Project WET (Same as Ia LL 573W)

A Ecl 589. Population Ecology. (Cross-listed with EEOB). (2-2) Cr. 3. F. *Prereq: Biol 312, Stat 101 or 104, a course in calculus, or graduate standing.* Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

A Ecl 590I. Graduate Independent Study. (Cross-listed with Ia LL, EEOB, Anthr). Cr. arr. Repeatable. SS. *Prereq: Graduate classification and permission of instructor.*

A Ecl 599. Creative Component. Cr. arr. *Prereq: Nonthesis M.S. option only.*

Courses primarily for graduate students

A Ecl 600. Seminar. (2-0) Cr. 1. Repeatable. F.S. Current topics in ecological research, fish and wildlife management, and environmental problems related to fish or wildlife resources.

A Ecl 611. Analysis of Populations. (Cross-listed with EEOB). (2-2) Cr. 3. Alt. F., offered 2010. *Prereq: Biol 312; Stat 401; a course in calculus.* Quantitative techniques for analyzing vertebrate population data to estimate parameters such as density and survival. Emphasis on statistical inference and computing.

A Ecl 698. Animal Ecology Teaching Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification in animal ecology and permission of instructor.* Graduate student experience in the animal ecology teaching program. Satisfactory-fail only.

A Ecl 699. Research. Cr. arr. Repeatable.

A Ecl 699I. Research. (Cross-listed with Ia LL, Anthr, GDCB, EEOB). Cr. arr. Repeatable.

Forestry (For)

Courses primarily for undergraduate students

For 201. Forest Biology. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 202, 203, 204, 205, and 206.* Discussion of ecological concepts, individual tree structure and growth, variation and diversity in tree populations. Physical environment of trees and forests, ecological processes in forest communities, and introduction to different regional forest communities.

For 202. Wood Utilization. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 201, 203, 204, 205, and 206.* Processing of sustainable materials including wood into products and general properties and proper use of these products.

For 203. Resource Measurements/Evaluation. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 201, 202, 204, 205, and 206; Math 140.* Survey techniques involved in quantification, valuation, and evaluation of tree and stand growth and other variables in the forest environment (e.g., recreational use, wildlife habitat value, biomass, and solid wood).

For 204. Forest Ecosystem Decision-Making. (2-0) Cr. 2. F. *Prereq: Concurrent enrollment in 201, 202, 203, 205, and 206.* Methods of decision-making related to forest ecosystems including communications, teams and conflict resolution. Current issues relating to public, private, and urban forests; quantification of processes, services, and goods produced by the forest and expected by the public such as wildlife, water, range, recreation, wilderness, biodiversity, as well as wood and fiber products.

For 205. Integrated Forestry Laboratory. (0-8) Cr. 3. F. *Prereq: Concurrent enrollment in 201, 202, 203, 204, and 206.* Field and laboratory exercises integrating the evaluation and management of forest goods, services, and the processing of wood products.

For 206. Fall Forestry Camp. Cr. 4. F. *Prereq: Concurrent enrollment in 201, 202, 203, 204, and 205.* Three-week field camp to address topics and issues covered in 201, 202, 203, 204, and 205.

For 280. Wood Properties and Identification. (3-3) Cr. 4. S. Properties of wood and how they relate to its successful use. Comparative anatomical characteristics, scientific nomenclature, and hand lens identification of commercially important North American woods.

For 283. Pesticide Application Certification. (Cross-listed with Ent, Agron, Hort). (2-0) Cr. 2. S. Holscher. Core background and specialty topics in agricultural, and horticultural pesticide applicator certification. Students can select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

For 290. Special Problems. Cr. arr. Repeatable. *Prereq: Freshman or Sophomore classification, permission of instructor.*
A. Leadership in Forestry Teams (LIFT) Learning Community
B. Forest Ecosystem Management
C. Natural Resource Conservation
D. Urban and Community Forestry
E. Wood Science and Technology

For 302. Silviculture. (2-3) Cr. 3. S. *Prereq: 201.* Manipulation of forest vegetation based on ecological principles for the production of goods and services. Nonmajor graduate credit.

For 342. Dynamics of Forest Stands. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 203, Stat 101.* Change in forest species composition and structure at the stand and landscape scales resulting from site quality, tree growth, competition, succession, and disturbance. Methods for assessing tree growth and reconstructing past stand development. Applications to forest and savanna management. Nonmajor graduate credit.

For 356. Dendrology. (Cross-listed with Biol). (2-4) Cr. 4. F. *Prereq: Biol 211.* Identification and ecology of North American woody plant species. Importance of woody plants in timber production and wildlife habitat. Natural disturbances, human impacts, management and restoration concerns for major North American forest regions will be addressed. Nonmajor graduate credit.

For 416. Forest Insect and Disease Ecology. (Cross-listed with Pl P). (3-3) Cr. 4. S. *Prereq: 8 credits in biological sciences, including Biol 211.* Harrington. Nature of insects and pathogens of forest and shade trees; their role in the dynamics of natural and managed forest ecosystems; and the management of indigenous and exotic pests. Nonmajor graduate credit.

For 451. Forest Resource Economics and Quantitative Methods. (3-3) Cr. 4. S. *Prereq: 203, Econ 101, Math 150.* Application of economic principles to forest resource management considering both market and non-market goods and services. Methods of identifying and specifying problems in the management and use of forest resources. Application of mathematical and statistical models to the solution of managerial problems. Nonmajor graduate credit.

For 452. Ecosystem Management. (Cross-listed with NREM). (2-3) Cr. 3. F. *Prereq: Junior classification, and NREM 301 or A Ecl 312.* Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints. Nonmajor graduate credit.

For 453. Forest Resource Policy and Administration. (3-0) Cr. 3. S. *Prereq: junior or senior classification.* Forest and related natural resource policies and contemporary policy issues. Integration of elements of policy development processes, various participants in these processes, and resulting programs. Ethics in professional forestry and natural resource conservation, and conflict resolution. Participation in the policy process involving communication with policy makers and natural resource professionals, study of current issues, promotion of issues with students as issue educators. Participation in policy meetings to identify/determine various elements and applications of strategies associated with the policy development process. Nonmajor graduate credit.

For 454. Forestry Practicum. (1-4) Cr. 3. S. *Prereq: 20 credits in student's major at 300 level or above.* Integrated decision-making related to the conservation, management, and preservation of private and public forests, wildlands, urban/community forests, and/or the production and utilization of wood products. Student teams work with a client and develop management plans that incorporate ecological, social, economic, ethical, and institutional/political factors. Effective teamwork, written/oral/visual communication, and problem-solving stressed. Multiple trips to project site and client. Nonmajor graduate credit.

For 475. Urban Forestry. (Cross-listed with Hort). (2-3) Cr. 3. F. *Prereq: Junior or senior classification, 3 credits in biology.* Discussion of establishment and management of woody perennials in community-owned urban greenspaces, consideration of urban site and soil characteristics, plant physiology, plant culture, urban forest valuation, inventory methods, species selection, and urban forest maintenance (health care and pest management). Nonmajor graduate credit.

For 480. Wood Anatomy and Fiber Analysis. (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 280 or permission of instructor.* Microscopic anatomy and ultrastructure of wood and other industrial lignocellulosic materials. Microscopy techniques for fiber analysis. Comparison of fiber properties. Nonmajor graduate credit.

For 481. Conversion of Lignocellulosic Materials. (Cross-listed with TSM). (2-3) Cr. 3. F. *Prereq: 280 or TSM 210 or A E 216 or equivalent.* Chemical properties of lignocellulosic materials. Wood chemistry. Various conversion processes. Pulp and paper technology. Biobased products. Other fiber products. Cellulose derivatives. Term paper and/or student project required for graduate level. Nonmajor graduate credit.

For 483. Wood Deterioration and Preservation. (Cross-listed with Pl P). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: For 280.* Deterioration of wood in use by biological and physical agents. Wood preservation and fire retardant treatments. Environmental impact of wood treating. Nonmajor graduate credit.

For 485. Lignocellulosic Composite Materials. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 280 or permission of instructor.* Consolidation behavior of lignocellulosic materials. Principles of adhesion. Manufacturing processes for wood and lignocellulose composites such as plywood, oriented strand products, laminated lumber, particleboard, and medium density fiberboard. Extrusion processing of natural fiber/plastic composites. Nonmajor graduate credit.

For 486. Moisture Interactions of Lignocellulosic Materials. (2-3) Cr. 3. Alt. S., offered 2010. *Prereq: 280 or permission of instructor.* Principles of moisture relations in hygroscopic materials; adsorption, desorption, equilibrium moisture content. Transport processes in natural materials such as wood. Drying processes for wood and other lignocellulosic materials. Influence of moisture on dimensional stability and durability of lignocellulosics and composites. Nonmajor graduate credit.

For 487. Physical Properties of Wood. (3-3) Cr. 4. Alt. S., offered 2010. *Prereq: 280.* Mechanical, thermal, electrical, and acoustical properties of wood. Lumber grading and stress rating, nondestructive evaluation of wood and wood composite products. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

For 599. Creative Component. Cr. arr. Repeatable.
A. Forest Biology
B. Forest Biometry
C. Forest and Recreation Economics
D. Forest Management and Administration
E. Wood Science

Courses for graduate students

For 603. Plant Physiological Ecology. (4-0) Cr. 4. Alt. F., offered 2010. *Prereq: NREM 301 or a course in plant physiology.* Structural and functional adaptations in woody and herbaceous plant species to environmental variables, with and emphasis on understanding relationships between physiological processes at the whole plant scale with ecosystem processes related to nutrient, water, and carbon cycling. Plant physiological responses to natural disturbances, management practices, global climate change, and other forces of environmental change.

For 696. Research Seminar. (Cross-listed with GDCB, Agron, BBMB, Hort, PlBio). Cr. 1. Repeatable. Research seminars by faculty and graduate students. Satisfactory-fail only.

For 699. Research. Cr. arr. Repeatable.
A. Forest Biology - Wood Science
B. Forest Biometry
C. Forest Economics
D. Forest Management and Administration
E. Wood Science
F. Plant Physiology

Natural Resource Ecology and Management (NREM)

Courses primarily for undergraduate students

NREM 104. Practical Work Experience. Cr. R. Three months of relevant work experience in natural resources, animal ecology, or forestry. Study at a summer biological station may be applicable. See adviser for specific requirements and approval process.

NREM 110. Orientation in Natural Resource Ecology and Management. Cr. R. F. Orientation to the University and to the Department of Natural Resource Ecology and Management. Discussion of departmental learning outcomes, strategies for academic success and academic planning. Satisfactory-fail only.

NREM 111. NREM Transitions Learning Community Seminar. (1-0) Cr. 1. F.S. Enrollment limited to members of the NREM Transitions Learning Community. Designed to assist new transfer students and continuing sophomore students with their transition to the academic expectations and professional development aspects of the natural resource program. Satisfactory-fail only.

NREM 112. Orientation to Learning and Productive Team Membership. (Cross-listed with Aer E, FS HN, Hort, TSM). (2-0) Cr. 2. F. Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

NREM 114. Developing Responsible Learners and Effective Leaders. (Cross-listed with FS HN, Hort, TSM). (2-0) Cr. 2. S. Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

NREM 120. Introduction to Renewable Resources. (Cross-listed with Agron, Env S). (3-0) Cr. 3. F.S. Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

NREM 130. Natural Resources and Agriculture. (Cross-listed with Env S). (3-0) Cr. 3. S. Survey of the ecology and management of fish, forest, and wildlife resources in areas of intensive agriculture, with emphasis on Iowa. Conservation and management practices for private agricultural lands. Designed for nonmajors.

NREM 211. Careers in Natural Resources. Cr. 1. F.S. *Prereq: Sophomore classification.* Career planning exploration in natural resources. Discussion of the job application process, including techniques for successful interviewing and development of an effective resume. Satisfactory-fail only.

NREM 256. Midwestern Prairie Plants. (1-2) Cr. 1. F. Offered 1st half semester only. Survey of the major plant families, genera, and representative species of Midwestern prairies with emphasis on plant identification and use of keys. Prairie restoration, conservation, and management issues will also be considered.

NREM 285. The National Parks: Culture and Nature. (Cross-listed with L A). (2-0) Cr. 2. Alt. F., offered 2010. Reviews cultural setting for park establishment and management, ideas about wilderness, and philosophy of parks as types of land use. History of landscape architecture in the National Park Service, the development of American parks, the history of park wildlife management and nature interpretation. Recent initiatives in ecosystem management, community conservation, and international points of comparison. Readings, discussion, exercises.

NREM 301. Natural Resource Ecology and Soils. (Cross-listed with EnSci). (3-3) Cr. 4. F. *Prereq: Biol 211, 211L; For 201 or a second course in biology.* Effects of environmental factors on ecosystem structure and function using forest, prairie and agricultural ecosystems as models. Special emphasis is given to soil-forming factors and the role of soil in nutrient and water cycling and ecosystem dynamics. Additional emphasis is given to human influences on natural ecosystems and the role of perennial plant communities in agricultural landscapes. Nonmajor graduate credit.

NREM 303. Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor and sophomore standing.* Placement with county conservation boards, camps, zoos, parks, etc., for experience as interpreters, rangers, and technicians.

NREM 303I. Undergraduate Internship. (Cross-listed with Ia LL). Cr. arr. Repeatable. SS. *Prereq: Permission of instructor and sophomore standing.* Placement with county conservation boards, camps, parks, etc. For experience as interpreters, rangers, and technicians.

NREM 305. Seminar. (2-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.* Current topics in natural resources or related issues.

NREM 330. Interpretation of Natural Resources. (2-3) Cr. 3. S. *Prereq: 6 credits in biological sciences.* History, objectives, forms, and techniques of natural resources interpretation in the settings of county, state, national parks, and zoos.

NREM 345. Natural Resource Photogrammetry and Geographic Information Systems. (Cross-listed with EnSci). (2-3) Cr. 3. F. *Prereq: Junior classification.* Measurement and interpretation of aerial photos in resource management. Introduction to Geographic Information Systems (GIS) using ArcGIS including digitizing, development and query of attribute tables, georeferencing, and use of multiple GIS layers in simple spatial analyses. Nonmajor graduate credit.

NREM 385. Natural Resource Policy. (Dual-listed with 585). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Junior standing.* History, theory, and practice of natural resource policy. Integrative approach with topical studies in wildlife, forest, water, and other natural resources, mainly in North America. Examine roles and relationships in policy formulation between major policy actors, including legislative bodies, government agencies, and non-profits. The role of science and scientists in policy.

NREM 390. Fire Ecology and Management. (3-0) Cr. 3. F. Characteristics and role of fire in forest ecosystems. Major topics covered include fuels, fire weather, fire behavior, fire danger rating systems, fire control, prescribed burning, and fire dynamics in major ecosystem types. Nonmajor graduate credit.

NREM 402. Watershed Hydrology. (Cross-listed with Agron, EnSci, Geol, Mteor). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing.* Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

NREM 407. Watershed Management. (Dual-listed with 507). (Cross-listed with EnSci, Env S). (3-3) Cr. 4. S. *Prereq: A course in general biology.* Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

NREM 430. Media Techniques in Natural Resources Interpretation. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 330.* Media techniques used by interpreters for teaching the public about natural resources. Nonmajor graduate credit.

NREM 446. Integrating GPS and GIS for Natural Resource Management. (Dual-listed with 546). (Cross-listed with EnSci). (2-3) Cr. 3. S. *Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS.* Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

NREM 452. Ecosystem Management. (Cross-listed with For). (2-3) Cr. 3. F. *Prereq: Junior classification, and NREM 301 or A Ecl 312.* Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints. Nonmajor graduate credit.

NREM 460. Controversies in Natural Resource Management. (Cross-listed with Env S). (3-0) Cr. 3. F.S. *Prereq: 120, and A Ecl 312 or NREM 301, and Junior classification.* Analysis of controversial natural resource issues using a case approach that considers uncertainty and adequacy of information and scientific understanding. Ecological, social, political, economic, and ethical implications of issues will be analyzed. Nonmajor graduate credit.

NREM 465. Landscape Change and Conservation. (Dual-listed with 565). (Cross-listed with L A). (3-0) Cr. 3. F. *Prereq: L A 202.* Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

NREM 471. Agroforestry Systems; Local and Global Perspectives. (Dual-listed with 571). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in biological science at 300 level or above.* Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry.

NREM 472. Landscape Ecology and Natural Resource Management. (Dual-listed with 572). (2-2) Cr. 3. F. *Prereq: NREM 301 or A Ecl 312 or equivalent and NREM 345 or C R P 451 or equivalent.* Analysis and management of spatial patterns and processes in populations, communities, and ecosystems with emphasis on broad spatial scales. Human influences on natural systems are strongly considered.

NREM 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or senior classification, permission of instructor.*
A. Animal Ecology
B. Forestry
E. Entrepreneurship
H. Honors Program

NREM 490I. Undergraduate Independent Study. (Cross-listed with Ia LL). Cr. arr. Repeatable. *Prereq: Junior or senior classification and permission of the instructor.*

NREM 493. Workshop. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Ecological concepts and management practices for landowners, teachers and others. Not for students majoring in animal ecology or forestry. NREM 493 may be taken more than once for graduation credit.

NREM 496. Travel Course. (Dual-listed with 596). Cr. arr. Repeatable. *Prereq: Permission of instructor.* Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.
A. International
B. Domestic

NREM 498. Cooperative Education. Cr. arr. *Prereq: Permission of departmental chair.* Required of all cooperative education students. Students must register prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

NREM 501. Genecology. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Gen 320 or Biol 313.* Genecology principles as they apply to natural and improved populations of plants and animals. Genetic systems as they interact with long-term natural selection to produce clinal or ecotypic variation. The impact of current environments and genetic modifications of domesticated organisms on short-term selection pressures. Special coverage of species of interest to students enrolled in the course.

NREM 504. Forest Landscapes, Wildlife, and Silviculture. (3-3) Cr. 4. Alt. F., offered 2010. *Prereq: 301.* Detailed analysis of factors and processes underlying forest and stand growth and development. Applications of this knowledge to forest culture to support a diversity of use and protection objectives. Discussions of regional silviculture, tropical forests, and experimentation in forest biology.

NREM 505. Seminar. (2-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor or graduate classification.* Current topics in natural resources research and management.

NREM 507. Watershed Management. (Dual-listed with 407). (Cross-listed with EnSci). (3-3) Cr. 4. S. *Prereq: A course in general biology.* Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

NREM 508I. Aquatic Ecology. (Cross-listed with Ia LL, EnSci). Cr. 4. SS. *Prereq: Courses in ecology, chemistry, and physics.* Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

NREM 529. Publishing in Biological Sciences Journals. (Cross-listed with Agron, Hort). (2-0) Cr. 2. S. *Prereq: Permission of instructor; evidence of a publishable unit of the student's research data.* Process of preparing a manuscript for submission to a refereed journal in the biological sciences. Emphasis on publishing self-generated data from thesis or dissertation research.

NREM 532. Human Dimensions of Natural Resource Management. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: A Ecl 312 or equivalent plus 6 credits of biological sciences; permission of instructor.* Exploration of institutions that help shape natural resource management and policies. Current research on interaction of humans with natural resources. Roles of social forces, politics and economics in natural resource management.

NREM 535. Restoration Ecology. (Cross-listed with EnSci, EEOB). (2-3) Cr. 3. F. *Prereq: Biol 366 or 474 or graduate standing.* Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies.

NREM 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BBMB, BCB, B M S, FS HN, Hort, NutrS, VDPAM, EEOB, V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

NREM 546. Integrating GPS and GIS for Natural Resource Management. (Dual-listed with 446). (Cross-listed with EnSci). (2-3) Cr. 3. S. *Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS.* Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

NREM 565. Landscape Change and Conservation. (Dual-listed with 465). (Cross-listed with L A). (3-0) Cr. 3. F. *Prereq: L A 202.* Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

NREM 570. Advanced Decision-making in Natural Resource Allocation. (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: For 451 or two courses in economics.* Analytical approach to economic aspects of forest resource management problems. Theory and application of economic decision-making criteria to traditional and modern forest resource management issues. Current problems in the allocation of forest resources.

NREM 571. Agroforestry Systems. (Dual-listed with 471). (Cross-listed with SusAg). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in biological science at 300 level or above.* Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry.

NREM 572. Landscape Ecology and Natural Resource Management. (Dual-listed with 472). (2-2) Cr. 3. F. *Prereq: NREM 301 or A Ecl 312 or equivalent and NREM 345 or C R P 451 or equivalent.* Analysis and management of spatial patterns and processes in populations, communities, and ecosystems with emphasis on broad spatial scales. Human influences on natural systems are strongly considered.

NREM 580. Research Orientation. (2-0) Cr. 2. F. *Prereq: 20 credits in biological sciences and a course in statistics.* Research design, proposal preparation, and technical writing.

NREM 581. Methods for Presenting Scientific Results. (2-0) Cr. 2. S. *Prereq: Permission of instructor.* Techniques of proper platform presentation. Discussion of effective audio/visual techniques for presentation of research findings. Practice in development of overheads and slides. Use of computer generated and projected visuals. Practice in oral presentation with critical review. Development of effective posters for scientific presentation.

NREM 585. Natural Resource Policy. (Dual-listed with 385). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate standing or permission of instructor. History, theory, and practice of natural resource policy.* Integrative approach with topical studies in wildlife, forest, water, and other natural resources, mainly in North America. Examine roles and relationships in policy

formulation between major policy actors, including legislative bodies, government agencies, and non-profits. The role of science and scientists in policy.

NREM 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
A. Animal Ecology
B. Forestry

NREM 593. Workshop. Cr. arr. Repeatable. *Prereq: Graduate classification.*

NREM 596. Travel Course. (Dual-listed with 496). Cr. arr. Repeatable. *Prereq: Permission of instructor.* Limited enrollment. Extended field trips to study ecological topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.
A. International
B. Domestic

NREM 599. Creative Component. Cr. arr.

Courses for graduate students

NREM 600. Seminar. Cr. 1. Repeatable. F.S. Current topics in natural resources research and management.

NREM 699. Research. Cr. arr. Repeatable.

Naval Science

www.iastate.edu/~navy

Captain Gary Waring, Chair of Department

Professors: Waring

Assistant Professors (Adjunct): Asjes

Instructors (Adjunct): Corbeill, Dienes, Kamp

The Department of Naval Science is embedded within the College of Liberal Arts and Sciences as an interdisciplinary program but does not offer an academic degree. The courses offered by the Department are developed by the Department of the Navy. The Naval Science Department and Naval ROTC (NROTC) Program develop individuals mentally, morally, and physically, and imbue in them the highest ideals of duty and loyalty, in order to commission them upon graduation as Navy and Marine Corps officers. Program graduates possess a basic professional background, are motivated towards careers in the Naval Service, and have a potential for future development in mind and character so as to assume the highest responsibilities of command, citizenship, and government. Emphasis is placed on the core values of courage, honor and commitment.

Naval Science courses are open to any ISU student who has met the course prerequisites. To participate in the Naval ROTC Program, students must apply through one of two programs: the NROTC Scholarship Program (full scholarship; which includes a book stipend, tuition, laboratory fees, uniforms, and a monthly stipend), or the College Program (nonscholarship, with limited financial assistance). Applicants for the Scholarship Program are selected through a comprehensive nationwide competition. Applicants for the College Program are selected by the Professor of Naval Science from among students already in attendance at, or selected for admission by, the university. The College Program involves limited financial assistance for each of the last two academic years. Upon application, students choose between the Navy Option and Marine Corps Option, for the purposes of training focus. NROTC students pursue their studies like other university students except that they must meet certain additional requirements that will prepare them to serve as naval officers upon graduation.

A Scholarship Program student incurs a minimum 4 -year active duty military obligation as a commissioned officer after graduation; a College Program student incurs a 3-year active duty obligation.

Further information is available from the Professor of Naval Science, Iowa State University.

While in the NROTC Program, students will participate (with pay) in summer at-sea training cruises. Students are also exposed to regular and extracurricular activities that teach leadership principles and help them decide which field of the Navy or Marine Corps they wish to enter. These activities also include weekly leadership laboratory periods and opportunities for involvement in several student societies.

Undergraduate Study

Naval science courses are primarily for those students in the NROTC program, however, other university students may also enroll. Students enrolled in the NROTC program must fulfill the following requirements:

1. N S 111, N S 212, N S 220, N S 230, N S 320, N S 330, N S 410, N S 412 and N S 440. Marine option students will complete N S 111, N S 212, N S 220, N S 321, N S 412, N S 421, and N S 440.

2. All NROTC students must complete one course in American military history or national security policy. A course in non-western culture or religion is also required of all Navy-option students.

3. All Navy option scholarship students must successfully complete Math 165 and 166 by the end of the sophomore year and Phys 221 and 222 by the end of the junior year.

4. In addition to the normal Naval Science courses, all NROTC students are required to participate in laboratory periods that supplement the various academic courses. The Leadership Lab emphasizes human relations principles, teaches basic military formations, movements, commands, courtesies, and honors, and provides practice in unit leadership. Non NROTC program students enrolled in Naval Science courses are not required to participate in laboratory periods.

5. Navy option scholarship students are encouraged to major in engineering and physical sciences to meet the technological requirements of the modern Navy, however Navy-option students and Marine Corps-option students may pursue any major leading to a Bachelor's Degree.

6. The College of Liberal Arts and Sciences offers a minor in military studies. Requirements for the minor include taking a minimum of 15 credits of ROTC instruction, which may be taken from any of the three ROTC programs offered on campus. At least 6 credits must be in courses numbered 300 or above.

For basic undergraduate curriculum requirements, see *Liberal Arts and Sciences, Curriculum; or Engineering, Curricula.*

Courses primarily for undergraduate students

N S 111. Introduction to Naval Science. (3-0) Cr. 3. F. Introduction to the organization, regulations, and capabilities of the Navy, with emphasis on mission and principal warfare components.

N S 212. Seapower and Maritime Affairs. (3-0) Cr. 3. S. Requests to waive this prerequisite must be approved by Naval Science Department. Development of concept of seapower including the Merchant Marine; role of various warfare components of the Navy in supporting the Navy's mission; implementation of seapower as an instrument of national policy; evolution and network-centric warfare and review of Cold War naval strategy.

N S 220. Leadership and Management. (3-0) Cr. 3. S. Experiential approach to learning the principles of leadership and management by examining business management theories and their applications. Skills are developed in the areas of communication, counseling, control, direction, management, and leadership through active guided participation.

N S 230. Navigation. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Requests to waive this prerequisite must be approved by Naval Science Department. Study of the fundamentals of marine navigation used by ships at sea; includes practical exercises in piloting using visual and electronic means. In-depth discussion of laws that govern conduct of vessels in national/international waters. Course is supplemented with review/analysis of case studies involving actual navigation incidents.

N S 320. Naval Ship Systems I (Engineering). (3-0) Cr. 3. F. *Prereq: Physics 221, sophomore classification.* Requests to waive these prerequisite must be approved by Naval Science Department. An introduction to naval engineering with emphasis on the equipment and machinery involved in the conversion of energy for propulsion and other purposes aboard the major ship types of the U.S. fleet. Basic concepts of the theory and design of steam, gas turbine, diesel, and nuclear propulsion. Introduction to ship design, stability, hydrodynamic forces, compartmentation, electrical and auxiliary systems.

N S 321. Evolution of Warfare. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Sophomore classification. Requests to waive this prerequisite must be approved by Naval Science Department.* Evolution of warfare from 3500 B.C. to contemporary times; analysis of the impact of historical precedents on modern military thought and action; emphasis on the historical development of military tactics, strategy, and technology.

N S 330. Naval Ship Systems II (Weapons). (3-0) Cr. 3. S. *Prereq: Physics 221, sophomore classification. Requests to waive this prerequisite must be approved by Naval Science Department.* Introduction to the theory and principles of operation of naval weapon systems. Included coverage of types of weapons and fire control systems, capabilities and limitations; theory of target acquisition, identification and tracking; basics of naval ordnance.

N S 410. Naval Operations and Seamanship. (3-0) Cr. 3. F. *Prereq: Senior classification. Requests to waive this prerequisite must be approved by Naval Science Department.* Study of tactical naval operations; employs practical use of maneuvering boards together with shiphandling principles to arrive at tactical shipboard maneuvering solutions for single ship and formation operations. Study also of command and control, leadership, and ethics issues associated with surface naval operations.

N S 412. Leadership and Ethics. (3-0) Cr. 3. S. *Prereq: For NROTC students only - N S 111, N S 212 or Hist 389, N S 220, N S 230, N S 320, N S 330 and N S 410. Requests to waive this prerequisite must be approved by Naval Science Department.* Basic background concerning the duties and responsibilities of the junior naval officer and division officer in the areas of integrity and ethics, human resources management, personnel management, material management, and the administration of discipline. Preparation for responsibilities encountered immediately upon commissioning.

N S 421. Evolution of Amphibious Warfare. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Sophomore classification. Requests to waive this prerequisite must be approved by Naval Science Department.* Defines the concept of amphibious operations, origins, development from 600 B.C.

N S 440. Senior Naval Science Seminar. (1-0) Cr. 1. F.S. *Prereq: Senior classification. Requests to waive this prerequisite must be approved by Naval Science Department.* Current leadership issues in the Navy which will challenge the newly commissioned officer. Opportunities to analyze, provide solutions, and discuss actions related to a variety of real world situations.

N S 490. Independent Study. Cr. arr. Repeatable. *Prereq: Senior classification and prior approval of Naval Science Department Chair, 6 credits in naval science.* No more than 9 credits of N S 490 may be counted toward graduation.

Neuroscience

www/neuroscience.iastate.edu/

(Interdepartmental Graduate Program)

Co-Chairs: D. Sakaguchi, R. Martin

Supervisory Committee: V. Bracha, S. Jeftinija, A. G. Kanthasamy, R. Martin, D. Sakaguchi

Participating Faculty: V. Anantharam, L. Anderson, J. Bloedel, V. Bracha, E Cooper, J. Cunnick, T. Day, N. M. Ellinwood, H. Greenlee, V. Honavar, W. Hsu, S. Jeftinija, A.G. Kanthasamy, A. Kanthasamy, M. Kimber, V.S. Lin, S. Mallapragada, R. J. Martin, M. Nilsen-Hamilton, J. Ourednik, V. Ourednik, A. Robertson, R. Robson, D. Sakaguchi, R. Singh, A. Smiley-Oyen, C. Tuggle, E. Uemura

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in neuroscience. Cooperating departments include Animal Science; Biochemistry, Biophysics and Molecular Biology; Biomedical Sciences; Chemical and Biological Engineering; Chemistry; Ecology, Evolution and Organismal Biology; Genetics, Development and Cell Biology; Kinesiology; and Psychology.

Facilities and faculty are committed to research in the following areas: neuronal membrane functions, signal transduction, neuroanatomy, neurodegenerative diseases, neuroendocrinology, neurotoxicology, neuropathology, developmental neurobiology, neurogenetics, computational neuroscience, neural networks, and behavioral neuroscience.

An undergraduate or advanced degree in the sciences is ordinarily a prerequisite for admission to the program. A student majoring in neuroscience will select a major professor from the faculty participating in the program.

All students take a core curriculum consisting of Neuro 556, 557, 661, 690, 696, BBMB 404, and Stat 401. All students are also expected to take elective neuroscience courses from the following: B M S 537, 575; Com S 474; E E 545; Psych 517, 519; and Tox 501.

Courses for graduate students

Neuro 556. Cellular, Molecular and Developmental Neuroscience. (Cross-listed with GDCB, B M S). Cr. arr. F. *Prereq: Biol 335 or Biol 436; physics recommended.* Fundamental principles of neuroscience including cellular and molecular neuroscience, nervous system development, sensory, motor and regulatory systems.

Neuro 557. Advanced Neuroscience Techniques. (Cross-listed with GDCB). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Neuro 556 or equivalent course.* Research methods and techniques; exercises and/or demonstrations representing individual faculty specialties.

Neuro 661. Current Topics in Neurobiology. (Cross-listed with GDCB, BBMB). Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics may include communication, hormones and behavior, neural integration, membrane biophysics, molecular and cellular neuroscience, developmental neurobiology, neuroanatomy and ultrastructure, sensory biology, social behavior, techniques in neurobiology and behavior.

Neuro 690. Journal Club in Neuroscience. (1-0) Cr. 1. Repeatable. F.S. *Prereq: 556.* Students are required to attend and make at least one presentation at a weekly journal club focusing on current topics.

Neuro 696. Neuroscience Seminar. (1-0) Cr. 1. Repeatable. F.S. *Prereq: 556.* Presentations and discussion of research by students, faculty, and visiting scholars.

Neuro 699. Research. Cr. arr. Repeatable.

Nuclear Engineering

www.iastate.edu/~nuclearengineering

Minor administered by Mechanical Engineering

The nuclear engineering undergraduate minor allows engineering students to acquire a formal background in nuclear engineering topics that will not only benefit them, but also fulfill a societal need for future hiring of engineers. Through this program, students can enroll in a formal minor that enables them to acquire a basic and fundamental knowledge of nuclear sciences and engineering, thus enabling them to pursue employment in any one of a number of fields associated with the construction, operation or regulation of nuclear power generation.

Students completing this minor acquire a body of knowledge in the fundamentals of nuclear science and engineering. The required courses selected ensures that all graduates of the nuclear engineering minor obtain a minimum body of knowledge in nuclear science and engineering that would allow them to apply their specialized field of engineering knowledge to nuclear-related applications, such as nuclear plant and site construction, nuclear power plant operations, nuclear safety and radiation protection.

The supporting courses that are listed in this program provide an opportunity for students to build upon the knowledge gained in the required courses by taking either more advanced courses or more specialized courses dealing with specific areas of nuclear engineering.

Undergraduate Study

Students interested in completing the nuclear engineering minor must be enrolled in the College of Engineering at Iowa State University. They should complete and submit the "Request for Minor" form. The selection process is based on approval by the administering department, Mechanical Engineering.

The course requirements for the undergraduate minor in nuclear engineering are: Required courses (9 credits) – Nuc E 401, 3 cr., Nuc E 402, 3 cr., and Nuc E 405, 3 cr.; Supporting courses (select two for 6 credits) – Nuc E 410, 3 cr., Nuc E 411, 3 cr. Nuc E 490, 3 cr., or M E 433, 3 cr. The minor must include at least nine credits which are beyond the total used to meet curriculum requirements for the bachelors degree in engineering.

Interinstitutional Program:
Contact: Gregory Maxwell

Participating Faculty:
Iowa State University
Gregory Maxwell, gmaxwell@iastate.edu
Carolyn Heising, cheising@iastate.edu

Kansas State University
William Dunn, dunn@ksu.edu
Kenneth Shultis, jks@ksu.edu

University of Missouri Columbia
Mark Prelas, PrelasM@missouri.edu

Texas A&M University
Raymond Juzaitis, rjuzaitis@tamu.edu

University of Texas at Austin
Sheldon Landsberger,
s.landsberger@mail.utexas.edu

Nuclear engineering courses are provided through an inter-institutional distance education program offered through the Web. Some of the courses that comprise this minor are offered at Iowa State University, while others are offered through four of the Big 12 Engineering Consortium universities that have formal nuclear engineering departments or programs. The four universities offering an assortment of nuclear engineering courses via web-based distance education are Texas A & M (TAMU), the University of Missouri Columbia (UMC), Kansas State University (KSU) and the University of Texas at Austin (UTA).

Courses primarily for undergraduate students

Nuc E 401. Nuclear Radiation Theory and Engineering. (3-0) Cr. 3. F. *Prereq: Phys 222, Math 266 or 267.* Atomic and nuclear physics. Radioactivity and reaction rates. Cross sections. Introduction to neutron diffusion theory. Engineering applications of radiation theory. Nonmajor graduate credit.

Nuc E 402. Nuclear Reactor Engineering. (3-0) Cr. 3. S. *Prereq: 401.* WWW only. Fission and chain reactions. Neutron diffusion and moderation. Reactor equations. Fermi Age theory. Multigroup and multiregional analysis.

Nuc E 405. Radiation Protection and Shielding. (3-0) Cr. 3. *Prereq: 401.* WWW only. Basic principles and concepts of radiation protection and design: dosimetric units and response functions, hazards of radiation dose, radiation sources, basic methods for dose evaluation, and shielding design techniques for photons and neurons.

Nuc E 410. Nuclear Reactor Theory. (3-0) Cr. 3. F. *Prereq: 405.* WWW only. An introduction to neutron diffusion theory, neutron moderation, conditions for criticality of nuclear reactors.

Nuc E 411. Nuclear Reactor Analysis. (3-0) Cr. 3. S. *Prereq: 410.* WWW only. Group diffusion method. Multiregion reactors, heterogeneous reactors. Reactor kinetics, changes in reactivity.

Nuc E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior Classification.* Investigation of nuclear engineering topics. Election of course and topic must be approved in advance by supervising faculty.

Nutritional Sciences

(Interdepartmental Graduate Major)

Advisory Committee: K. Schalinske, Chair; D. Beitz, M. Spurlock, M. Reddy, W. White

Participating Faculty: Faculty mainly from Food Science and Human Nutrition and Animal Science and also from other departments such as Kinesiology; Biochemistry, Biophysics, and Molecular Biology; Agronomy; Human Development and Family Studies, Sociology; Agricultural and Biosystems Engineering, and Statistics

Graduate Study

The Interdepartmental Graduate Program in Nutritional Sciences (IGPNS), administered through the Graduate College, under the auspices of the Chairs of Food Science and Human Nutrition (FS HN) and Animal Science, will provide the structure for coordinating and enhancing interdisciplinary nutrition research and graduate education. M.S. and Ph.D. degrees in Nutritional Sciences will be offered with three specializations: Animal Nutrition, Human Nutrition, or Molecular/Biochemical Nutrition.

The following undergraduate course work is recommended of all applicants who are applying to the IGPNS, but may be modified depending upon the student's area of emphasis. Recommended course work includes organic chemistry

with laboratory, physics, analytical chemistry, a nutrition course that requires biochemistry or organic chemistry as a prerequisite, and a course in biology/physiology or anatomy. Under certain circumstances students can be admitted or provisionally admitted with course work deficiencies. Students with an undergraduate degree will be generally admitted into the M.S. program and upon completion, they can then apply for admission into the Ph.D. program. However, exceptional students with experience can apply directly to the Ph.D. program.

The general requirements of the Nutritional Sciences degree at the MS level, in addition to those of Graduate College, are: NutrS 501; NutrS 502; a minimum of 4 additional credits of graduate-level advanced nutrition or nutritional physiology; 3-6 credits of graduate-level biochemistry; 3 credits of graduate-level statistics (STAT 401); graduate student orientation course (FS HN 580 or An S 501); seminar(s) attendance in Food Science and Human Nutrition (FS HN 581) or Animal Science (An S 603); seminar presentation course (FSHN 681 or An S equivalent); one semester credit of seminar pertaining to student's research; Teaching assistant requirement (FS HN 590C or AnS 590L), summer lectureship (NutrS 505) and successful completion of a thesis and defense of the thesis. They are expected to complete the course work established by the Program of Study (POS) committee based on specialization with a minimum of 30 graduate-level semester credits, not less than 22 of which must be earned at Iowa State University.

The general requirements of the Nutritional Sciences degree at the PhD level, in addition to those of the Graduate College, are: completion of all requirements of the MS degree in Nutritional Sciences; 3 additional credits in each of graduate-level biochemistry, graduate-level statistics (Stat 402), and systemic physiology; and one additional graduate-level courses in the field of study as deemed appropriate by the POS Committee and additional teaching assistant requirements (FS HN 590C or An S 690L). Satisfactory completion of a preliminary examination, a written dissertation, seminar presentation of dissertation research, and defense of the dissertation is also required. Overall a minimum of 72 graduate-level semester credits, no less than 36 of which must be earned at Iowa State University.

Courses for graduate students

NutrS 501. Biochemical and Physiological Basis of Nutrition: Macronutrients. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in BBMB 404 or BBMB 420.* Integration of the molecular, cellular, and physiologic aspects of macronutrient and energy metabolism in mammalian systems. Dietary energy, carbohydrates, fiber, lipids, proteins, their interactions, metabolic consequences, and major research methodologies.

NutrS 502. Biochemical and Physiological Basis of Nutrition: Vitamins and Minerals. (3-0) Cr. 3. S. *Prereq: BBMB 404 or BBMB 420, and credit or enrollment in BBMB 405.* Integration of the molecular, cellular, and physiologic aspects of vitamin and mineral metabolism in mammalian systems. Interactions among nutrients, metabolic consequences of deficiencies or excesses, relevant polymorphisms, major research methodologies, and current topics related to micronutrients.

NutrS 503. Biology of Adipose Tissue. (2-0) Cr. 2. S. *Prereq: Undergraduate: consent of instructor; Graduate: NutrS 501.* Principles regarding the development of adipose tissue and its role in energy balance, and will focus considerably on endocrine and immune actions of the adipocyte. Course material will be in lecture format, including handouts and selected journal articles. Students will be asked to lead critical discussions of key research findings as summary material for a given topic. Species differences will be highlighted, particularly as they relate to research models.

NutrS 505. Short Course. Cr. arr. F.S.SS. *Prereq: Permission of instructor.*

NutrS 518. Digestive Physiology and Metabolism of Non Ruminants. (Cross-listed with AN S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: An S 419 or NutrS 501.* Digestion and metabolism of nutrients. Nutritional requirements and current research and feeding programs for poultry and swine.

NutrS 519. Food Toxicology. (Cross-listed with FS HN, Tox). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: A course in biochemistry.* Basic principles of toxicology. Toxicants in the food supply: modes of action, toxicant defense systems, toxicant and nutrient interactions, risk assessment. Only one of NutrS 419 and 519 may count toward graduation.

NutrS 520. Digestive Physiology and Metabolism of Ruminants. (Cross-listed with AN S). (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: An S 419 or NutrS 501.* Digestive physiology and nutrient metabolism in ruminant and preruminant animals

NutrS 542. Introduction to Molecular Biology Techniques. (Cross-listed with B M S, BCB, BBMB, EEOB, FS HN, GDCB, Hort, NREM, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

NutrS 552. Advanced Vertebrate Physiology II. (Cross-listed with B M S, Kin, An S). (3-0) Cr. 3. S. *Prereq: Biol 335; credit or enrollment in BBMB 404 or 420.* Cardiovascular, renal, respiratory, and digestive physiology.

NutrS 561. Medical Nutrition and Disease I. (4-0) Cr. arr. F. *Prereq: FS HN 360, 3 credits in physiology at 300 level or above.* (Dual listed with FS HN 461.) Pathophysiology of selected chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state. Recitation section (1 cr.) will focus on refinement of assessment skills, diagnosis of nutritional problems, nutrition care, and documentation. Course must be taken for 4 credits if Didactic Program in Dietetics (DPD) verification statement of completion is desired. Graduate students may take the lecture portion without the recitation section.

NutrS 562. Assessment of Nutritional Status. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: FS HN 461/NutrS 561 or NutrS 501.* Overview and practical applications of methods for assessing nutritional status, including: theoretical framework of nutritional health and disease, dietary intake, biochemical indices, clinical examination, and body composition.

NutrS 563. Community Nutrition. (3-0) Cr. 3. F. *Prereq: FSHN 203, 362.* Dual listed with FS HN 463. Survey of current public health nutrition problems among nutritionally vulnerable individuals and groups. Discussion of the multidimensional nature of those problems and community programs designed to help solve them. The role of community nutritionists in grant writing for project development. Significant emphasis on written and oral communication.

NutrS 564. Medical Nutrition and Disease II. (4-0) Cr. arr. S. *Prereq: FS HN 360, FS HN 461, or NutrS 561. 3 credits in physiology at 300 level or above.* (Dual listed with FS HN 464.) Pathophysiology of selected acute and chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state. Recitation section (1 cr.) will focus on refinement of assessment skills, diagnosis of nutritional problems, nutrition care, and documentation. Course must be taken for 4 credits if Didactic Program in Dietetics (DPD) verification statement of completion is desired. Nutritional science undergraduates and graduate students may take the 3 credit lecture portion without the recitation section.

NutrS 619. Advanced Nutrition and Metabolism - Protein. (Cross-listed with An S). (2-0) Cr. 2. *Prereq: BBMB 405.* Digestion, absorption, and intermediary metabolism of amino acids and protein. Regulation of protein synthesis and degradation. Integration of cellular biochemistry and physiology of mammalian protein metabolism.

NutrS 680. Modern Views of Nutrition. Cr. R. Repeatable. S. Current concepts in nutrition and related fields. Required for all graduate students in nutrition.

NutrS 695. Grant Proposal Writing. (Cross-listed with FS HN). (1-0) Cr. 1. F. *Prereq: 3 credits of graduate course work in food science and/or nutrition.* Grant proposal preparation experiences including writing and critiquing of proposals and budget planning. Formation of grant writing teams in food science and/or nutrition. Satisfactory-fail only.

NutrS 699. Research in Nutritional Sciences. Cr. arr. F.S.SS. Satisfactory-fail only.

Officer Education Programs

Iowa State University offers Reserve Officers Training Corps (ROTC) programs for the professional training of officers for the Army, Air Force, Navy and Marines.

The purpose of these programs is to provide an avenue for interested students to become reserve or regular officers in one of the United States military services, and the university regards this training as the foundation for possible careers in the military. The Air Force and the Navy require a period of active duty service upon completion of the ROTC program. Graduates from Army ROTC serve in either active Army, the Army Reserve, or the National Guard.

All students enrolled in advanced ROTC programs receive financial allowances, which are described under Student Financial Aid. Scholarships are also available for all services as outlined in the section on financial aid.

For specific courses and programs see also Air Force Aerospace Studies, Military Science, and Naval Science.

Operations and Supply Chain Management

(Administered by the Department of Logistics, Operations and Management Information Systems)

Richard Poist, Chair of Department

Distinguished Professor (Emeritus): Baumel

Professors: Crum, Poist, Walter

Professors (Emeritus): Thompson, Voorhees

Associate Professors: Blackhurst, Johnson, Mennecke, Montabon, Nilakanta, Ruben, Suzuki, Tiwana, Townsend, Zhu

Assistant Professors: Jiang, Martens, Scheibe

Instructors (Adjunct): Choobineh

Lecturer: Helmer

Undergraduate Study

For undergraduate curriculum in business, major in Operations and Supply Chain Management, see *College of Business, Curricula.*

Operations and Supply Chain Management is a program of study concerned with the efficient and timely flow of materials, products, and information within and among organizations. Operations management encompasses the planning, control and implementation of the processes used to transform inputs into finished goods and services. Supply chain management involves the integration of business processes across organizations, from material sources and suppliers through manufacturing and processing to the final customer. Operations management is, thus, taught in the context and framework of inter-organizational supply chain systems.

The study of Operations and Supply Chain Management prepares students for professional careers with manufacturers, distributors, logistics service providers and consulting firms. The curriculum provides the required theoretical/conceptual base and analytical methods for making sound operational and strategic business decisions.

The requirements for the Operations and Supply Chain Management major are met by completion of the following courses: OSCM 422, 424, 485, 486, 487, plus one course from an approved list.

The department also offers a minor for non Operations and Supply Chain Management majors in the College of Business. The minor requires 15 credits from an approved list of courses, of which 9 credits must stand alone. Students with declared majors have priority over students with declared minors in courses with space constraints.

Graduate Study

For graduate study options, including the Ph.D. degree, see the Supply Chain Management listing.

Courses primarily for undergraduate students

OSCM 320. Production/Operations Management. (3-0) Cr. 3. *Prereq: Stat 226.* Introduction and analysis of the basic concepts in production/operations management. Topics include: applied forecasting, aggregate planning, scheduling, shop floor control, total quality management, inventory management, facility layout, and project management.

OSCM 422. Manufacturing Planning and Control. (3-0) Cr. 3. *Prereq: OSCM 320.* Advanced treatment of manufacturing planning and control procedures. Master production scheduling, material requirements planning, enterprise resource planning, capacity planning, shop floor control, just-in-time, and competitive analyses of modern manufacturing systems. Nonmajor graduate credit.

OSCM 424. Process Management, Analysis, and Improvement. (3-0) Cr. 3. *Prereq: OSCM 320.* The design, analysis, and management of production processes to improve performance. Performance measures and their relationships; process design and evaluation; and managerial levers for improving and controlling process performance. Nonmajor graduate credit.

OSCM 428. Special Topics in Operations Management. (3-0) Cr. 3. *Prereq: OSCM 320.* In-depth analysis of current issues, problems, and systems in operations management with emphasis on new theoretical and methodological developments. Topics may include in different semesters, supply chain management, productivity and quality improvement, management of technology and innovation, information technology in operations management, quick response manufacturing, and service operations management. Nonmajor graduate credit.

OSCM 440. Supply Chain Information Systems. (Cross-listed with MIS, LSCM). (3-0) Cr. 3. *Prereq: MIS 330, OSCM 320, LSCM 360.* Internal and inter-organizational information systems necessary for a supply chain to achieve competitive advantage. Topics include: design, development, implementation, and maintenance of supply chain information systems; enterprise resource planning; advanced planning and scheduling, manufacturing execution systems; and the interface between manufacturing planning and control processes, logistics processes, and the information system.

OSCM 485. Demand Planning and Management. (Cross-listed with LSCM). (3-0) Cr. 3. *Prereq: LSCM 360, OSCM 320.* Demand planning process which synchronizes demand with manufacturing and distribution. Addresses linking business plans and demand forecasts both horizontally and vertically within the organization and collaboratively among supply chain partners. Forecasting, customer relationship management, sales and operations planning, customer service, distribution channels, e-fulfillment, and information systems requirements. Nonmajor graduate credit.

OSCM 486. Principles of Purchasing and Supply Management. (Cross-listed with LSCM). (3-0) Cr. 3. *Prereq: LSCM 360, OSCM 320.* Sourcing strategies, concepts, tools and dynamics in the context of the integrated supply chain. Make or buy decision, supplier evaluation and selection, global sourcing, the total cost of ownership, contracts and legal terms, negotiation, purchasing ethics, and information systems requirements. Nonmajor graduate credit.

OSCM 487. Strategic Supply Chain Management. (Cross-listed with LSCM). (3-0) Cr. 3. *Prereq: OSCM 422 or OSCM 424 or LSCM 460; OSCM 485 or OSCM 486.* Capstone course in supply chain management. Integrating and applying the theories, concepts, and methods covered in the prerequisite courses through the use of readings, case studies, projects, and industry speakers. Nonmajor graduate credit.

OSCM 490. Independent Study. Cr. arr. Repeatable. *Prereq: OSCM 320, senior classification, permission of instructor.*

Courses primarily for graduate students, open to qualified undergraduate students

The department offers graduate courses under the heading of Supply Chain Management. These courses include SCM 502, 520, 522, 524, 560, 561, 563, 585, and 590. For descriptions of these courses, see *Supply Chain Management*.

Courses for graduate students

The department offers graduate courses under the heading of Supply Chain Management. These courses include SCM 601, 602, 603, 604, 605, 650, 651, and 699. For descriptions of these courses, see *Supply Chain Management*.

Philosophy and Religious Studies

Tony Smith, Chair of Department

University Professor: Kupfer

Professors: Avalos, Hollinger, Kirschenmann, Robinson, Sawyer, Smith, Wilson

Professors (Emeritus): Hollenbach, Vaniten

Associate Professors: Bado-Fralick, T. Butler, Clifford, De Laplante, Fehr, Geirsson, Holmgren, Wolf

Assistant Professors: Alexander, A. Butler, Kelley, Padgett-Walsh, Qu

Senior Lecturer: Northway

Lecturer: Bevin, Wirth

Philosophy

Undergraduate Study

Philosophy tries to make sense of human experience and reality through critical reflection and argument. The questions it treats engage and provoke all of us, and they occupy an important place in our intellectual tradition: Are there objective standards for deciding what is right and wrong, or is morality merely a subjective matter? Is capitalism morally acceptable? Do I have a will, and is it free? How do my words and thoughts come to be about the world? Does God exist? Can machines think? How are mind and body related? Students in philosophy classes will be exposed to arguments on both sides of such questions, and they will be encouraged to develop and rationally defend their own positions.

Philosophy is not an isolated discipline. It enjoys mutually beneficial exchanges with many fields of study within the humanities and sciences. Philosophers develop tools that allow them to examine critically the assumptions and implications of the social and natural sciences, religion, and law.

The study of philosophy provides several benefits. It emphasizes rigourous understanding of problems, together with careful analysis of the strengths and weaknesses of the available solutions. It encourages clarity in the presentation of one's own ideas, as well as sensitivity in the consideration of the ideas of others. The study of philosophy therefore encourages one to develop skills and habits that are useful not only in philosophy, but in other areas as well. Philosophy students historically do well, for example, in law and medical schools.

However, one should not think that philosophy is only valuable in academic settings. Philosophical questions arise in many areas of family, business, and civic life. Philosophers strive to face these questions with the kind of intellectual honesty that leads to respect for the views of others, and continual reassessment of their own. In this way, the study of philosophy fosters values and attitudes that are helpful for responding to a lifetime of intellectual challenges.

The degree program in philosophy requires a minimum of 33 credits, plus the zero credit 492 course. The following courses compose the core program of the major from which 15 credits shall be chosen. Additionally, two courses at the 400 level or above (other than 490 and 492) are required.

a. Ethical theory: One course required. Choose from 330 (Ethical Theory), 335 (Social and Political Philosophy), 535 (Contemporary Political Philosophy).

b. History: Two courses required, namely, 310 (Ancient Philosophy) and either 314 (17th Century Philosophy) or 315 (18th Century Philosophy).

c. Metaphysics and Epistemology: One course required. Choose from 364 (Metaphysics: God, Minds, and Matter), 366 (Truth, Belief, and Reason), 380 (Philosophy of Science).

d. Logic: 207 (Introduction to Symbolic Logic) is required.

The department offers a minor in philosophy which may be earned by completing a total of 15 credits in philosophy. At least 9 credits must be in courses numbered 300 or above. Students may want to emphasize specific areas by taking 15 hours of courses chosen from the following:

Philosophy of Science: 201, 206 or 207, 314, 315, 380, 381, 480, 483, 485

History of Philosophy: 201, 310, 314, 315, 316, 317, 318, 460

Law, Social Values and Policy: 230, 235, 331, 332, 333, 335, 336, 338, 343, 430, 535

Communication Proficiency requirement: The department requires a grade of C+ or better in each of Engl 150 and 250 (or 250H), and approval of writing by instructor of any philosophy course 300 level or above, to be designated by the student.

Graduate Study

The department offers work for a graduate minor in philosophy. For those taking the M.A. or M.S., the minor requirement is two courses above 300 (but not 490) each taken in conjunction with 590. For those taking the Ph.D., the requirement is four courses above 300, at least one of which is above 400 (but not 490) each taken in conjunction with 590. Interested students should ask the chair to assign a minor adviser.

The department participates in the interdepartmental program in general graduate studies. (See *Index*.)

Courses primarily for undergraduate students

Phil 201. Introduction to Philosophy. (3-0) Cr. 3. F.S.SS. It has been rumored that the unexamined life is not worth living. Philosophy is an attempt to begin examining life by considering such questions as: What makes us human? What is the world ultimately like? How should we relate to other people? Is there a god? How can we know anything about these questions? Understanding questions of this kind and proposed answers to them is what this course is all about.

Phil 206. Introduction to Logic and Scientific Reasoning. (3-0) Cr. 3. F.S.SS. Basic principles of critical reasoning and argument evaluation. A consideration of basic forms of argumentation in science and everyday life. Application to contemporary issues and controversies.

Phil 207. Introduction to Symbolic Logic. (Cross-listed with Ling). (3-0) Cr. 3. S. Introduction to fundamental logical concepts and logical symbolism. Development of natural deduction through first order predicate logic with identity. Applications to arguments in ordinary English and to philosophical issues. Majors should take Phil 207 as early as possible.

Phil 230. Moral Theory and Practice. (3-0) Cr. 3. F.S.SS. Investigation of moral issues in the context of major ethical theories of value and obligation; e.g., punishment, abortion, economic justice, job discrimination, world hunger, and sexual morality. Emphasis on critical reasoning and argument analysis.

Phil 235. Ethical Issues in A Diverse Society. (3-0) Cr. 3. S. This course will examine a range of arguments on diversity issues. Topics will include: the social status of women, the moral status of sexuality and homosexuality, the nature and role of racism in contemporary society, the relationship between biology, gender roles and social status, and various proposals for change from a variety of political perspectives.

Phil 310. Ancient Philosophy. (Cross-listed with Cl St). (3-0) Cr. 3. F. *Prereq: 201.* Survey of ancient Greek philosophy, focusing on the pre-Socratics, Plato, and Aristotle. Questions concerning being, knowledge, language, and the good life are treated in depth. Nonmajor graduate credit.

Phil 314. 17th Century Philosophy. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 201.* Readings from philosophers such as Hobbes, Descartes, Spinoza, Leibniz, and Locke. Changing conceptions of knowledge, self, and deities in response to Galileo's new science and post-reformation challenge to ecclesiastical authority. Nonmajor graduate credit.

Phil 315. 18th Century Philosophy. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 201.* Readings from philosophers such as Berkeley, Hume, and Kant. Development of Enlightenment thought. Issues include idealism, causation, freedom, and knowledge regarding science, ethics, and deities. Nonmajor graduate credit.

Phil 316. 19th Century Continental Philosophy. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 201.* The thought of Hegel, Marx, Nietzsche, and their contemporaries. Various perspectives on the philosophy of history, the nature of reason and subjectivity, the contrast between dialectical and nondialectical philosophy, and the relationship between philosophy and society. Nonmajor graduate credit.

Phil 317. 20th and 21st Century Continental Philosophy. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 201.* Major movements of 20th and 21st century thought, such as Phenomenology, Critical Theory, Post-structuralism, Postmodernism, and Feminism. Issues include the assumptions and limits of Western metaphysics, the nature of reason, the relationship between language and power. Nonmajor graduate credit.

Phil 318. 20th and 21st Century Anglo-American Philosophy. (3-0) Cr. 3. S. *Prereq: 201.* Major movements in recent and contemporary philosophy such as realism, logical positivism, ordinary language philosophy, and naturalism. Russell, Wittgenstein, Quine and other leading figures. Topics include knowledge of the material world, mind, language, values, and philosophical method. Nonmajor graduate credit.

Phil 320. Existentialism and Its Critics. (3-0) Cr. 3. F. *Prereq: 201.* An investigation of Existentialism and its critics in historical and cultural context. Emphasis on existential phenomenology and French existentialism, and on criticisms. Existential Marxism and Heidegger's later philosophy. Nonmajor graduate credit.

Phil 330. Ethical Theory. (3-0) Cr. 3. F. *Prereq: 201 or 230.* Major theories in normative ethics and metaethics. Includes such views as relativism, emotivism, and absolutism. Comparison of ethics with science and how moral judgments are justified. Nonmajor graduate credit.

Phil 331. Moral Problems in Medicine. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 230 or junior classification.* In-depth study of some of the central moral problems arising in medicine, e.g., abortion, euthanasia, patients' rights, health care professionals' duties and responsibilities, allocation of medical resources. Major moral theories will be examined and applied. Nonmajor graduate credit.

Phil 332. Philosophy of Law. (Cross-listed with CJ St). (3-0) Cr. 3. F.S. *Prereq: 201 or 230.* Extent of our obligation to obey the law; what constitutes just punishment; how much of the immoral should be made illegal? Relation of these questions to major theories of law and the state. Discussion of such concepts as coercion, equality, and responsibility. Nonmajor graduate credit.

Phil 333. Family Ethics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 3 credits in philosophy.* Moral dimensions of marriage and love, parent-child relations, domestic work, and moral education. Can parents and children be friends? What do children "owe" their parents? Is there a feminist mode of moral thinking? Nonmajor graduate credit.

Phil 334. Environmental Ethics. (Cross-listed with Env S). (3-0) Cr. 3. F. *Prereq: 3 credits in philosophy or junior classification.* Thorough study of some of the central moral issues arising in connection with human impact on the environment, e.g., human overpopulation, species extinction, forest and wilderness management, pollution. Several world views of the proper relationship between human beings and nature will be explored. Nonmajor graduate credit.

Phil 335. Social and Political Philosophy. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 201 or 230.* Foundations of social and political life. The basis of political organization, the nature of social and political institutions, rights and authority, justice. Original texts. Nonmajor graduate credit.

Phil 336. Bioethics and Biotechnology. (3-0) Cr. 3. *Prereq: Phil 201 or 230 or 235.* In-depth study of some central moral issues in the life sciences, e.g., genetic screening and testing, genetically engineered plants and animals, risk analysis, biotechnology patents, research ethics, biodiversity, the impact of biotechnology on society and the environment. Major moral theories will be discussed and applied. (Phil 336 contains almost no similarities to Phil 331.) Nonmajor graduate credit.

Phil 338. Feminist Philosophy. (Cross-listed with W S). (3-0) Cr. 3. F. *Prereq: 3 credits in philosophy or women's studies recommended.* A critical, theoretical examination of the oppression of women, especially as it relates to issues of race, class, and sexual orientation. How concepts such as sex and gender, self and other, nature and nurture, complicate our understanding of what it means to be a woman. Historical and contemporary feminist philosophers addressing topics such as violence, sexuality, pornography, political power, family structure and women's paid and unpaid labor. Nonmajor graduate credit.

Phil 340. Aesthetics. (3-0) Cr. 3. F. *Prereq: 201 or 230.* Is liking all there is to appreciating works of art or natural beauty? We will examine our appreciative experiences, talk about such experiences (e.g., art criticism), and what makes them valuable. Do the different arts have common values? How are their differences important? Nonmajor graduate credit.

Phil 343. Philosophy of Technology. (Cross-listed with T SC). (3-0) Cr. 3. F.S. *Prereq: 6 credits of social science or T SC 341 and 3 credits of social science.* Moral and other philosophical problems related to developments in technology. Topics may include conditions under which technological innovations contribute to human emancipation, relationship of technology and democracy, utility and limits of technical rationality, and problems of ensuring that benefits of technological advance are communally shared. Topics discussed with reference to such issues as contemporary developments in microelectronics, technology transfer to the Third World, etc. Nonmajor graduate credit.

Phil 350. Philosophy of Religion. (Cross-listed with Relig). (3-0) Cr. 3. F. *Prereq: 201.* The value and truth of religious life and belief. Mystical experience; religious faith and language; arguments for God's existence; the problem of evil; miracles; and religion and morality. Historical and contemporary readings. Nonmajor graduate credit.

Phil 364. Metaphysics: God, Minds, and Matter. (3-0) Cr. 3. S. *Prereq: 3 credits in philosophy.* A survey of classical and contemporary views on some basic metaphysical issues. Issues discussed include: Does God exist? Do you have a mind and, if so, how does it relate to your body? What is the nature of cause and effect? Do objects have any essential properties? How can we account for properties objects have in common? Nonmajor graduate credit.

Phil 366. Truth, Belief and Reason. (3-0) Cr. 3. F. *Prereq: 201 or permission of instructor.* This course focuses on significant topics in theory of knowledge, including the value of true beliefs, the role of sense experience in supporting our theoretical views, and the place of reason in human nature. Historical and contemporary views will be considered.

Phil 380. Philosophy of Science. (3-0) Cr. 3. F. *Prereq: 201 or 6 credits in a science.* Introduction to the philosophy of science. A variety of basic problems common to the natural and social sciences: the nature of explanation, the structure of theories, the unity of science, and the distinction between science and nonscience. Nonmajor graduate credit.

Phil 381. Philosophy of the social and Behavioral Sciences. (3-0) Cr. 3. S. *Prereq: 201 or 6 credits in the social sciences.* Methodological, ideological, and doctrinal issues about the social and behavioral sciences against the background of influence of the natural sciences. Focus is on the historical and cultural background of 19th and 20th century western thought. Nonmajor graduate credit.

Phil 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period. Nonmajor graduate credit.

Phil 430. Value Theory. (3-0) Cr. 3. Repeatable. S. *Prereq: 230.* Theoretical and normative issues in ethics, aesthetics, religious thought, or political philosophy. Topics vary each time offered. Nonmajor graduate credit.

Phil 450. Persons and Causes. (3-0) Cr. 3. Repeatable. F. *Prereq: 3 credits in philosophy; 207 strongly encouraged.* Personal identity, agency, free will, moral responsibility, causation, future contingents, and time will be discussed. What makes a person the same person over time? Do humans have free will? Are we not morally responsible if our actions are inevitable consequences of the past and the laws of nature? What distinguishes causes from non-causes? Are there facts about the future? Nonmajor graduate credit.

Phil 460. Epistemology and Metaphysics. (3-0) Cr. 3. Repeatable. S. *Prereq: 6 credits in philosophy.* Issues in epistemology and metaphysics. Topics vary each time offered. Nonmajor graduate credit.

Phil 465. Brains, Minds, and Computers. (3-0) Cr. 3. F. *Prereq: 201.* Examination of concepts such as computability, intelligence, programming, and free will; and of arguments about whether any human capacity is forever beyond realization in a machine. Nonmajor graduate credit.

Phil 480. Controversies in Science. (3-0) Cr. 3. Repeatable. S. *Prereq: 3 credits in philosophy or 6 credits in a natural or social science.* Philosophical treatment of a branch of science that has (or has had) significant social, political, religious and/or moral implications. Possible topics include: the IQ debate, implications of Darwinism, the Galileo affair, the role of values in science, critical analysis of current science policy (e.g., the Human Genome Project). Topics will be arranged to meet the needs of interested students. Often team taught by a philosopher and a scientist from the relevant discipline. Nonmajor graduate credit.

Phil 483. Philosophy of Biology. (3-0) Cr. 3. S. *Prereq: 3 credits in philosophy or 3 credits in biology.* Biology is powerful, both as a science and in its effects on our culture. Philosophy of biology evaluates this power. Possible topics include: What makes sciences such as evolutionary theory, ecology or molecular biology so good at explaining things? What is life? Can evolution account for design? What role does chance play in evolution? Has there been progress in the evolution of life on earth? What can sociobiology tell us about human nature, behavior and culture? Nonmajor graduate credit.

Phil 485. Philosophy of Physics. (3-0) Cr. 3. *Prereq: 3 credits in Philosophy or 3 credits in Physics.* S. Conceptual and philosophical issues relating to the interpretation of theories in classical and modern physics. May include one or more of the following topics: the relationship between mathematics and the physical world; Newtonian physics (determinism and predictability); thermodynamics and statistical physics (the nature of probability; entropy and the direction of time); relativistic physics (indeterminism; realism and nonlocality; consciousness and the role of the observer). Nonmajor graduate credit.

Phil 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in philosophy; permission of instructor, approval of chairman.* Guided reading and research on special topics selected to meet needs of advanced students. No more than 9 credits of Phil 490 may be counted toward graduation.
H. Honors

Phil 492. Graduating Senior Survey. Cr. R. F.S. *Prereq: Graduating senior.* Final presentation for graduation and the future. Outcomes assessment activities. Satisfactory-fail only.

Phil 496. Ecology and Society. (Dual-listed with 596). (3-0) Cr. 3. *Prereq: Graduate classification in biological or environmental sciences/studies with at least one course in ecology.* Analysis of conceptual and methodological debates in ecology. Historical development of competing research traditions and philosophies. Topics include i) methodological issues in ecological science, ii) conceptual issues in theoretical ecology, iii) conceptual issues in applied ecology, iv) relation of ecology to environmental and social issues. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Phil 535. Contemporary Political Philosophy. (Cross-listed with Pol S). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits of philosophy or political science.* Examination of theories of justice proposed by contemporary political philosophers. Analysis of the philosophical foundations of perspectives such as liberalism, libertarianism, communitarianism, socialism, feminism. Normative assessments of socio-political institutions.

Phil 590. Special Topics in Philosophy. Cr. arr. Repeatable. *Prereq: Permission of instructor, 9 credits in philosophy.*
A. History of Philosophy
B. Epistemology and Metaphysics
C. Value Theory
D. Logic and Philosophy of Science

Phil 596. Ecology and Society. (Dual-listed with 496). (Cross-listed with EEOB). (3-0) Cr. 3. *Prereq: Graduate classification in biological or environmental sciences/studies with at least one course in ecology.* Analysis of conceptual and methodological debates in ecology. Historical development of competing research traditions and philosophies. Topics include i) methodological issues in ecological science, ii) conceptual issues in theoretical ecology, iii) conceptual issues in applied ecology, iv) relation of ecology to environmental and social issues.

Religious Studies (Relig)

Undergraduate Study

Religious studies gives students the opportunity to investigate and reflect on the world's religions in an objective, critical, and appreciative manner. Though there is emphasis in religious studies on the wide variety of religious phenomena as well as on the various methods in the study of religion, the aim is to help students develop their own integrated understanding of the nature of religion and its role in individual and social life.

Graduates of the religious studies program have knowledge of the religious diversity in the United States and the world. They have the ability to interpret religion empathetically and critically and to compare and contrast historical and contemporary differences and similarities of religious systems. They understand ways in which religion influences and is influenced by the historical, social, and cultural contexts in which religious systems function. Graduates often pursue careers in non-profit, community organizations; apply to professional schools or graduate programs; or enter seminaries to prepare for ministry.

The program provides students with the following opportunities: to major or minor in religious studies, to fulfill group requirements, to take religious studies courses that are integrated into another major, to take religious studies courses as electives, and to develop an interdisciplinary studies major. (See the professor in charge of the religious studies program for advice.)

The major in religious studies seeks to provide both breadth and depth. Breadth is provided through the exploration of the world's various religious traditions and through exposure to a variety of theoretical approaches and methodologies in the academic study of religion. Depth is achieved through specialized courses in particular religious traditions and particular issues in the study of religions, culminating in research seminars. The objective is to expose the student to various components of the discipline of Religious Studies and by doing so develop skills that are valuable in a number of careers and that provide the necessary foundation for pursuing graduate studies.

Students pursuing a major in religious studies must complete a minimum of 33 credits, including the following requirements:

1. Either Relig 205, Introduction to World Religions or Relig 210, Religion in America.

2. One course from Judaism or Christianity:
Relig 220, Introduction to the Bible.
Relig 242, History of Christianity.
Relig 280, Introduction to Catholicism.
Relig 321, Old Testament.
Relig 322, New Testament.
Relig 333, Introduction to Judaism.

3. Either 356, African Religions or 358, Introduction to Islam.

4. Either 352, Religious Traditions of India or 353, Buddhism.

5. One course from Religion, Culture, and Society.
Relig 328, American Indian Religions.
Relig 334, African American Religious Experience.
Relig 336, Women and Religion.
Relig 339, Goddess Religions.
Relig 342, Religion and U.S. Lation/a Literature.
Relig 370, Religion and Politics.
Relig 377, Social Dimensions of Religion.
Relig 384, Religion and Ecology.

6. Relig 385, Theory and Methods in the Study of Religion.

7. Three hours of Relig 475, Seminar.

8. A minimum of 12 credits of elective Religious Studies courses.

The program offers a minor which may be earned by completing a total of 15 credits in religious studies including either Relig 205 or 210. Nine hours must be in courses at the 300 level or above (no more than 3 hours of seminar and no more than 3 hours of independent study).

Communication Proficiency requirement: The department requires a grade of C or better in each of English 150 and 250 (or 250H), and requires one 300 level course in religious studies in which writing is evaluated as acceptable.

Students may choose to do a senior thesis under the supervision of a religious studies faculty adviser. This option may earn 3-6 credits toward the completion of the major.

Graduate Study

The program offers courses for nonmajor graduate credit in religious studies as supporting work in other fields. Religious studies may also be one of the three areas used for the interdisciplinary graduate studies master's degree.

Courses primarily for undergraduate students

Relig 205. Introduction to World Religions. (3-0) Cr. 3. F.S.SS. An introduction to the academic study of religions, including myths, beliefs, rituals, values, social forms. Examples chosen from oral cultures and major religions of the world.

Relig 210. Religion in America. (3-0) Cr. 3. F.S.SS. Introductory study of the major beliefs, practices, and institutions of American Judaism, Catholicism, Protestantism, and Islam with emphasis on the diversity of religion in America, and attention to issues of gender, race, and class.

Relig 220. Introduction to the Bible. (3-0) Cr. 3. F.S. Basic overview of the contents of the Old and New Testament in light of their ancient socio-historical background, and with attention to a variety of interpretations and relevance to modern American society.

Relig 242. History of Christianity. (3-0) Cr. 3. F.S.SS. An introduction to Christian thought and practice from an historical point of view, stressing the development of belief, spirituality, and organization, and the continuities and changes involved in these developments.A. The Early Church through the Medieval period. B. The Reformation period to the present time.

Relig 280. Introduction to Catholicism. (3-0) Cr. 3. F. An explanation of the beliefs, spirit, and practices of Roman Catholicism, including its understanding of God, sacramentality, the human person, and community, and its relationship to other forms of Christianity and other world religions.

Relig 321. Old Testament. (3-0) Cr. 3. F. An in-depth study of the literature and religion of ancient Israel in light of recent archaeological discoveries, research about the ancient Near East, and a variety of interpretations. Nonmajor graduate credit.

Relig 322. New Testament. (3-0) Cr. 3. S. A detailed survey of the sacred scriptures of Christianity in light of recent archaeological discoveries and historical research about their Greco-Roman and Jewish background. Nonmajor graduate credit.

Relig 323. Science and Religion. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of changing interplay of science and religion in our understanding nature, from the trial of Galileo to the reception of Darwin.

Relig 328. American Indian Religions. (Cross-listed with Am In). (3-0) Cr. 3. An introduction to the beliefs and rituals of Native American religious traditions, with attention to cultural and historical contexts and implications. Nonmajor graduate credit.

Relig 333. Introduction to Judaism. (3-0) Cr. 3. An introduction to basic Judaism. Special attention is given to Jewish sacred texts, rituals, social practices, and modern forms.

Relig 334. African American Religious Experience. (Cross-listed with Af Am). (3-0) Cr. 3. F. *Prereq: Prior course work in Religious Studies or African American Studies required.* Examination of the African American experience from the perspective of black religion and the black church, with attention to political, economic, and social, as well as spiritual, concerns. Nonmajor graduate credit.

Relig 336. Women and Religion. (Cross-listed with W S). (3-0) Cr. 3. F. *Prereq: 105, 210 or W S 201 recommended.* Examines the status of women in various religions, feminist critiques of religious structures and belief systems, and contemporary women's spirituality movements. Nonmajor graduate credit.

Relig 339. Goddess Religions. (Cross-listed with W S). (3-0) Cr. 3. *Prereq: Relig 205 recommended.* Exploration of the foundational myths of Goddess spirituality, including historical and cross-cultural female images of the divine and their modern usage by American women. Nonmajor graduate credit.

Relig 340. Magic, Witchcraft, and Religion. (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 201 or 306.* Origin and development of indigenous magico-religious systems; myth and ritual; therapeutic aspects; symbols and meanings; religion and sociocultural change, including acculturation, nativistic, and revitalization movements.

Relig 342. Religion and U.S. Latino/a Literature. (3-0) Cr. 3. Alt. S., offered 2010. A study of the religious behavior and attitudes expressed in the literature of Mexican Americans, Puerto Ricans, Cuban Americans and other groups of people living in the U.S. who trace their ancestry to the Spanish-speaking countries of Latin America. Nonmajor graduate credit.

Relig 348. Psychology of Religion. (Cross-listed with PSYCH). (3-0) Cr. 3. *Prereq: Nine credits in psychology.* Survey of psychological theory and research investigating religious and spiritual attitudes, beliefs and practices.

Relig 350. Philosophy of Religion. (Cross-listed with Phil). (3-0) Cr. 3. F. *Prereq: Phil 201.* The value and truth of religious life and belief. Mystical experience; religious faith and language; arguments for God's existence; the problem of evil; miracles; and religion and morality. Historical and contemporary readings. Nonmajor graduate credit.

Relig 352. Religious Traditions of India. (3-0) Cr. 3. *Prereq: Prior course work in Asian, Asian-American or Religious Studies or Anthropology required.* Examines the religious traditions of India, including Hinduism, Jainism, and Skihism, through text, ritual, and contemporary practice. Nonmajor graduate credit.

Relig 353. Buddhism. (3-0) Cr. 3. S. The various Buddhist paths to realize enlightenment and freedom. Special attention to meditation and yoga and their relationship to altered states of consciousness and to social contexts. Nonmajor graduate credit.

Relig 356. African Religions. (3-0) Cr. 3. *Prereq: Prior course work in African, African-American or Religious Studies or Anthropology required.* An introduction to the teachings, practices, and history of the religions that originated in Africa and other religions which have gained substantial followings among African peoples. Nonmajor graduate credit.

Relig 358. Introduction to Islam. (3-0) Cr. 3. An introduction to Islamic religion, culture, and society from 700 to the present. Nonmajor graduate credit.

Relig 360. Religious Ethics. (3-0) Cr. 3. Investigates different religious ethical theories and traditions of reasoning about practical moral issues (e.g., abortion, the just distribution of wealth, environmental ethics). Explores in detail the relationship between religious beliefs and moral practice.

Relig 367. Christianity in the Roman Empire. (Cross-listed with Cl St). (3-0) Cr. 3. An historical introduction to the rise of Christianity in the Roman empire, with special attention to the impact of Greco-Roman culture on the thought and practice of Christians and the interaction of early Christians with their contemporaries. Nonmajor graduate credit.

Relig 370. Religion and Politics. (Cross-listed with Pol S). (3-0) Cr. 3. *Prereq: Relig 105 or 210 recommended.* The interaction of religion and politics in the U.S. from both an historical and contemporary perspective, as well as the role of religion in politics internationally. Nonmajor graduate credit.

Relig 376. Classical Archaeology. (Cross-listed with Cl St, Hist). (3-0) Cr. 3. Repeatable. S. Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.
A. Bronze Age (Minoan and Mycenaean palatial cultures) and Early Iron Age Greece. (ca 3000-700 BC).
B. Archaic through Hellenistic Greece (ca 700-30 BC).

Relig 377. Social Dimensions of Religion. (Cross-listed with Soc). (3-0) Cr. 3. *Prereq: Prior course work in Religious Studies or Sociology required.* The influence of religion in society, both as a conservator of values and as a force for social change. Nonmajor graduate credit.

Relig 380. Catholic Social Thought. (3-0) Cr. 3. S. Examines biblical roots of and major developments in Catholic social thought. Contemporary issues such as human rights, economic justice, the environment, and war and peace will be treated using principles of Catholic ethics, social analysis, official church documents, and contributions of notable theologians and activists. Nonmajor graduate credit.

Relig 384. Religion and Ecology. (Cross-listed with Env S). (3-0) Cr. 3. Introduction to concepts of religion and ecology as they appear in different religious traditions, from both a historical and contemporary perspective. Special attention to religious response to contemporary environmental issues. Nonmajor graduate credit.

Relig 385. Theory and Method in Religious Studies. (3-0) Cr. 3. *Prereq: 6 credits in Religious Studies or permission of instructor.* Examines the variety of theories and methods employed in the study of religion. Application of these methods to various religions of the world. Nonmajor graduate credit.

Relig 475. Seminar: Issues in the Study of Religion. (3-0) Cr. 3. *Prereq: 6 credits in religious studies.* Topic changes each time offered. Closed to freshmen. Sophomores must have approval of instructor. Nonmajor graduate credit.

Relig 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in religious studies, and permission of instructor, approval of professor in charge of program.* Guided reading and research on special topics selected to meet the needs of advanced students. No more than 9 credits of Relig 490 may be counted toward graduation.
H. Honors

Relig 491. Senior Thesis. Cr. 3. Written under the supervision of a Religious Studies faculty advisor.

Relig 494. Special Studies in Religious Research Languages. Cr. arr. Repeatable. *Prereq: 6 credits in Religious Studies and permission of instructor.*

Relig 499. Peace and Justice Internship. Cr. arr. Repeatable. *Prereq: 3 credits in religious studies, permission of faculty internship coordinator.* Supervised placement with a peace and justice agency; structured reflection on the relation of religion and practical social issues. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Relig 590. Special Topics in Religious Studies. Cr. arr. Repeatable. *Prereq: Permission of instructor, 9 credits in religious studies.*

Physics and Astronomy

www.physics.iastate.edu/

Joseph Shinar, Chair of Department

Distinguished Professors: Canfield, Goldman, Harmon, Ho, Johnston, Soukoulis

Distinguished Professors (Emeritus): Clem, Finnemore, Lynch, Swenson

University Professor: Willson

Professors: Anderson, Carter-Lewis, Crawley, Hauptman, Hill, Kawaler, Krennrich, Lajoie, Luban, Ogilvie, Qiu, Rosenberg, Schmalian, Shinar, Struck, Tringides, Valencia, Vary, Whisnant, Wolford

Professors (Adjunct): Meyer, Vaknin

Professor (Collaborator): Womersley

Associate Professors: Cochran, Mcqueeney, Pohl, Prell, Rosati, Travesset-Casas

Associate Professors (Adjunct): Biswas, Budko, Kogan

Assistant Professors: Kaminski, Kerton, Prozorov, Sivasankar, Tuchin, Wang, Yu

Assistant Professor (Adjunct): Kreyssig

Senior Lecturers: Atwood, Herrera-Siklody

Lecturers: Fretwell, Frishman, Levin, Meyers, Schuler, Shirokov

Undergraduate Study

For the undergraduate curriculum in liberal arts and sciences, major in physics, leading to the degree bachelor of science, see *Liberal Arts and Sciences, Curriculum.*

Physics and astronomy are basic natural sciences which attempt to describe and provide an understanding of both our world and our universe. Physics serves as the underpinning of many different disciplines including the other natural sciences

and technological areas. Graduates are proficient in the methods of rigorous scientific analysis, relevant mathematical techniques, and modern computational and laboratory methods. They have a broad knowledge of physics, including mechanics, electricity and magnetism, thermodynamics, and modern physics. They are able to communicate clearly and effectively at general and technical levels. They are prepared to pursue a wide range of careers as a professional physicist, astronomer, or science educator. They are also prepared to pursue advanced studies and careers in areas as diverse as engineering, medicine, law, and business administration.

Many opportunities exist for students who terminate their studies with a bachelor's degree, especially when combined with technology studies in other areas. Students who meet the necessary scholastic standards often continue their studies in a graduate college, exploring and contributing to new developments in the field.

The department normally expects each student majoring in physics to complete at least the following courses: Phys 221, 222, 321, 321L, 322, 322L, 304, 306, 361, 362, 364, 365, and three credits of laboratory work chosen from 310, 311, 311T, 470L, or Astro 344L. All students are required to earn at least 5 credits in laboratory work in physics in addition to the laboratory components of Phys 221 and 222. These 5 credits must be in courses numbered 300 or higher or in approved substitutions. All students must earn at least 20 credits in physics and astronomy courses numbered 304 or higher. The basic list of expected courses is not a rigid requirement and changes in this basic list will be approved by the department curriculum committee on recommendation of the student's adviser when such changes will better serve the student's needs. In particular, students planning a physics major and also seeking certification for high school teaching may, with the approval of their adviser, follow a significantly different program designed to meet their particular needs; these students should consult the department for further information. Further information concerning programs of study, including sample degree programs, is available from the department.

Students majoring in physics who wish an emphasis in astronomy/astrophysics should consider a minor in astronomy (see below). Those planning graduate work in physics or astronomy/astrophysics should add to the basic list the courses Phys 480 and 481. Other useful courses include Phys 496, Math 365, 426, and 471, and Stat 447. One or more of Astro 405, Phys 511 or 526 may also be added according to interest.

The department offers a minor in physics which may be earned by completing 20 credits in physics courses chosen as follows: Phys 221, 222; 321; at least one credit of laboratory chosen from 321L, 322L, 310, 311, and 311T. Other acceptable courses are 304, 306, 322, 361, 362, 364, 365, 480, 481, and 496.

The department offers a minor in astronomy which may be earned by completing 15 credits chosen as follows: a total of 12 or more credits in Astro courses (must include Astro 344L and may include one of the courses Astro 120, Astro 150 or Astro 250), with the remaining 3 credits (if applicable) chosen from among Physics 304, 321, 361, 362, 364, 365, 480, 481, or 496; 12 or more credits must be at the 300 level or higher. Note that the same course may not be used to satisfy both the requirements of a physics major and an astronomy minor.

Communication Proficiency requirement: The department requires a grade of C or better in each of Engl 150 and 250 (or 250H), and a C– or better in Engl 302, 305, 309 or 314. Students are also encouraged to study at least one foreign language.

The expected outcomes for students in these programs are: (1) a broad knowledge of physics, including mechanics, electricity and magnetism, thermodynamics, wave motion and modern physics; (2) proficiency in laboratory methods; (3) proficiency in modern scientific computational methods; and (4) a sound foundation in the liberal arts including proficiency in communication skills.

In addition to the performance on exams and course grades, information on evaluating of the success in meeting these goals is obtained by: (1) an annual written survey of all students majoring in the program: (2) an annual written survey of all graduating seniors; (3) a periodic written survey of program alumni; (4) student evaluations of all courses; (5) adviser evaluations; and (6) a bimonthly meeting of program majors with the department chair.

Graduate Study

The department offers studies for the degrees master of science and doctor of philosophy with majors at both levels in applied physics, astrophysics, condensed matter physics, high energy physics, nuclear physics, and physics; and minor credit courses for students majoring in other departments.

Facilities of various research groups of the department, the Ames Laboratory, and the Applied Science Center, including the Microelectronics Research Center, are available for research.

Students with bachelor's degrees in physics or astronomy from other institutions ordinarily will qualify for graduate study at Iowa State provided they have satisfactorily completed course work similar to that suggested for undergraduate majors here intending to go on to graduate school. In some cases additional instruction at the intermediate level may be required.

Graduates have a broad understanding of physical science, as well as mastery of state-of-the-art methods in their area of specialization. They are able to communicate effectively to a wide range of audiences, from the general public to research colleagues. Their skills in rigorous scientific thinking prepare them for leadership in the broader community. They are skilled in carrying out research, communicating research results, and soliciting research support. They have considerable teaching experience. They have developed problem solving skills that prepare them for careers in either industry or academia.

All candidates for an advanced degree in physics are expected to complete Phys 531, 564, 571, 572, 591 and 592. Candidates for an advanced degree in applied physics are expected to complete Phys 571, 591, 470L (6 cr.), 699 (3 cr.), and either 572. Candidates for an advanced degree in astrophysics should complete Phys 531 and/or 564, Phys 571, Phys 591, Astro 505, and Astro 510. Astrophysics Ph.D. candidates must take at least three of the 580 level Astro courses, while candidates for the Research Masters must take at least two 580 level Astro courses.

Except for the applied physics major where a thesis is always required, the degree master of science is offered both with and without thesis. For all areas of study except applied physics the basic requirements for the M.S. are the same: at least 30 credits of acceptable graduate work must be completed, not less than 21 of which must be in physics or astronomy. Students must complete not less than 6 credits from outside their major area, with 3 credits being required from outside the department, and 3 credits from a 500 or 600 level course in another area of specialization. Students choosing a M.S. degree with thesis may apply up to 8 credits of 699 but no credits of 599 toward the minimum 30 credits. Students choosing a degree without thesis should apply 2 credits of 599, but may not apply any credits of 699 toward the minimum 30 credits.

Students whose major area is applied physics must complete at least 30 credits of acceptable graduate work for the M.S. degree and not less than 19 credits of these must be in the required courses listed above; the remaining 11 credits of the 30 credit minimum may be chosen freely either from within the student's major area or from without and either from the department or outside, but it should be noted that not more than 3 credits of Phys 699 may be applied toward the 30 credit minimum.

In addition to course work in the major area of study, all candidates for the Ph.D. degree must complete 12 credits from outside this area. Of these 6 must be taken from other departments and 6 must be taken from the department with the additional constraint that this latter 6 must include at least one 500 or 600 level introductory course in another area of specialization. Each candidate for the Ph.D. degree is required to teach one year of elementary physics or astronomy.

Graduate students interested in a physics minor should contact the department for requirements.

Astronomy and Astrophysics (Astro)

Courses primarily for undergraduate students

Astro 102. North Star Astronomy. Cr. 1. F.S. An entirely WEB-based course covering topics in observing the sky and navigation by the stars for students with little or no previous experience. The course combines material on common naked-eye phenomena, such as daily and seasonal variations in the sky, with information on how these helped navigators determine where they are on Earth. The course "lectures" are on-line, interactive units with build in exercises, hands-on (offline) activities and layers of help. Graded homework and quizzes are administered via Web-CT. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

Astro 103. Evening Star. Cr. 1. F.S. An entirely web-based course covering topics in celestial mechanics. ("Rocket science!") For students with little or no previous experience. It combines the geography of the solar system with discussion of methods of traveling to the other planets. The course "lectures" are on-line, interactive units with built-in exercises, hands-on (offline) activities, and layers of help. Graded homework and quizzes are administered via WebCT. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

Astro 120. The Sky and the Solar System. (3-0) Cr. 3. F.S.SS. For the nonscientist. The sky: constellations; motions of the sun, moon, and planets; seasons and the calendar; eclipses. The solar system: origin and evolution; characteristics of the sun, planets, satellites, comets, meteorites, and asteroids. Extensive use of the planetarium is included. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

Astro 125L. The Sky and the Solar System Laboratory. (0-2) Cr. 1. F.S. *Prereq: Concurrent or previous enrollment in Astro 120.* Laboratory course to accompany Astro 120. Students carry out practical exercises involving naked eye and telescopic observing to explore and reinforce ideas covered in Astro 120. Activities based on a sky-simulation computer program and other weather-independent exercises are also included.

Astro 150. Stars, Galaxies, and Cosmology. (3-0) Cr. 3. F.S. For the nonscientist. Observational aspects of stellar astronomy: motions, distances, sizes, spectra; types of stars; variability; binary systems. Stellar evolution: the birth, life, and death of stars, including supernovae, neutron stars, and black holes. The Milky Way Galaxy: clouds of matter in space, the structure and evolution of our galaxy. Other galaxies, clusters of galaxies, quasars. Theories of the origin of the universe.

Astro 250. Astronomy Bizarre. (3-0) Cr. 3. S. *Prereq: 120 or 150.* For the nonscientist. New and exciting topics in modern astronomy. Galaxy and star formation. Black holes and pulsars. Colliding galaxies. Quasars. Cosmology, the Big Bang and the future of the universe. Prospects and searches for extraterrestrial life.

Astro 290. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

Astro 342. Introduction to Solar System Astronomy. (3-0) Cr. 3. F. *Prereq: Phys 222.* Analytical and comparative studies of solar system objects-planets, satellites, rings, asteroids, comets, meteoroids, and interplanetary dust-with emphasis on the physical processes affecting them, their interactions, and their evolution. Orbital mechanics, including perturbations, stability, and resonances. Tidal forces and effects. Radiation laws and thermal physics with applications. Brief study of the sun as a star, and of stellar evolution. Origin and evolution of the solar system. Detection of other planetary systems. Nonmajor graduate credit.

Astro 344L. Astronomy Laboratory. (1-6) Cr. 3. F. *Prereq: Phys 222.* Experiments in optical astronomy. Observational techniques, ranging from stellar photometry to CCD imaging. Available instruments include a variety of small telescopes up to 14-inch in size. Class meets at Fick Observatory south of Boone. Nonmajor graduate credit.

Astro 346. Introduction to Astrophysics. (3-0) Cr. 3. S. *Prereq: Phys 222.* Basic radiation theory; spectra. Observational determination of stellar properties; spectral classification. Binary systems. Stellar structure and evolution. White dwarfs, neutron stars, black holes. The Galaxy: structure and composition; the interstellar medium. Other galaxies; active galaxies; cosmology. Nonmajor graduate credit.

Astro 405. Astrophysical Processes. (Dual-listed with 505). (3-0) Cr. 3. F. *Prereq: 346 or permission of instructor.* Survey of astrophysical processes relating to stars, galaxies and the Universe. Radiation transport, radiation processes, scattering, kinetic description of plasma, hydrodynamics, magnetohydrodynamics, MHD waves, shocks, properties of systems in local thermodynamic equilibrium, non-thermal systems, astrophysical effects of general relativity.

Astro 450. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Research under supervision of astronomy faculty.

Astro 450L. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: 344L and permission of instructor.* Laboratory or observational project under supervision of astronomy faculty.

Astro 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in astronomy, permission of instructor.* No more than 9 credits of Astro 490 may be counted toward graduation.
H. Honors

Courses primarily for graduate students, open to qualified undergraduate students

Astro 505. Astrophysical Processes. (Dual-listed with 405). (3-0) Cr. 3. F. *Prereq: 346 or permission of instructor.* Survey of astrophysical processes relating to stars, galaxies and the Universe. Radiation transport, radiation processes, scattering, kinetic description of plasma, hydrodynamics, magnetohydrodynamics, MHD waves, shocks, properties of systems in local thermodynamic equilibrium, non-thermal systems, astrophysical effects of general relativity.

Astro 510. Observational Astrophysics. (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 405 or 505.* Techniques in optical and near-IR astronomy, including spectroscopy and CCD photometry. Emphasis on projects involving proficiency in the use of research telescopes and modern instrumentation. Project topics range from photometric studies of pulsating and binary star systems to deep CCD imaging of faint nebulae and galaxies.

Astro 580. Stellar Astrophysics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 405 or 505.* The interior structure and atmospheric properties of stars: Stellar structure equations and constitutive relations: energy generation, energy transport by radiation and convection; equation of state, nuclear energy generation and nucleosynthesis. Numerical and analytic solutions to the equations of structure and evolution. Observational connections through the theory of radiative transfer. Line and continuum processes and sources of opacity. Non-LTE and statistical equilibrium. Line profiles. Interpretation of stellar spectra: temperature, pressure, and abundance determinations. Stellar evolution from formation to final phases.

Astro 582. High Energy Astrophysics. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 405 or 505.* Interactions of high-energy particles, non-thermal radiation processes, spectral evolution of non-thermal systems, cosmic rays, active galactic nuclei, pulsars, neutrinos, measurement techniques for relativistic charged particles, high energy photons, and neutrinos.

Astro 584. Galactic Astronomy. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 405 or 505.* Overall structure of our Galaxy and the interstellar medium. Physical processes in the interstellar medium (e.g., heating and cooling mechanisms, turbulence). Observational techniques for studying the interstellar medium. Kinematics and chemical evolution of the Galaxy.

Astro 586. Extragalactic Astronomy. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 405 or 505.* Galaxy evolution, dynamics of external galaxies, evolution and classification of galaxies, groups and clusters of galaxies, extragalactic radio sources, quasars, structure formation, cosmological models and their observational consequences.

Astro 590. Special topics. Cr. arr. Repeatable.

Astro 599. Creative Component. Cr. arr. *Prereq: Permission of instructor.* Individually directed study of research-level problems for students electing the nonthesis M.S. option in astronomy.

Astro 650. Advanced Seminar. (1-0) Cr. 1. Repeatable. F.S. Topics of current interest in astronomy and astrophysics. Satisfactory-fail only.

Astro 660. Advanced Topics in Astronomy and Astrophysics. Cr. arr. Repeatable. F.S. Topics in stellar, galactic, and extragalactic astronomy, including stellar evolution, solar physics, variable stars, compact objects, the interstellar medium, active galaxies and quasars, formation and evolution of galaxies, cosmology, high energy astrophysics, advanced observational techniques, and astrophysical applications of hydrodynamics.

Astro 675. Advanced Stellar Astrophysics. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 405 or 505 and 580.* Advanced topics in stellar astrophysics. Dynamic and extended atmospheres, chromospheres, coronae, and stellar winds. MHD, stellar activity, and dynamo theory. Radiative transfer and the transition from extended atmospheres to the interstellar medium. Diffusive processes in stellar atmospheres and interiors. Techniques for quantitative analysis of planetary and stellar spectra including detailed modeling and spectrum synthesis. Evolution in interacting binaries. Nucleosynthesis II. Variable stars. Supernovae. Neutron stars and black holes.

Astro 699. Research. Cr. arr. Repeatable.

Physics (Phys)

Courses primarily for undergraduate students

Phys 101. Physics for the Nonscientist. (3-0) Cr. 3. F.S. Survey of the principal areas of both classical and modern physics. Emphasis on the nature of the physical universe and the application of physical principles to life in the modern world. Not suitable to meet a general physics requirement for natural science majors.

Phys 106. The Physics of Common Experience. (4-2) Cr. 4. F.S. Elementary topics from mechanics, heat, electricity, sound, and light, emphasizing the use of basic principles to understand everyday experience. Includes practical problem exercises and a coordinated laboratory. Not suitable to meet a general physics requirement for natural science majors.

Phys 111. General Physics. (4-2) Cr. 4. F.S.SS. *Prereq: 1 1/2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry.* General background in physical concepts, principles, and methods for those who do not plan advanced study in physics or engineering. Mechanics, fluids, heat and thermodynamics, vibrations, waves, sound.

Phys 112. General Physics. (4-2) Cr. 4. F.S.SS. *Prereq: 111.* General background in physical concepts, principles, and methods for those who do not plan advanced study in physics or engineering. Electricity and magnetism, ray and wave optics, topics in modern physics.

Phys 198. Physics of Music. (2-2) Cr. 3. F. Introductory level course on sound for nonphysics majors. Properties of pure tones and harmonics; human perception of sound; room acoustics; scales; production, and analysis of musical by voice, string, woodwind, brass, and percussion instruments. Not suitable to meet a general physics requirement for natural science majors.

Phys 199. Introductory Seminar. Cr. R. F. (1-1) Gain experience in key skills that physicists/astronomers use routinely, but are rarely explicitly taught in formal courses. Participate in faculty-led discussions on frontier areas and careers. Satisfactory-fail only.

Phys 221. Introduction to Classical Physics I. (4-1) Cr. 5. F.S.SS. *Prereq: Credit or enrollment in Math 166.* For engineering and science majors. 3 hours of lecture each week plus 3 recitations and 1 laboratory every 2 weeks. Elementary mechanics including kinematics and dynamics of particles, work and energy, linear and angular momentum, conservation laws, rotational motion, oscillations, gravitation. Heat, thermodynamics, kinetic theory of gases; waves and sound.
H. Honors. F.S.

Phys 222. Introduction to Classical Physics II. (4-2) Cr. 5. F.S.SS. *Prereq: 221, Math 166.* 3 hours of lecture each week plus 1 recitation and 1 laboratory each week. Electric forces and fields. Electrical currents; DC circuits. Magnetic forces and fields: LR, LC, LCR circuits; Maxwell's equations; ray optics and image formation; wave optics: topics in modern physics.
H. Honors. F.S.

Phys 290. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

Phys 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Phys 302. The Challenge of Contemporary Physics. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* A largely nonmathematical but intellectually challenging exploration of physics, which assumes no previous work in the field. Selected material from classical and modern physics establishes the conceptual framework for the study of major areas of contemporary physics, culminating in the discussion of topics at the frontier of present knowledge. Topics vary yearly and

may include quarks, lasers, superconductivity, fission and fusion, solid state devices, gravitational waves, string theory, facilities, left handed materials, and quantum computing. Not suitable to meet a general physics requirement for natural science majors.

Phys 304. Thermal Physics. (3-0) Cr. 3. F. *Prereq: 222, Math 266.* Concepts of temperature, entropy, and other characteristic thermodynamic functions, with application to macroscopic properties of matter. The laws of thermodynamics. Introduction to statistical mechanics, including quantum statistics. Application to black body radiation, crystalline vibrations, magnetic ions in solids, electronic heat capacity of metals. Phase transformations and chemical reactions. Nonmajor graduate credit.

Phys 306. Physics of Wave Motion. (3-0) Cr. 3. S. *Prereq: 222, credit or enrollment in Math 267.* Oscillating systems including damped and forced oscillations; fluids, geometric optics, water waves, the wave equation, Fourier and Laplace transforms, non-uniform media, cylindrical and spherical waves, polarization, interference and diffraction, transmission lines, non-linear waves.

Phys 310. Electronic Instrumentation for Experimental Physics. (2-4) Cr. 4. F. *Prereq: 222; Math 166.* Common electrical instruments; power supplies; transducers; passive and active devices, analog integrated circuits, including filters and amplifiers; digital integrated circuits; signal transmission and enhancement. Nonmajor graduate credit.

Phys 311. Intermediate Laboratory. Cr. arr. Repeatable. S. *Prereq: 322.* Experiments in classical and modern physics performed independently by each student. Nonmajor graduate credit.

Phys 311T. Intermediate Laboratory. (0-6) Cr. 3. Repeatable. S. *Prereq: 112 or 222.* Experiments in classical and modern physics performed independently by each student. For students preparing for a career in high school teaching.

Phys 321. Introduction to Modern Physics I. (3-0) Cr. 3. F. *Prereq: 222, credit or enrollment in Math 266.* Quantum nature of matter: photons, de Broglie's postulate: wave-like properties of matter; Bohr's model of hydrogen atom; Schrodinger equations in one dimension: energy quantization; detailed solutions for potential steps, barriers and wells; one-electron atoms, spin and magnetic interactions; ground states, optical and x-ray excitations of multi-electron atoms.

Phys 321L. Introductory Laboratory in Modern Physics. (0-2) Cr. 1. F. *Prereq: Credit or enrollment in 321.* Experiments related to the foundations of modern physics. The dual wave and particle character of electrons and photons, statistics, interferometry and x-ray spectroscopy.

Phys 322. Introduction to Modern Physics II. (3-0) Cr. 3. S. *Prereq: 321.* Quantum statistics; lasers; physics of molecules. Properties of solids, including electron band structure, superconductivity and magnetism. Nuclear physics, including nuclear sizes and masses, stability, decay modes, reactions, fission and fusion. Elementary particles, including strangeness, charm, and quarks. Fundamental forces of nature.

Phys 322L. Introductory Laboratory in Modern Physics II. (0-2) Cr. 1. S. *Prereq: Credit or enrollment in 322.* Experiments related to the foundations of modern physics. Radioactive decay, elementary particles, Hall effect, quantization, spectroscopy, statistics and instrumentation.

Phys 361. Classical Mechanics. (3-0) Cr. 3. F. *Prereq: 222, Math 265, 266.* Newtonian mechanics including forced oscillations, central forces and orbital motion, collisions, moving frames of reference, Lagrange's equations. Nonmajor graduate credit.

Phys 362. Intermediate Mechanics. (3-0) Cr. 3. S. *Prereq: 361.* Rigid body motion; small oscillations, normal modes. Special relativity including length contraction, time dilation, simultaneity, Lorentz transformation, 4-vector covariant formalism, relativistic mechanics. Nonmajor graduate credit.

Phys 364. Electricity and Magnetism I. (3-0) Cr. 3. F. *Prereq: 222, Math 385 or Math 395.* Static electric and magnetic fields, potential theory; electromagnetism, Maxwell's equations. Nonmajor graduate credit.

Phys 365. Electricity and Magnetism II. (3-0) Cr. 3. S. *Prereq: 364.* Relativistic electromagnetic theory; radiation and propagation of electromagnetic waves; interaction with matter. Nonmajor graduate credit.

Phys 389. Seminar. Cr. R. S. (1-0) Required of all junior physics majors. Career opportunities: graduate school programs and application, job placement, alternative careers, basic skills needed for the job market competition. Satisfactory-fail only.

Phys 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Phys 399. Seminar on Secondary School Physics. Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Review of materials and curricula for secondary school physics presented and discussed by members of the class. Required for approval to teach physics in secondary schools.

Phys 432. Molecular and Cell Biophysics. (Dual-listed with 532). (3-0) Cr. 3. S. *Prereq: 304 or Chem 325..* Quantitative description of biological systems using basic physical laws, including a brief discussion of a variety of biophysical techniques. Topics include: thermodynamics, chemical equilibrium, gene expression, structure and physical properties of nucleic acids and proteins, folding of nucleic acids and proteins, chemical kinetics, catalysis, allosteric enzymes, cell membrane structure and physical properties, and machines in cell membranes. Nonmajor graduate credit.

Phys 450. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Theoretical research under supervision of physics faculty.

Phys 450L. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: 311, permission of instructor.* Laboratory project under supervision of physics faculty.

Phys 470L. Applied Physics Laboratory. Cr. arr. Repeatable. F.S.SS. *Prereq: 322 and permission of instructor.* Studies in modern experimental techniques via experimentation and simulation in various areas of applied physics, e.g. superconductivity, optical spectroscopy, nuclear magnetic resonance, electron spin resonance, x-ray diffraction, and computation of electronic and structural properties of matter.

Phys 480. Quantum Mechanics I. (3-0) Cr. 3. F. *Prereq: 322, Math 385.* First semester of a full-year course. A systematic development of the formalism and applications of quantum mechanics. Solutions to the time independent Schrodinger equation for various one-dimensional potentials including the harmonic oscillator; operator methods; Heisenberg picture; angular momentum; the hydrogen atom; spin; symmetry properties. Nonmajor graduate credit.

Phys 481. Quantum Mechanics II. (3-0) Cr. 3. S. *Prereq: 480.* Continuation of 480. Addition of angular momentum; charged particles in electromagnetic fields; time-independent perturbation theory; variational principles; WKB approximation; interaction picture; time-dependent perturbation theory; adiabatic approximation; scattering; selected topics in radiation theory; quantum paradoxes. Nonmajor graduate credit.

Phys 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in physics, permission of instructor.* No more than 9 credits of Phys 490 may be counted toward graduation.
H. Honors

Phys 496. Modern Optics. (Cross-listed with E E). (3-0) Cr. 3. *Prereq: Credit or enrollment in Phys 322 and 365.* Review of wave and electromagnetic theory; topics selected from: reflection/refraction, interference, geometrical optics, Fourier analysis, dispersion, coherence, Fraunhofer and Fresnel diffraction, holography, quantum optics, nonlinear optics. Nonmajor graduate credit.

Phys 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduate students

Phys 501. Oral Communication of Physics Seminar. (2-0) Cr. 1. Repeatable. F. A practical introduction to communication methods in physics and astronomy classrooms and professional settings. For graduate physics majors only. Satisfactory-fail only.

Phys 502. Introductory Research Seminar. Cr. R. F. (1-1) Discussion by research staff of their research areas, expected thesis research work, and opportunities in the field. For graduate physics majors only. Satisfactory-fail only.

Phys 511. Condensed Matter Physics I. (3-0) Cr. 3. S. *Prereq: 304, credit or enrollment in 481.* First semester of a full-year course. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

Phys 512. Condensed Matter Physics II. (3-0) Cr. 3. F. *Prereq: 511.* Continuation of 511. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

Phys 526. Particle and Nuclear Physics. (4-0) Cr. 4. S. *Prereq: Credit or enrollment in 481.* Basic properties and structures of nuclei, hadrons, and elementary particles; weak and strong interactions; the Standard Model; accelerators and detectors; nuclear models; nuclear decay and stability; nuclear astrophysics; the Higgs mechanism; the CKM matrix; running coupling constants; relativistic heavy-ion collisions; selected topics beyond the standard model such as SUSY and grand unification.

Phys 531. Statistical Mechanics. (3-0) Cr. 3. S. *Prereq: 304 and credit or enrollment in 481, Math 465, credit or enrollment in Math 365 or 426.* Thermodynamic properties of systems of many particles obeying Boltzmann, Fermi-Dirac, and Bose-Einstein statistics; microcanonical, canonical, and grand canonical ensembles and their application to physical problems; density matrices; introduction to phase transitions; renormalization group theory; kinetic theory and fluctuations.

Phys 532. Molecular and Cell Biophysics. (Dual-listed with 432). (3-0) Cr. 3. S. *Prereq: 304 or Chem 325..* Quantitative description of biological systems using basic physical laws, including a brief discussion of a variety of biophysical techniques. Topics include: thermodynamics, chemical equilibrium, gene expression, structure and physical properties of nucleic acids and proteins, folding of nucleic acids and proteins, chemical kinetics, catalysis, allosteric enzymes, cell membrane structure and physical properties, and machines in cell membranes.

Phys 534. Symmetry and Group Theory in Physics. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 481.* Theory of groups and group representations; introduction to both point and continuous groups, and their applications in physics.

Phys 535. Physics of Semiconductors. (Cross-listed with E E). (3-3) Cr. 4. *Prereq: E E 311 and E E 332.* Basic elements of quantum theory, Fermi statistics, motion of electrons in periodic structures, crystal structure, energy bands, equilibrium carrier concentration and doping, excess carriers and recombination, carrier transport at low and high fields, phonons, optical properties, amorphous semiconductors, heterostructures, and surface effects. Laboratory experiments on optical properties, carrier lifetimes, mobility, defect density, doping density.

Phys 536. Physics of Semiconductor Devices. (Cross-listed with E E). (3-0) Cr. 3. *Prereq: E E 535.* P-n junctions, band-bending theory, tunneling phenomena, Schottky barriers, heterojunctions, bipolar transistors, field-effect transistors, negative-resistance devices and optoelectronic devices.

Phys 541. General Relativity. (3-0) Cr. 3. F. *Prereq: 362 or Math 465.* Tensor analysis and differential geometry developed and used to formulate Einstein field equations. Schwarzschild and Kerr solutions. Other advanced topics may include gravitational radiation, particle production by gravitational fields, alternate gravitational theories, attempts at unified field theories, cosmology.

Phys 551. Computational Physics. (0-4) Cr. 2. S. *Prereq: 365, credit or enrollment in 481.* Use of modern computational techniques to analyze topics in classical and modern physics. Satisfactory-fail only.

Phys 564. Advanced Classical Mechanics. (3-0) Cr. 3. F. *Prereq: 362, Math 426, 465.* Variational principles, Lagrange's equations, Hamilton's canonical equations, canonical transformations, Hamilton-Jacobi theory, infinitesimal transformations, classical field theory, canonical perturbation theory, classical chaos.

Phys 571. Electricity and Magnetism I. (3-0) Cr. 3. F. *Prereq: 365, Math 426.* Electrostatics, magnetostatics, boundary value problems, Maxwell's equations, wave phenomena in macroscopic media, wave guides.

Phys 572. Electricity and Magnetism II. (3-0) Cr. 3. S. *Prereq: 571.* Special theory of relativity, least action and motion of charged particles in electromagnetic fields, radiation, collisions between charged particles, multipole fields, radiation damping.

Phys 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics of current interest.
A. Nuclear Physics
B. Condensed Matter Physics
C. High Energy Physics
D. Physics
E. Applied Physics
F. Biophysics

Phys 591. Quantum Physics I. (4-0) Cr. 4. F. *Prereq: 481.* First semester of a full-year course. Postulates of quantum mechanics; time-dependent and time-independent Schrodinger equations for one-, two-, and three-dimensional systems; theory of angular momentum; Rayleigh-Schrodinger time-independent perturbation theory.

Phys 592. Quantum Physics II. (4-0) Cr. 4. S. *Prereq: 591.* Continuation of 591. Variational theorem and WKB method; time-dependent perturbation theory; method of partial waves and Born approximation for scattering by central potentials; identical particles and symmetry; Dirac and Klein-Gordon equation for free particles; path integral formalism.

Phys 599. Creative Component. Cr. arr. *Prereq: Permission of instructor.* Individually directed study of research-level problems for students electing the nonthesis M.S. degree option.

Courses for graduate students

Phys 501. Oral Communication of Physics Seminar. (2-0) Cr. 1. Repeatable. F. A practical introduction to communication methods in physics and astronomy classrooms and professional settings. For graduate physics majors only. Satisfactory-fail only.

Phys 502. Introductory Research Seminar. Cr. R. F. (1-1) Discussion by research staff of their research areas, expected thesis research work, and opportunities in the field. For graduate physics majors only. Satisfactory-fail only.

Phys 511. Condensed Matter Physics I. (3-0) Cr. 3. S. *Prereq: 304, credit or enrollment in 481.* First semester of a full-year course. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

Phys 512. Condensed Matter Physics II. (3-0) Cr. 3. F. *Prereq: 511.* Continuation of 511. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

Phys 526. Particle and Nuclear Physics. (4-0) Cr. 4. S. *Prereq: Credit or enrollment in 481.* Basic properties and structures of nuclei, hadrons, and elementary particles; weak and strong interactions; the Standard Model; accelerators and detectors; nuclear models; nuclear decay and stability; nuclear astrophysics; the Higgs mechanism; the CKM matrix; running coupling constants; relativistic heavy-ion collisions; selected topics beyond the standard model such as SUSY and grand unification.

Phys 531. Statistical Mechanics. (3-0) Cr. 3. S. *Prereq: 304 and credit or enrollment in 481, Math 465, credit or enrollment in Math 365 or 426.* Thermodynamic properties of systems of many particles obeying Boltzmann, Fermi-Dirac, and Bose-Einstein statistics; microcanonical, canonical, and grand canonical ensembles and their application to physical problems; density matrices; introduction to phase transitions; renormalization group theory; kinetic theory and fluctuations.

Phys 532. Molecular and Cell Biophysics. (Dual-listed with 432). (3-0) Cr. 3. S. *Prereq: 304 or Chem 325.*. Quantitative description of biological systems using basic physical laws, including a brief discussion of a variety of biophysical techniques. Topics include: thermodynamics, chemical equilibrium, gene expression, structure and physical properties of nucleic acids and proteins, folding of nucleic acids and proteins, chemical kinetics, catalysis, allosteric enzymes, cell membrane structure and physical properties, and machines in cell membranes.

Phys 534. Symmetry and Group Theory in Physics. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 481.* Theory of groups and group representations; introduction to both point and continuous groups, and their applications in physics.

Phys 535. Physics of Semiconductors. (Cross-listed with E E). (3-3) Cr. 4. *Prereq: E E 311 and E E 332.* Basic elements of quantum theory, Fermi statistics, motion of electrons in periodic structures, crystal structure, energy bands, equilibrium carrier concentration and doping, excess carriers and recombination, carrier transport at low and high fields, phonons, optical properties, amorphous semiconductors, heterostructures, and surface effects. Laboratory experiments on optical properties, carrier lifetimes, mobility, defect density, doping density.

Phys 536. Physics of Semiconductor Devices. (Cross-listed with E E). (3-0) Cr. 3. *Prereq: E E 535.* P-n junctions, band-bending theory, tunneling phenomena, Schottky barriers, heterojunctions, bipolar transistors, field-effect transistors, negative-resistance devices and optoelectronic devices.

Phys 541. General Relativity. (3-0) Cr. 3. F. *Prereq: 362 or Math 465.* Tensor analysis and differential geometry developed and used to formulate Einstein field equations. Schwarzschild and Kerr solutions. Other advanced topics may include gravitational radiation, particle production by gravitational fields, alternate gravitational theories, attempts at unified field theories, cosmology.

Phys 551. Computational Physics. (0-4) Cr. 2. S. *Prereq: 365, credit or enrollment in 481.* Use of modern computational techniques to analyze topics in classical and modern physics. Satisfactory-fail only.

Phys 564. Advanced Classical Mechanics. (3-0) Cr. 3. F. *Prereq: 362, Math 426, 465.* Variational principles, Lagrange's equations, Hamilton's canonical equations, canonical transformations, Hamilton-Jacobi theory, infinitesimal transformations, classical field theory, canonical perturbation theory, classical chaos.

Phys 571. Electricity and Magnetism I. (3-0) Cr. 3. F. *Prereq: 365, Math 426.* Electrostatics, magnetostatics, boundary value problems, Maxwell's equations, wave phenomena in macroscopic media, wave guides.

Phys 572. Electricity and Magnetism II. (3-0) Cr. 3. S. *Prereq: 571.* Special theory of relativity, least action and motion of charged particles in electromagnetic fields, radiation, collisions between charged particles, multipole fields, radiation damping.

Phys 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics of current interest.
A. Nuclear Physics
B. Condensed Matter Physics
C. High Energy Physics
D. Physics
E. Applied Physics
F. Biophysics

Phys 591. Quantum Physics I. (4-0) Cr. 4. F. *Prereq: 481.* First semester of a full-year course. Postulates of quantum mechanics; time-dependent and time-independent Schrodinger equations for one-,two-, and three-dimensional systems; theory of angular momentum; Rayleigh-Schrodinger time-independent perturbation theory.

Phys 592. Quantum Physics II. (4-0) Cr. 4. S. *Prereq: 591.* Continuation of 591. Variational theorem and WKB method; time-dependent perturbation theory; method of partial waves and Born approximation for scattering by central potentials; identical particles and symmetry; Dirac and Klein-Gordon equation for free particles; path integral formalism.

Phys 599. Creative Component. Cr. arr. *Prereq: Permission of instructor.* Individually directed study of research-level problems for students electing the nonthesis M.S. degree option.

Phys 611. Quantum Theory of Condensed Matter. (3-0) Cr. 3. S. *Prereq: 512, 681.* Quasiparticles in condensed matter: phonons, magnons, photons, electrons. Quantum theory of interacting many body systems: Green's functions and diagrammatic techniques.

Phys 624. Advanced Nuclear Physics. (3-0) Cr. 3. *Prereq: 526 and 592.* Microscopic few-body and many-body theory; theory of effective Hamiltonians; relativistic nuclear physics; nuclear effects in hadron-nucleus, lepton-nucleus, and nucleus-nucleus reactions.

Phys 625. Physics of Strong Interactions. (3-0) Cr. 3. *Prereq: 681.* Quark model; Quantum Chromodynamics IQCD); perturbation methods for QCD; effective field theories for pions and nucleons; finite temperature field theories; quark-gluon plasma; phase transitions in QCD.

Phys 637. Elementary Particle Physics I. (3-0) Cr. 3. *Prereq: 526 and 592.* First semester of a full year course. Properties of leptons, bosons, and quarks and their interactions; quantum chromodynamics, Glashow-Weinberg-Salam model, grand unification theories, supersymmetry; modern theoretical techniques and tests of the Standard Model.

Phys 638. Elementary Particle Physics II. (3-0) Cr. 3. *Prereq: 637.* Continuation of 637. Properties of leptons, bosons, and quarks and their interactions; quantum chromodynamics, Glashow-Weinberg-Salam model, grand unification theories, supersymmetry, and superstring theory; modern theoretical techniques.

Phys 650. Advanced Seminar. (1-0) Cr. 1. Repeatable. F.S. Topics of current interest. Satisfactory-fail only.
A. Nuclear Physics
B. Condensed Matter Physics
C. High Energy Physics
D. Physics
E. Applied Physics
F. Biophysics

Phys 660. Advanced Topics in Physics. Cr. arr. Repeatable. F.S. Courses on advanced topics and recent developments.
A. Nuclear Physics
B. Condensed Matter Physics
C. High Energy Physics
D. Physics
E. Applied Physics
F. Biophysics

Phys 681. Quantum Field Theory I. (3-0) Cr. 3. F. *Prereq: 564, 572, 592.* Quantization of fields (canonical and path integral); Feynman rules; introduction to gauge theories; Quantum Electrodynamics; radiative corrections; renormalization and renormalization group.

Phys 682. Quantum Field Theory II. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 681.* Continuation of 681. Systematics of renormalization; renormalization group methods; symmetries; spontaneous symmetry breaking; non-abelian gauge theories; the Standard Model and beyond; special topics.

Phys 699. Research. Cr. arr. Repeatable.

Plant Biology

(Interdepartmental Graduate Major)

www.agron.iastate.edu/ptf/ippm/home.asp

Supervisory Committee: K. Wang, Chair; D. Hannapel, Interim Associate Chair; M. Bhattacharyya, M. James, R. Thornburg (ex-officio), S. Whitham

The Interdepartmental Plant Physiology Major (IPPM) coordinates graduate education and research in the areas of plant biology including but not limit to plant biochemistry, plant cellular and molecular biology and plant physiology. Graduate study in IPPM, leading to the M.S. and Ph.D. Degrees, is offered through seven participating departments: Agronomy, Biochemistry, Biophysics & Molecular Biology, Chemical and Biological Engineering, Ecology, Evolution and Organismal Biology, Genetics Development & Cell Biology, Horticulture, and Plant Pathology.

Research conducted by the faculty and students of the major represents basic plant physiology, biochemistry and molecular biology. The experimental approaches represented in the major span the range of complexity from molecular studies, to cellular, organismal and the ecological level (crop monocultures and natural populations). Graduates have a broad understanding of basic, functional plant biology with emphases on fundamental biology, biochemistry, and molecular biology. They are able to address complex research and policy problems in agriculture, biotechnology, and basic plant biology.

All M.S. candidates take a core curriculum comprising courses recommended from the following four categories, attend research seminars, research credits (PlBio 699), annual Loomis Lecture and mini-symposium and retreats. Students will take additional courses of interest as directed by their Program of Study (POS) Committee members.

A total of 36 credits including a minimum of 16 course credits are required for a M.S.

(1) Complete the following core courses:

a) Stat 401; b) BBMB 404 or BBMB 501; c) GDCB 513; d) Agron/Gen/Pl P 565; e) Make two seminar presentations and enroll each term in the Interdepartmental Plant Physiology seminar PlBio 696P or its listed equivalent. The first seminar must be during the student's first year and is a 20 minutes seminar. The last presentation must be an exit seminar.

(2) Take one course from the following courses:

a) GDCB 512; b) GDCB 529;

(3) Take additional courses from the following list:

Agron 516; Agron 527; Agron/Hort/NREM 529; Agron 616; Agron 625; BBMB 405; BBMB 451; BBMB 502; BBMB 607; BBMB 645; BBMB 660; BBMB 675; BBMB 676; BCB 551; BCB 596; Biol 454; Biol 474; EEOB 563; EEOB 566; EEOB 595; GDCB 510; GDCB 511; GDCB 512; GDCB 528; GDCB 529; GDCB 545; GDCB 640; GDCB 679; GDCB 680; GDCB 681.

All Ph.D. candidates take a core curriculum comprising courses recommended from the following four categories, attend research seminars, research credits (PlBio 699), annual Loomis Lecture and mini-symposium and retreats. Students will take additional courses of interest as directed by their Program of Study (POS) Committee members.

A total of 72 credits including a minimum of 24 course credits are required for a Ph.D.

(1) Complete the following core courses:

a) Stat 401; b) BBMB 404 or BBMB 501; c) GDCB 513; d) Agron/Gen/Pl P 565; e) Make four seminar presentations and enroll each term in the Interdepartmental Plant Physiology seminar PlBio 696P or its listed equivalent. The first seminar must be during the student's first year and is a 20 minutes seminar. The last presentation must be an exit seminar.

(2) Take one course from the following courses:

a) BBMB 405; b) BBMB 502; c) GDCB 511; d) GDCB 545

(3) Take one course from the following courses:

a) GDCB 512; b) GDCB 529

(4) Take additional courses from the following list:

Agron 516; Agron 527; Agron/Hort/NREM 529; Agron 616; Agron 625; BBMB 405; BBMB 451; BBMB 502; BBMB 607; BBMB 645; BBMB 660; BBMB 675; BBMB 676; BCB 551; BCB 596; Biol 454; Biol 474; EEOB 563; EEOB 566; EEOB 595; GDCB 510; GDCB 511; GDCB 512; GDCB 528; GDCB 529; GDCB 545; GDCB 640; GDCB 679; GDCB 680; GDCB 681.

Requirements for students seeking Plant Physiology as Minor:

(1) Prerequisite courses:

Stat 401; BBMB 404 or BBMB 501.

(2) Take a minimum of nine credits from the following courses:

Agron 516; Agron 527; BBMB 607; Biol 454; GDCB 512; GDCB 513; GDCB 529; GDCB 545.

In addition to the required core courses, a wide selection of courses is available to IPPM graduate students for broadening their scientific education. Decisions about which courses are taken and when they are taken are made by the student, initially in consultation with his or her temporary advisor, and then with his or her major advisor and eventually with POS Committee, which also serves as the Thesis or Dissertation Committee.

Courses for graduate students

PLBio 512. Plant Growth and Development. (Cross-listed with GDCB, MCDB). (2-0) Cr. 2. S. *Prereq: Biol 330 or a course in developmental biology; GDCB 545 or BBMB 404, 405 or GDCB 520.* Plant growth and development and its molecular genetic regulation. Hormone biosynthesis, metabolism, and action. Signal transduction in plants.

PlBio 513. Plant Metabolism. (Cross-listed with GDCB). (2-0) Cr. 2. F. *Prereq: Biol 330, Phys 111, Chem 331; one semester of biochemistry recommended.* Photosynthesis, respiration, and other aspects of plant metabolism.

PlBio 545. Plant Molecular Biology. (Cross-listed with GDCB, MCDB). (3-0) Cr. 3. F. *Prereq: Biol 314, 330.* Organization and function of plant nuclear and organelle DNA; regulation of gene expression. Methods of generating novel genetic variation. Impact of plant biotechnology on agriculture.

PlBio 696. Research Seminar. (Cross-listed with Agron, BBMB, GDCB, Hort, For). Cr. 1. Repeatable. F.S. Research seminars by faculty and graduate students. Satisfactory-fail only.

PlBio 699. Research. Cr. arr. Repeatable.

Plant Pathology

www.plantpath.iastate.edu

Thomas Baum, Chair of Department

Distinguished Professors (Emeritus): Tiffany

University Professors (Emeritus): McNabb

Professors: Baum, Braun, Bronson, Gleason, Harrington, Hill, Miller, Nutter, Tylka, Yang

Professors (Emeritus): Durand, Epstein, Hodges, Mcgee, Stewart

Professor (Collaborator): Wise

Associate Professors: Beattie, Bogdanove, Munkvold, Whitham

Assistant Professors: Halverson, Leandro, Robertson

Assistant Professors (Collaborators): Block, Lauter

Undergraduate Study

The department participates in the interdepartmental undergraduate Microbiology major; see *Agriculture, Curricula.*

Graduate Study

The department offers studies for the degrees master of science and doctor of philosophy with a major in plant pathology, and minor work for students majoring in other departments or programs. A master of science nonthesis option is available. The department also participates in the interdepartmental majors in microbiology; toxicology; genetics; plant physiology; molecular, cellular, and developmental biology; ecology and evolutionary biology; and sustainable agriculture.

Students entering graduate programs in the department need a sound background in the physical, biological, and mathematical sciences as well as adequate preparation in English.

Graduates have a broad understanding of the biology and management of plant pathogenic microorganisms and the interactions of pathogens with their host plants. They understand the relationship between plant pathology and allied disciplines and are able to communicate effectively with scientific colleagues and the general public in both formal and informal settings. Graduates are able to address complex plant disease problems facing agricultural and bioscience professionals, taking into account the related ethical, social, legal, and environmental issues. They are skilled in research procedures, communicating research results, and writing concise and persuasive grant proposals.

Courses primarily for undergraduate students

Pl P 391. Practical Plant Health. (0-4) Cr. 2. F. *Prereq: 6 credits in biological sciences.* Diagnosis of all types of plant health problems caused by diseases, insects, weeds, nutrient deficiencies and toxicities, herbicide injury, and environmental stress. Emphasis is on acquiring practical skills. Students will gain experience in written and oral communication.

Pl P 408. Principles of Plant Pathology. (Dual-listed with 508). (2-3) Cr. 3. F.S. *Prereq: 8 credits in biological sciences, including Biol 212.* Braun. Principles underlying the nature, diagnosis, and management of plant diseases. Laboratory complements lecture topics and provides experience in plant disease diagnosis.

Pl P 416. Forest Insect and Disease Ecology. (Cross-listed with For). (3-3) Cr. 4. S. *Prereq: 8 credits in biological sciences, including Biol 211.* T. Harrington, M. Harris . Nature of insects and pathogens of forest and shade trees; their role in the dynamics of natural and managed forest ecosystems; and the management of indigenous and exotic pests. Nonmajor graduate credit.

Pl P 452. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 552). (Cross-listed with Ent, Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Pl P 477. Bacterial-Plant Interactions. (Dual-listed with 577). (Cross-listed with Micro). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interaction with plants; covers symbiotic nitrogen fixation, plant pathogenesis, plant growth promotion, and biological control.

Pl P 483. Wood Deterioration and Preservation. (Cross-listed with For). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: For 280.* Deterioration of wood in use by biological and physical agents. Wood preservation and fire retardant treatments. Environmental impact of wood treating. Nonmajor graduate credit.

Pl P 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior or senior classification, 7 credits in biological sciences, permission of instructor.* A maximum of 6 credits of Pl P 490 may be used toward the total of 128 credits required for graduation.
A. Plant Pathology
H. Honors

Pl P 494. Seed Pathology. (Dual-listed with 594). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: 408.* Munkvold. Significance of diseases on the major phases of seed production; growing, harvesting, conditioning, storing, and planting seed. Pathogens considered include fungi, bacteria, viruses, nematodes, and abiotic agents. Emphasis on epidemiology, management, host-pathogen relationships, seed transmission, and seed health testing. Credit may not be obtained for both Pl P 494 and STB/Pl P 592.

Courses primarily for graduate students, open to qualified undergraduate students

Pl P 506. Plant-Pathogen Interactions. (2-0) Cr. 2. S. *Prereq: 408 or 416, Biol 313.* Baum, Whitham. Introduction to mechanisms of plant-parasite interaction. Genetics and molecular genetics of plant disease resistance and pathogenicity.

Pl P 508. Principles of Plant Pathology. (Dual-listed with 408). (2-3) Cr. 3. F.S. *Prereq: 8 credits in biological sciences, including Biol 212.* Braun. Principles underlying the nature, diagnosis, and management of plant diseases. Laboratory complements lecture topics and provides experience in plant disease diagnosis.

Pl P 509. Plant Virology. (Cross-listed with Micro). (2-6) Cr. 4. Alt. S., offered 2011. *Prereq: 408, Biol 454, BBMB 405, Chem 211.* Hill. Plant viruses and the diseases they cause. Emphasis on epidemiology and control. Structure, function, and biochemical-biophysical properties of plant viruses.

Pl P 511. Integrated Management of Tropical Crops. (Cross-listed with Ent, Hort). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Pl P 408 or 416 or Ent 370 or 376 or Hort 221.* Gleason, Lewis, Nonnecke. Applications of Integrated Crop Management principles (including plant pathology, entomology, and horticulture) to tropical cropping systems. Familiarization with a variety of tropical agroecosystems and Costa Rican culture is followed by 10-day tour of Costa Rican agriculture during spring break, then writeup of individual projects. Tour expenses paid by students.

Pl P 530. Ecologically Based Pest Management Strategies. (Cross-listed with Agron, Ent, SusAg). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: SusAg 509.* Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

Pl P 543. Ecology and Epidemiology of Plant Diseases. (2-4) Cr. 4. Alt. F., offered 2009. *Prereq: 408 or 416.* Nutter. Theory and practice related to the ecology and epidemiology of plant disease epidemics. Interactions among host and pathogen populations as affected by the environment are quantified with respect to time and space. Analysis of ecological and host and pathogen genetic factors that alter the course of plant disease epidemics. Risk assessment theory, disease forecasting, and modeling the impact of biotic plant stresses on yield and quality are also emphasized.

Pl P 552. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 452). (Cross-listed with Ent, Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Hort 351.* Gleason, D. Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Pl P 565. Professional Practice in the Life Sciences. (Cross-listed with Agron, An S, BCB, Hort, V MPM, Micro). Cr. arr. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.
A. Professional Practices in Research. (Cr. 1.0). Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5). Ethical and legal issues facing life scientists involved in research interactions with industry.

Pl P 574. Plant Nematology. (2-3) Cr. 3. Alt. F., offered 2010. *Prereq: 408 or 416.* Baum. Morphology, anatomy, identification, control, and life cycles of common plant-parasitic nematodes; host-parasite interactions; Caenorhabditis elegans.

Pl P 577. Bacterial-Plant Interactions. (Dual-listed with 477). (Cross-listed with Micro). (3-1) Cr. 3. Alt. S., offered 2010. *Prereq: 3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interaction with plants; covers symbiotic nitrogen fixation, plant pathogenesis, plant growth promotion, and biological control.

Pl P 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: 10 credits in biological sciences, permission of instructor.*

Pl P 592. Seed Health Management. (Cross-listed with STB). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Admission to the Graduate Program in Seed Technology and Business/Consent of instructor.* Munkvold. Occurrence and management of diseases during seed production, harvest, conditioning, storage, and planting. Emphasis on epidemiology, disease management in the field, seed treatment, effects of conditioning on seed health, and seed health testing. Credit may not be obtained for both Pl P/STB 592 and Pl P 594.

Pl P 594. Seed Pathology. (Dual-listed with 494). (2-3) Cr. 3. Alt. S., offered 2011. *Prereq: 408.* Munkvold. Significance of diseases on the major phases of seed production; growing, harvesting, conditioning, storing, and planting seed. Pathogens considered include fungi, bacteria, viruses, nematodes, and abiotic agents. Emphasis on epidemiology, management, host-pathogen relationships, seed transmission, and seed health testing. Credit may not be obtained for both Pl P 594 and STB/Pl P 592.

Courses for graduate students

Pl P 608. Molecular Virology. (Cross-listed with V MPM, Micro). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: BBMB 405 or GDCB 511.* C. Miller, B. Blitvich, A. Miller. Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

Pl P 691. Field Plant Pathology. (0-6) Cr. 2. Repeatable. Alt. SS., offered 2011. *Prereq: 408 or 416.* Diagnosis of plant diseases, plant disease assessment methods, and the integration of disease management into commercial crop production practices. Objectives are to familiarize students with common diseases of Midwest crops and landscape plants, and to provide experience in disease diagnosis. Field trips include commercial operations, agricultural research facilities, and ornamental plantings.

Pl P 692. Molecular Biology of Plant-Pathogen Interactions. (Cross-listed with Micro). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 506 or BBMB 405 or Gen 411 or Micro 402 or course in molecular biology.* Bogdanove, Whitham. Seminal and current research in molecular and physiological aspects of plant interactions with pathogens, including mechanisms of pathogenesis, host-pathogen recognition and host defense, with an emphasis on critical evaluation of primary literature. Students also complete an interinstitutional research proposal writing and peer review exercise.

Pl P 694. Colloquium in Plant Pathology. (2-0) Cr. 2. Repeatable. F.S. *Prereq: 408 or 416, permission of instructor.* Advanced topics in plant pathology, including biological control, cultural control, resistance gene deployment, genetic engineering for disease resistance, chemical control, integrated pest management, emerging diseases, fungal genetics, insect vector biology, professional communications, etc.

Pl P 698. Seminar. Cr. 1. Repeatable. F.S.

Pl P 699. Thesis and Dissertation Research. Cr. arr. Repeatable. F.S.SS.

Political Science

www. iastate.edu/~polsci/

James McCormick, Chair of Department

Distinguished Professors (Emeritus): Rasmussen

University Professors: Schmidt, Shelley

Professors: Dobratz, Mansbach, McCormick, Smith

Professors (Emeritus): Dearin, Kihl, Lee, Maney, Moses

Associate Professors: Hutter, Potoski, Tuckness, Wolf

Associate Professor (Emeritus): Whitmer

Associate Professor (Adjunct): Waggoner

Assistant Professors: Birskyte, Conger, D. Cunningham, K. Cunnigham, Urbatsch

Assistant Professor (Adjunct): Bystrom

Senior Lecturer: Deam

Undergraduate Study

For the undergraduate curriculum in Liberal Arts and Sciences, with major in political science, leading to the degree of Bachelor of Arts, see *Liberal Arts and Sciences, Curriculum.*

The study of political science is designed to enable students to understand the nature of politics, public values, and the institutions and processes of politics in their various forms.

Students completing a major in political science will understand and be able to interrelate the leading theories, literature, and approaches in the subfields of American government, political theory and methods, international relations, and comparative politics. Graduates can analyze and formulate effective argumentation in written and oral forms, including the ability to appreciate and

accommodate diverse political ideas, and the ability to collect and critique information and ideas of others in support of original arguments. Graduates appreciate the knowledge and civic responsibilities required for effective participation in political life.

The political science major is often chosen by students preparing for a career in law. Students with this goal should consult with the department in selecting courses. See also Preprofessional Study.

Several internship options are available to the political science major, offering students the opportunity to experience practical application of the knowledge learned in academic courses.

Requirements for the Major:

For the purpose of defining undergraduate requirements in the Department of Political Science, the Department employs four subfields within the discipline, with the following courses in each:

I. Theory and Methods (Pol S 235, 313, 334, 335, 356, 406, 430, 431, 433, 470, 480, 487, 490B).

II. American Government and Politics (Pol S 215, 305, 310, 311, 312, 318, 319, 320, 334, 335, 344, 358, 359, 360, 361, 363, 370, 371, 385, 413, 417, 420, 421, 442, 464, 475, 476, 477, 480, 482, 483, 490A).

III. Comparative Politics (Pol S 241, 314, 340, 341, 343, 346, 347, 349, 350, 442, 485, 490C).

IV. International Relations (Pol S 251, 315, 356, 357, 358, 359, 381, 422, 452, 453, 485, 487, 490D).

To complete the major in Political Science a student must earn 33 semester credits of courses in Political Science subject to the following conditions:

a. Students must satisfactorily complete Pol S 101, 301, and 302.

b. Students must complete at least 3 credits in each of the four subfields listed above. Students may apply only one half-semester mini-course (Pol S 312, 313, 314, 315) in each group.

c. Political Science courses in which a student has a grade of D+ or lower will not count for the major but can be counted as electives.

d. At least 18 credits of Political Science courses must be numbered 300 or above.

e. Students must pass one statistics course from among Stat 101, 104, 226 or 231.

f. No more than six credits of Pol S 490 or 499 (alone or in combination) can be used to fulfill any of these requirements. A maximum of three credits of Pol S 490 can be applied to meet any of the four subfield requirements.

g. A maximum of six credits from half-semester mini-courses (Pol S 312, 313, 314, 315) can be applied to satisfy the above requirements.

h. At least 15 credits of Political Science coursework must be earned at Iowa State University.

i. Advanced Communication Skills: Majors must earn at least a C+ in each of Engl 150 and 250. Those who do not must complete Engl 309 or 314 with a grade of C or higher. Majors must also complete Pol S 302.

The department offers a minor in political science that may be earned by completing 15 credits beyond the 100-level of coursework in political science, nine of which must be at the 300 level or above. A student minoring in Political Science normally will be expected to take at least 9 credits in Political Science coursework at Iowa State University. Only 3 credits of Pol S 490 or Pol S 499, alone or in combination, and only 2 credits of Pol S 312-315 may be included in the total of 15 credits required for the minor. All minors in the College of Liberal Arts and Science required a minimum of 6 credits in courses numbered 300 and above taken at ISU with a grade of C or higher. Credits earned in Pol S 499, offered on a satisfactory/fail basis only, will not fulfill this requirement.

Graduate Study

The department offers work for a Master of Arts degree (M.A.), with a major in political science, and minor for students in other departments. The department also offers work for a Master of Public Administration (MPA) degree or a Graduate Certificate of Public Management (GCPM) for those interested in an educational certificate program that requires less work than a full masters program. In addition, the Political Science Department offers work for the Master of Science in Information Assurance. Information with detailed requirements for all graduate degrees may be obtained at the department's web page at www.pols.iastate.edu/gradhome.shtml.

The M.A. program is designed to enable its graduates to engage in governmental research, enter public service or private industry, teach, or pursue further graduate study. Graduate students may also wish to work for certification for high school or junior college teaching. A thesis is required for this degree. The department also has a joint Master of Arts/Juris Doctor (M.A./J.D.) program with the Law School of Drake University. Detailed information for the M.A./J.D. can be found at the ISU Political Science webpage as well as the Drake Law School website (under Joint Degree): www.law.drake.edu/admissions/ specprograms.html. Students wishing to pursue this joint degree must submit separate applications to both Drake University and Iowa State University and be accepted by both institutions.

M.A. graduates have a broad substantive understanding of the political process and the academic study of politics. They also have in-depth knowledge of one or more subfields in political science. Graduates are skilled at conducting research and preparing thorough research summaries. They are able to identify and address complex political questions, taking into account related ethical, legal, economic, and social issues.

The usual prerequisites for major graduate work in the M.A. program normally are completion of at least 15 credits in political science, the GRE (Graduate Record Examination), one year of a foreign language (equivalent to 8 semester hours) and a course in basic statistics (equivalent to Stat 101). If the basic statistics requirement has not been met, the student may remedy the deficiency by passing equivalent courses, for which no graduate credit will be received. During their program of study, all students are expected to complete Stat 401, Pol S 502, and a thesis. Students normally do concentrated course work in at least one of the following three areas: international relations, comparative politics, or American politics. The student's program of study committee may require additional work.

Students in other graduate programs may obtain a minor in political science by completing at least 9 credits of political science courses, including one of the proseminars. Interested students should consult the Graduate College Handbook for additional information on graduate minors.

The Master of Science in Information Assurance (MSIA) is a multi-disciplinary program designed to provide students with diverse backgrounds and interests the opportunity to obtain professional training in the emerging field of information assurance. The core of the MSIA program is built around a series of courses taught in Electrical and Computer Engineering, Mathematics, and Computer Science that introduce students to software and hardware aspects of cryptography and computer security. The program also recognizes, however, that information assurance-defined in terms of security, privacy, access, and reliability-is not simply a technical problem but also involves important societal dimension, including policy, education, ethics, and management. Recognizing that political science offers many potential intersections with information assurance (e.g., public sector management of information technology; forensics and computer crime; information technology policy and law; information technology and international relations; information warfare; etc.), students with interests in these areas are encouraged to select the Department of Political Science as their home department.

Students opting to pursue a MSIA degree through the Department of Political Science can expect to acquire skills and background knowledge relevant to a career in public policy or public sector management of information assurance technologies. The InfAs degree can also help prepare students who wish to go on to pursue a PhD in information politics and policy.

Students interested in the InfAs degree program should consider Political Science as a home department if their future career and/or educational interests lie in such areas as: institutional issues related to the internet and information technologies; information technology, international security, and information warfare; information technology policy and law; and public administration and public sector management of information technology.

Admission requirements generally follow the same guidelines as the M.A. or MPA in Political Science. Degree requirements are specified by the InfAs program in cooperation with Political Science. More in-depth information on the program can be found at: http://www.issi.iastate.edu/infas.html.

Public Policy and Administration

The Public Policy and Administration program offers work for the professional Master of Public Administration degree (MPA). The program is designed to educate and train students for careers in management and policy analysis at the federal, state, and local levels of government, and nonprofit sector management. The program serves a diverse student body, including pre-service students and in-service employees in government and nonprofit organizations. The curriculum covers a broad range of public administration and policy topics, including organizational and administrative processes, eGovernment, leadership, organizational change dynamics, human resource management, budgeting, cost benefit analysis, financial management, policy analysis, and ethics. The program offers three concentrations: Public Management, eGovernment and Management of Information Technology, and Policy Analysis.

The MPA degree requires 37 credits, which includes (a) 15 credits in core competency, (b) 9 credits in one of the concentration areas, (c) 4 credits in other required courses, (d) up to 7 credits of electives, and (e) 3 credits of creative component (a capstone project) or a minimum of 3 credits of research (thesis). Pre-service students are encouraged to obtain an internship for 3 credits.

The Program also offers a Graduate Certificate of Public Management program (GCPM), which requires a completion of 15 credits: 9 credits in the core, and two additional courses in the area of student interest. Some classes are available via videoconferencing, streaming video, one week and executive weekend formats, and online.

The Program also offers joint master's degrees with the Department of Community and Regional Planning (25 credits in each program plus a six credit thesis), and the interdisciplinary Information Assurance program (30 credits). The requirement for all double degrees consists of 22 credits from each discipline for a total of 54 credits. Under the rules of the Graduate College a graduate student may pursue a joint degree between any two disciplines of their interest. Interested students are encouraged to consult the ISU's Graduate Handbook. The minimum requirements for all double degrees consist of 22 credits from each program.

Requirements for admission are a graduate school application, an essay stating purposes for study, college transcripts, the GRE (waived for those with five or more years of public or nonprofit sector experience), three letters of recommendation, and the TOEFL for international students.

The department cooperates in the interdepartmental majors in transportation and water resources, and an interdepartmental minor in gerontology (see Index).

Refer to the Schedule of Classes (www.iastate.edu/~catalog/) or consult the Public Policy and Administration (MPA) web page (http://mpa.las.iastate.edu for up-to-date scheduling information.

Courses primarily for undergraduate students

Pol S 101. Orientation to Political Science. (2-0) Cr. 1. F.S. *Prereq: Political Science and Open Option majors only or permission of the instructor.* Introduction to the discipline and sub-fields of Political Science, including an introduction to analytical thinking, and research skills relevant to political science. Orientation to university, college, and departmental structure, policies, and procedures; student roles and responsibilities; degree planning and career awareness. Satisfactory-fail only.

Pol S 215. Introduction to American Government. (3-0) Cr. 3. F.S.SS. Fundamentals of American democracy; constitutionalism; federalism; rights and duties of citizens; executive, legislative, and judicial branches of government; elections, public opinion, interest groups, and political parties.

Pol S 235. Introduction to Ethics and Politics. (3-0) Cr. 3. F.SS. *Prereq: Sophomore standing.* Introduction to moral controversies surrounding political issues such as violence, deception, corruption, civil disobedience, democracy, justice, equality, and freedom. Students will read classic and contemporary texts and consider political applications. This course serves as an introduction to advanced courses in political theory.

Pol S 241. Introduction to Comparative Government and Politics. (3-0) Cr. 3. F.S. Basic concepts and major theories; application to selected political systems, including non-western political systems.

Pol S 251. Introduction to International Politics. (3-0) Cr. 3. F.S. Dynamics of interstate relations pertaining to nationalism, the nation state; peace and war; foreign policy making; the national interest; military capability and strategy; case studies of transnational issues, such as population, food, energy, and terrorism.

Pol S 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Pol S 301. Introduction to Empirical Political Science Research. (3-0) Cr. 3. F.S.SS. *Prereq: 3 credits in political science; one statistics course required; sophomore classification.* Techniques of quantitative and qualitative political research and analysis. Development and analysis of concepts and theories. Methods of data collection, research design, and critical thinking. Applications of statistics to political research.

Pol S 302. Politics of Writing, Speaking, and Reading. (3-0) Cr. 3. F.S. *Prereq: English 250; 3 credits in Political Science. Political Science majors only.* Focus on the connections between communicative and rhetorical skill and effective civic understanding and participation. Techniques of effective communication and persuasion in writing and speaking. Development of skills of critical and rhetorical analysis in reading.

Pol S 305. Political Behavior. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Empirical theories and descriptions of political behavior, including decision-making, opinion, and attitudes, with an emphasis on groups and political elites.

Pol S 310. State and Local Government. (3-0) Cr. 3. S. *Prereq: 3 credits in political science.* Role of state and local governments in the American federal system. Structures of participation: political parties, elections, interest groups. Major governmental institutions: legislative, executive, and judicial. Structure and functions of local governments.

Pol S 311. Municipal Government and Politics. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 215.* Legal position of municipal corporation; forms of organization; administration of municipal services; problem-solving in municipal government; urban and metropolitan political process; implications of federal urban policies.

Pol S 312. Minicourse in American Government and Politics. (3-0) Cr. 2. F.S. *Prereq: Sophomore classification.* Half-semester courses on selected topical issues in American government and politics. Designated repeat in Pol S 312 is not permitted. Use of Pol S 312 credit in Pol S major and minor is limited. See Undergraduate Study for information.

Pol S 313. Minicourse in Theory and Methods. (3-0) Cr. 2. F.S. *Prereq: Sophomore classification.* Half-semester course on selected topical issues in theory and methods in political science. Designated repeat in Pol S 313 is not permitted. Use of Pol S 313 credit in Pol S major and minor is limited. See Undergraduate Study for information.

Pol S 314. Minicourse in Comparative Politics. (3-0) Cr. 2. F.S. *Prereq: Sophomore classification.* Half-semester course on selected topical issues in comparative politics. Designated repeat in Pol S 314 is not permitted. Use of Pol S 314 credit in Pol S major and minor is limited. See Undergraduate Study for information.

Pol S 315. Minicourse in International Relations. (3-0) Cr. 2. F.S. *Prereq: Sophomore classification.* Half-semester course on selected topical issues in international relations. Designated repeat in Pol S 315 is not permitted. Use of Pol S 315 credit in Pol S major and minor is limited. See Undergraduate Study for information.

Pol S 318. Campaign and Elections. (3-0) Cr. 3. Alt. F., offered 2010. Methods and techniques of political campaigns in general elections. Supervised participation in candidate and political party campaign activities required.

Pol S 319. Law and Politics. (3-0) Cr. 3. F.S. *Prereq: Sophomore standing; 215 recommended.* An evaluation of the American judicial system as it relates to controversial topics emphasizing the relationship between law and politics. Primary emphasis on topics such as statutory construction, judicial review, the proper role of the judiciary, vagueness and ambiguity in law, competing constitutional philosophies, executive branch concerns, and relative power of different branches. Credit for both Pol S 319 and 230 may not be applied toward graduation.

Pol S 320. American Judicial Process. (Cross-listed with CJ St). (3-0) Cr. 3. S. *Prereq: Pol S 215.* An overview of the American judicial process. Emphasis on specific topics such as application of constitutional rights to the states (particularly the Fourth, Fifth, Sixth, and Fourteenth Amendments), mechanics of judicial opinions, constitutional philosophies of Supreme Court Justices, decisions of first impression, and the value and scope of precedent.

Pol S 334. Politics and Society. (Cross-listed with Soc). (3-0) Cr. 3. F. *Prereq: A course in political science or sociology.* The relationship between politics and society with emphasis on American society. Discussion of theories of inequality, power, social movements, elites, ruling classes, democracy, and capitalism.

Pol S 335. Science, Technology, and Public Policy. (3-0) Cr. 3. S. Examines the history and political dynamics of public science and technology policies. Examines differences in political and technological orientations. Assessment of the roles of politics, media, engineering, science, and private business in the formation public policies that put heavy reliance on or seek to advance science and technology.

Pol S 340. Politics of Developing Areas. (3-0) Cr. 3. Alt. S., offered 2010. Examination of economic and political development as they relate to the political process of developing states. Impact of social and technological change on political systems of developing areas. Some case studies.

Pol S 341. Politics of Asia. (3-0) Cr. 3. Alt. S., offered 2010. Political institutions, processes, and contemporary issues. Selected countries examined intensively to illustrate generalizations. Topics such as foreign policy, role of parties, military, religious groups, human rights, women, environmental issues, interest groups, ideology, and globalization.

Pol S 343. Latin American Government and Politics. (3-0) Cr. 3. Political institutions, processes, and contemporary issues. Selected countries examined intensively to illustrate generalizations. Role of parties, military, church, human rights, women, environmental issues, interest groups, ideology, and globalization.

Pol S 344. Public Policy. (3-0) Cr. 3. S. How agendas come to be set in public policy, theories describing the policy-making process, forces molding policy choices and the impact of such choices.

Pol S 346. European Politics. (3-0) Cr. 3. S. Comparative study of political institutions of Europe and the European Union; emphasis on parties, elections, and governmental structures. Substance and process of public policies in selected problem areas.

Pol S 347. African Politics. (3-0) Cr. 3. F. Major trends in African politics over the last 150 years and current issues facing Africans today. Basic African geography. Topics include democratization, economic development, civil conflict, ethnic politics and foreign aid.

Pol S 349. Politics of Russia and the Soviet Successor States. (3-0) Cr. 3. Alt. F., offered 2010. Nation-states of the former Soviet Union. Analysis of Soviet Communist system 1917-85 and the politics and revolutionary conflict leading to the dissolution of the Soviet Union from 1985 through 1991. Problems of post-Soviet nation-states of Russia and Central Eurasia since 1991.

Pol S 350. Politics of the Middle East. (3-0) Cr. 3. S. Introduction to the Middle East as a region and to issues of political importance to the Middle East and its place in the world. Topics covered include Islam, regional conflicts and alliances, local leaders, economic issues, and gender and social relations. Nonmajor graduate credit.

Pol S 356. Theories of International Politics. (3-0) Cr. 3. Introduction to essential theoretical concepts and approaches, both classical and contemporary on world politics including realism, empiricism, liberalism, and postpositivism; for example, war and

conflict, peace and cooperation, political economy, crisis decision-making, systemic theory, dependence and interdependence.

Pol S 357. International Security Policy. (3-0) Cr. 3. F. The major theoretical approaches in security policy – strategy and deterrence, game theory, bargaining theory, compellance, and coercive diplomacy, and crisis diplomacy. Illustration of these various approaches through historical and contemporary cases.

Pol S 358. United States Foreign Policy. (3-0) Cr. 3. F. *Prereq: 215 or 251, or Hist 467 or 470 or 471.* U.S. foreign policy since World War II with emphasis on changing American values in foreign policy, the role of the President, Congress, and the bureaucracy in policy making, and a survey of current foreign policy issues and problems.

Pol S 359. Current Issues in American Foreign Policy. (3-0) Cr. 3. S. *Prereq: 215, 251, or 358.* Examination of contemporary U.S. foreign policy issues (e.g., U.S. policy in the Middle East; defense budgeting in the post-Cold War era; conventional and nuclear arms control policy). The course will explore alternate methods to analyze policy, survey the evolution of each issue, and discuss different policy alternatives.

Pol S 360. American Institutions: Congress. (3-0) Cr. 3. *Prereq: 215.* Theory and practice of representation and deliberation in the legislative branch of the republic; operations of Congress in terms of its committees, leadership, legislative and oversight processes, partisan politics, electoral campaigns, service to local and special electoral campaigns, service to local and special interests, and interactions with the President.

Pol S 361. American Institutions: The Presidency. (3-0) Cr. 3. F. *Prereq: 215.* Creation and historical development of the office of chief executive; character and behavior of past chief executives; selection and control; powers, roles, functions; executive staff; relations with Congress, press, public opinion.

Pol S 363. American Institutions: Media. (3-0) Cr. 3. *Prereq: Sophomore standing.* Course surveys the influence of mass media organizations, forms, techniques, and technologies on the practices and expectations of American politics. Evaluates the role of media in the political process, exploring the extents to which media promotes or discourages political participation. Topics will examine the influence and political uses of news coverage, political advertising, political debates, talk radio, film, the Internet, and media spectacles.

Pol S 370. Religion and Politics. (Cross-listed with Relig). (3-0) Cr. 3. *Prereq: Relig 105 or 210 recommended.* The interaction of religion and politics in the U.S. from both an historical and contemporary perspective, as well as the role of religion in politics internationally. Nonmajor graduate credit.

Pol S 371. Introduction to Public Administration. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* A survey of the historic and contemporary administrative realities that contribute to the unique challenges of public governance at the administrative and managerial levels of international, national, state, and local government. This introductory course explores the essential issues and competencies involved in the efficient, effective, and ethical provision of public goods and services. Critical topics addressed in the course include crisis management, intergovernmental relations, social equity, public-private partnerships, and privatization.

Pol S 381. International Political Economy. (3-0) Cr. 3. S. Introduction to the theoretical perspectives on international political economy. Exploration of specific issues such as the changing international trade regime, international finance, and Third World development under conditions of globalization.

Pol S 385. Women in Politics. (Cross-listed with W S). (3-0) Cr. 3. S. Examination of the entry and participation of women in politics in the United States and other countries including a focus on contemporary issues and strategies for change through the political process.

Pol S 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing work period.

Pol S 406. Public Opinion and Voting Behavior. (3-0) Cr. 3. S. *Prereq: 6 credits in political science or junior classification.* The formation of political opinions and attitudes, political participation, and voting behavior of the general public, and their influences on American politics; polling as a means of assessing public opinions and behaviors. Nonmajor graduate credit.

Pol S 413. Intergovernmental Relations. (Dual-listed with 513). (3-0) Cr. 3. S. *Prereq: 6 credits in American government.* Theories and practices of the American federal system. Politics and policy making among federal, state, and local governments. Nonmajor graduate credit.

Pol S 417. Campaign Rhetoric. (Cross-listed with Sp Cm). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Sp Cm 212.* Backgrounds of candidates for state and national elections; selected speeches and issues; persuasive strategies and techniques of individual speakers. Nonmajor graduate credit.

Pol S 420. Constitutional Law. (3-0) Cr. 3. F. *Prereq: 215; junior classification.* Development of the United States Constitution through judicial action; influence of public law and judicial interpretations upon American government and society. Nonmajor graduate credit.

Pol S 421. Constitutional Freedoms. (3-0) Cr. 3. S. *Prereq: 320 or 420.* Leading Supreme Court cases interpreting the Bill of Rights and the Fourteenth Amendment. Emphasis on religion, speech, privacy, due process, and equal protection. Nonmajor graduate credit.

Pol S 422. International Law. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 215 or 251; junior classification.* Development of the principles of international law of peace and war; analysis of theories concerning its nature and fundamental conceptions; its relation to national law; problems of international legislation and codification. Nonmajor graduate credit.

Pol S 430. Foundations of Western Political Thought. (Cross-listed with Cl St). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European history.* Study of original texts in political thought ranging from the classical period to the renaissance. Topics such as justice, freedom, virtue, the allocation of political power, the meaning of democracy, human nature, and natural law. Nonmajor graduate credit.

Pol S 431. Early Modern Political Thought. (Dual-listed with 531). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European history.* Study of original texts in political thought ranging from the Reformation to the French Revolution and its aftermath. Topics such as justice, freedom, rights, democracy, toleration, property, power, skepticism, and normative views of international politics. Nonmajor graduate credit.

Pol S 433. American Political Thought. (3-0) Cr. 3. S. *Prereq: 6 credits in political science or in American history.* Review of major political concepts and theorists in American political history. Analysis of current concepts in U.S. political thought, and their possible impacts on our political institutions. Nonmajor graduate credit.

Pol S 442. The Policy and Politics of Coastal Areas. (Dual-listed with 542). (Cross-listed with Env S). (3-0) Cr. 3. SS. Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, trade-offs between conservation and jobs, the quality of coastal lifestyle, ways in which citizens participate in policy for coastal areas.

Pol S 452. Comparative Foreign Policy. (Dual-listed with 552). (3-0) Cr. 3. S. *Prereq: 251.* Various theoretical approaches to explain foreign policy making and behavior through the use of case studies of selected nations. Nonmajor graduate credit.

Pol S 453. International Organizations. (3-0) Cr. 3. S. *Prereq: 251.* Private and public organizations such as the United Nations, other specialized agencies, and multinational organizations, and their influence on our daily lives. Nonmajor graduate credit.

Pol S 464. Political Parties and Interest Groups. (3-0) Cr. 3. F. *Prereq: 215; junior classification.* Interest groups and American political parties, their principles, organizations and activities.

Pol S 470. Public Choice. (3-0) Cr. 3. *Prereq: Econ 101.* Application of economics to political science in the study of nonmarket decision-making. Behavior of bureaucrats, elected officials, and voters. Market failure, collective action, representative democracies, direct democracies, logrolling, voter paradoxes, and game theory. Nonmajor graduate credit.

Pol S 475. Management in the Public Sector. (Dual-listed with 575). (3-0) Cr. 3. F. *Prereq: 371.* Literature and research on organizational behavior and management theory with emphasis on applied aspects of managing contemporary public sector organizations. Topics include distinctions between public and private organizations, leadership, productivity, employee motivation, organizational structure, and organizational change. Nonmajor graduate credit.

Pol S 476. Administrative Law. (Dual-listed with 576). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 215; junior classification.* Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations. Nonmajor graduate credit.

Pol S 477. Government, Business, and Society. (Dual-listed with 577). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Junior classification.* Diverse perspectives on the changing roles and relationships of business, government and society so as to open the way for more effective policy decisions on corporate-government affairs. Topics may include the changing economy; transformation of workplace and community conditions; consumerism; social responsibilities of businesses; economic policies and regulations; and politics in the business-government relationship. Nonmajor graduate credit.

Pol S 480. Ethics and Public Affairs. (Dual-listed with 580). (3-0) Cr. 3. *Prereq: 6 credits in political science.* Study of decision making approaches and application to case studies. Topics such as the different roles of public officials, proper scope and use of administrative discretion, and the admissibility of religious, political, and philosophical commitments in governmental decision making. Nonmajor graduate credit.

Pol S 482. Environmental Politics and Policies. (Dual-listed with 582). (Cross-listed with Env S). (3-0) Cr. 3. F. *Prereq: 3 credits in political science or 3 credits in Environmental Studies; junior classification.* Major ideologies relation to conservation and ecology. Processes, participants, and institutions involved in state, national, and global environmental policymaking. Case studies of environmental controversies and proposals for policy reform. Nonmajor graduate credit.

Pol S 483. Law and Management. (Dual-listed with 583). (3-0) Cr. 3. Alt. F., offered 2009. Emerging constitutional/legal doctrines and requirements in public management: concept of new property rights in public employment/public service delivery; procedural due process requirement; scope of free speech and liberty protected in the conduct of public management; equal employment opportunity requirements; and the scope of official and personal immunities and liability in public affairs.

Pol S 485. Comparative Public Administration. (Dual-listed with 585). (3-0) Cr. 3. F. Comparisons of government bureaucratic in major world regions, trends and issues of administrative and management reforms, globalization and other contemporary challenges to state administrative structures and policies, skills needed to evaluate and implement public management reforms.

Pol S 487. Electronic Democracy. (2-1) Cr. 3. F. *Prereq: Sophomore standing or instructor approval.* The impact of computers, the Internet, and the World Wide Web on politics and policy. The positive and negative effects on information technology (IT) on selected topics such as freedom, power and control, privacy, civic participation, the sense of "community," virtual cities," interest group behavior, the new media, campaigns, elections, and voting will be examined. Nonmajor graduate credit.

Pol S 490. Independent Study. Cr. arr. Repeatable. F.S. *Prereq: 6 credits in political science.* Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. No more than 9 credits of Pol S 490 may be counted toward graduation.

A. American Government and Politics
B. Theory and Method
C. Comparative Politics
D. International Relations
E. Extended credit. The student may earn an additional 1 or 2 credits for extra study done for any 300- or 400-level course, with instructor's approval.
G. Catt Center Project
H. Honors

Pol S 491. Senior Thesis. Cr. 3. *Prereq: 21 credits of Pol S and permission of instructor.* Written under the supervision of a Political Science faculty advisor.

Pol S 495. Capstone Project in Political Science. (3-0) Cr. 3. S. *Prereq: 21 credits in political science and permission of instructor.* Capstone project for political science majors; integrating research, analysis and participation.

Pol S 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Pol S 499. Internship in Political Science. Cr. arr. F.S.SS. *Prereq: 6 credits in political science; junior or senior classification; and permission of internship coordinator.* Work experience with a specific nongovernmental or governmental agency at the local, state, national, or international level, combined with academic work under faculty supervision. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Pol S 501. Quantitative Methods for Public Managers. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Use of data in managerial decison-making and policy analysis. Research design and sampling methods. Statistical software use required.

Pol S 502. Political Analysis and Research. (3-0) Cr. 3. F. *Prereq: 6 credits in political science.* Scope and methods of political science. Introduction to theoretical approaches and analytical reasoning in political science. Relationship of theory and data. Research design.

Pol S 504. Proseminar in International Politics. (3-0) Cr. 3. S. *Prereq: 6 credits in political science or graduate standing.* An overview of the major theoretical and empirical works in the study of international politics and foreign policy. Among the major theoretical approaches surveyed and applied to international politics are realism, neo-realism, liberalism, functionalism, rational choice theory, game theory, and decision-making theory. Seminal writings by leading scholars will be reviewed.

Pol S 505. Proseminar in Comparative Politics. (3-0) Cr. 3. F. *Prereq: 6 credits in political science or graduate standing.* Major theoretic approaches to the study of comparative politics -- varying concepts and definitions of society and policy, administrative traditions, institutional arrangements, political behavior, etc. Contrasting research method designs.

Pol S 506. Proseminar in American Politics. (3-0) Cr. 3. S. *Prereq: 6 credits in political science or graduate standing.* A presentation of the major theories and research on American government and politics. Substantive topics include modern democratic theory, institutional performance, and mass political behavior. A variety of research methodologies are examined, including normative theory, behavioralism, and rational choice analysis.

Pol S 510. State Government and Politics. (3-0) Cr. 3. *Prereq: 310.* Comparative analysis of state political systems. Role of interest groups, political parties, legislatures, courts, and governors in state politics. Possible determinants of public policy outputs at the state level.

Pol S 513. Intergovernmental Relations. (Dual-listed with 413). (3-0) Cr. 3. S. *Prereq: 6 credits of American government.* Theories and practices of the American federal system. Politics and policy making among federal, state, and local governments.

Pol S 525. Mass Political Behavior. (3-0) Cr. 3. *Prereq: 6 credits in Political Science or graduate standing.*. An in-depth survey of the theoretical, empirical, and methodological works concerning mass political behavior in the United States. Substantive topics include political attitudes and ideologies, public opinion and voting behavior, and political psychology. Methods for studying mass behavior include survey research and experimental approaches.

Pol S 531. Early Modern Political Thought. (Dual-listed with 431). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European history.* Study of original texts in political thought ranging from the Reformation to the French Revolution and its aftermath. Topics such as justice, freedom, rights, democracy, toleration, property, power, skepticism, and normative views of international politics.

Pol S 534. Legal and Ethical Issues in Information Assurance. (Cross-listed with Cpr E, InfAs). (3-0) Cr. 3. S. *Prereq: Graduate classification; Cpr E 531 or InfAs 531.* Legal and ethical issues in computer security. State and local codes and regulations. Privacy issues.

Pol S 535. Contemporary Political Philosophy. (Cross-listed with Phil). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits of philosophy or political science.* Examination of theories of justice proposed by contemporary political philosophers. Analysis of the philosophical foundations of perspectives such as liberalism, libertarianism, communitarianism, socialism, feminism. Normative assessments of socio-political institutions.

Pol S 541. Strategic Public Management. (40-0) Cr. 3. S. Theory and practice of strategic planning and implementation in the public sector. Alignment of planning with other strategic systems. Discussion of fundamental strategic management issues and concepts. Introduction of alternatives to the bureaucratic paradigm. Includes group exercises and guidance for strategic management facilitation. Course is one-week intensive format.

Pol S 542. The Policy and Politics of Coastal Areas. (Dual-listed with 442). (3-0) Cr. 3. SS. Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, tradeoffs between conservation and jobs, the quality of coastal lifestyle, ways in which citizens participate in policy for coastal areas.

Pol S 544. Comparative Public Policy. (3-0) Cr. 3. *Prereq: 6 credits in political science.* Examines how, why, and to what effect governments deal with substantive policy problems differently. Environmental factors, ideologies, cultures, domestic policy making processes, and interest groups.

Pol S 547. Political Leadership and Elites. (3-0) Cr. 3. *Prereq: 6 credits in political science.* Various forms of leadership and leader-follower relations. Obligations, exchanges, incentives, coercion, corruption, bossism in both the U.S. and foreign experience.

Pol S 552. Comparative Foreign Policy. (Dual-listed with 452). (3-0) Cr. 3. S. *Prereq: 251.* Various theoretical approaches to explain foreign policy making and behavior through the use of case studies of selected nations.

Pol S 559. International Relations Theory. (3-0) Cr. 3. F. *Prereq: 6 credits in international studies.* Selected theoretical writings, both classical and contemporary, on world politics. Realism, war and conflict, peace and cooperation, political economy, crisis decision making, and transnational relations.

Pol S 560. American Political Institutions. (3-0) Cr. 3. *Prereq: 6 credits in American government.* Examination of policy-making and governance in a separation of powers system. Interaction between the chief executive, the legislature, administrative agencies, and the public. How political and legal forces affect policy makers and are reflected in public policies and programs.

Pol S 569. Foundations of Public Administration. (3-0) Cr. 3. F. *Prereq: Graduate classification.* An examination of the social, political, intellectual, and environmental factors contributing to the historical development and central issues of American Public Administration. Exploration of classic and contemporary texts of public administration emphasizing constitutional and civic roles of public servants, administrative responsibility in democratic governance and justice, and essential frameworks to identify managerial skills, perspectives, and resources for effective, equitable public service.

Pol S 570. Politics and Management of Nonprofit Organizations. (3-0) Cr. 3. *Prereq: Graduate classification.* Discussion of contemporary issues and perspectives shaping the policy development and management of national and international nonprofit organizations. Topics include an historic overview of nonprofit and philanthropic perspectives; exploration of nonprofit organization roles in public service provision; review of the legal framework influencing nonprofit governance; and consideration of capacity building issues such as strategic planning, board development, fundraising, human resources, and volunteer management.

Pol S 571. Organizational Theory in the Public Sector. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Major theories of administrative organization, including motivations of administrators and organizations, comparisons of organizational arrangements, factors affecting organizational arrangements, and formal and informal decision-making structures.

Pol S 572. Public Finance and Budgeting. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Topics such as the fiscal role of government in a mixed economy; evaluation of sources of public revenue and credit; administrative, political, and institutional aspects of the budget and the budgetary process; alternative budget formats; skills required to analyze public revenue and spending. Spreadsheet use required.

Pol S 573. Public Personnel Administration. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Course discusses the history and development of high performance personnel administration in the public and nonprofit sectors regarding strategic planning, employee rights and responsibilities, performance assessment, collective bargaining, and civil service systems. Emphasized basic competencies in the essential human resource management tools in the areas of recruitment, retention, employee development, compensation, discipline, and conflict resolution.

Pol S 574. Policy and Program Evaluation. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Integration, application, and utilization of public administration and public policy concepts in the interpretation of results and effectiveness of public programs and the prediction of consequences for policymakers and administrators.

Pol S 575. Management in the Public Sector. (Dual-listed with 475). (3-0) Cr. 3. S. *Prereq: 6 credits in political science.* Literature and research on organizational behavior and management. Theory with emphasis on applied aspects of managing contemporary

public sector organizations. Topics include distinctions between public and private organizations, leadership, productivity, employee motivation, organizational structure, and organizational change.

Pol S 576. Administrative Law. (Dual-listed with 476). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate classification.* Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations.

Pol S 577. Government, Business, and Society. (Dual-listed with 477). (3-0) Cr. 3. F. *Prereq: Graduate classification.* Diverse perspectives on the changing roles and relationships of business, government and society so as to open the way for more effective policy decisions on corporate-government affairs. Topics may include the changing economy; transformation of workplace and community conditions; consumerism; social responsibilities of businesses; economic policies and regulations; and politics in the business-government relationship.

Pol S 579. Public Revenues and Cost Analysis. (3-0) Cr. 3. S. *Prereq: Graduate classification.* Provides an overview of public revenue policies and administration, and concepts and techniques of cost analysis. Examines topics such as administration and policies of property taxes, income taxes, sales taxes, and user charges. Provides an introductory understanding of different cost analysis techniques such as average cost and marginal cost analysis and activity-based costing. Spreadsheet use required.

Pol S 580. Ethics and Public Affairs. (Dual-listed with 480). (3-0) Cr. 3. *Prereq: 6 credits in political science.* Study of decision making approaches and application to case studies. Topics such as the different roles of public officials, proper scope and use of administrative discretion, and the admissibility of religious, political, and philosophical commitments in governmental decision making.

Pol S 581. International Political Economy. (3-0) Cr. 3. F. *Prereq: 6 credits in political science.* An overview of the international political economy since the end of World War II. Special emphasis on national (primarily U.S.) development assistance and agricultural/food politics and policies, and those of the international food organizations, the World Bank, and the regional development banks.

Pol S 582. Environmental Politics and Policies. (Dual-listed with 482). (3-0) Cr. 3. F. *Prereq: 3 credits in political science or 3 credits in Environmental Studies; graduate classification.* Major ideologies relating to conservation and ecology. Processes, participants, and institutions involved in state, national, and global environmental policymaking. Case studies of environmental controversies and proposals for policy reform.

Pol S 583. Law and Management. (Dual-listed with 483). (3-0) Cr. 3. F. Emerging constitutional/legal doctrines and requirements in public management: concept of new property rights in public employment/public service delivery; procedural due process requirement; scope of free speech and liberty protected in the conduct of public management; equal employment opportunity requirements; and the scope of official and personal immunities and liability in public affairs.

Pol S 585. Comparative Public Administration. (Dual-listed with 485). (3-0) Cr. 3. Comparison of government bureaucratic in major world regions; trends and issues of administrative and management reforms; globalization and other contemporary challenges to state administrative structures and policies; skills needed to evaluate and implement public management reforms.

Pol S 590. Special Topics. Cr. arr. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor.*
A. American Political Institutions
B. Public Law
C. Political Theory and Methodology
D. Comparative Government
E. International Relations
F. Political Parties and Policy Formation
G. Public Administration and Public Policy
I. Internship
T. Teaching Preparation

Pol S 598. Public Administration Internship. Cr. arr. F.S. *Prereq: 15 credits in political science, permission of the instructor.* Supervised internship with administrative agencies, legislative organizations, judicial branch offices, and nonprofit groups.

Pol S 599. Creative Component. Cr. arr.

Courses for graduate students

Pol S 610. Graduate Seminars. (3-0) Cr. 3. Repeatable. F.S. *Prereq: 15 credits in political science.*
A. American Political Institutions
B. Public Law
C. Political Theory and Methodology
D. Comparative Government
E. International Relations
F. Policy Process
G. Public Administration and Public Policy

Pol S 699. Research. Cr. arr. Repeatable.

Preprofessional Study

Requirements for admission to most professional academic programs can be met by study at Iowa State University. These requirements may be met in the course of obtaining a bachelor's degree from Iowa State or at a level below that of a degree, depending on the intended field of study. The specific courses taken in a preprofessional program will depend primarily upon the admission requirements of the professional schools to which a student wants to apply. In some programs requiring three years of preprofessional work, a student may, by careful planning, complete requirements for the bachelor's degree upon transferring to Iowa State up to 32 semester credits of professional coursework. Generally these credits will be counted as electives, but a maximum of 24 may be used as major credits in interdisciplinary studies and a smaller number as major credits in appropriate departments.

Students who have not declared a major upon entry should enter as preprofessional students, i.e., premedical, prelaw, PHP (preprofessional health programs), or GENPV (General Undergraduate Studies Pre Vet), until they choose a major or transfer to a professional school. All students, whether they have selected a major or not, are encouraged to identify their interest in a professional career by designating it on their application.

Information about preprofessional program admissions requirements and career opportunities in human health or law may be obtained in the Liberal Arts and Sciences Advising Center. Information about veterinary medicine admissions requirements and career opportunities may be obtained from the coordinator of the preveterinary program in the Office of the Dean of the College of Veterinary Medicine.

Clinical Laboratory Science/Medical Technology

Clinical laboratory scientists, still commonly referred to as medical technologists, are important members of health-care teams. They perform the chemical, microscopic, radio-assay, and microbiological tests that are necessary in disease diagnosis, and they type and cross-match blood samples to facilitate blood transfusions. They usually work under the supervision of a physician in a hospital or clinic laboratory, but may also be employed by a pharmaceutical company or by manufacturers of analytical instruments. The professional training requires 12 months in a hospital-based CLS/MT program following at least 3 years of college study that emphasizes chemistry and the biological sciences. Students may earn a bachelor's degree by completing the admissions requirements of the CLS/MT program and most of the degree requirements in 3 years on campus, then spending their fourth year in one of the hospital programs that are affiliated with Iowa State University. Before beginning the off-campus studies, students must earn at least 88 credits; the 32 most recent credits must have been earned in residence at ISU. A maximum of 32 semester credits earned in professional CLS/MT school can be used to partially fulfill the requirements for the bachelor's degree. Students who complete all degree requirements in residence at the university may apply to any school of medical technology for which the admission requirements have been met.

The following CLS/MT programs are affiliated with Iowa State University:

Mercy College of Health Sciences Clinical Laboratory Science Program, Des Moines, Iowa. Program Director: Kyla Deibler.

St. Luke's Methodist Hospital, Cedar Rapids, Iowa. Education Coordinator: Nadine Sojka. Medical Director: Dorryl Buck.

Dentistry

Dentists diagnose, treat, and try to prevent diseases and injuries of the teeth, jaws, and mouth. Usually a general practitioner will have spent 3 or 4 years taking preprofessional courses at the undergraduate level and 4 years in dental school earning the degree of doctor of dental surgery (D.D.S.) or doctor of dental medicine (D.M.D.). Learning a specialty requires at least 2 more years. The courses necessary for admission to most dental schools include English, biology, general and organic chemistry, and physics. Students may earn a degree in any major that Iowa State University offers as they meet the admission requirements; they should choose their major to reflect their own interests and abilities. Highly qualified students may be accepted into dental school after 3 years of preprofessional study without earning a baccalaureate degree.

Health Information Management

Health information managers serve as supervisors of medical records departments in hospitals, clinics, nursing homes, and other healthcare institutions. Certified registered record administrators (R.R.A.) must have completed a program leading to a bachelor's degree in medical record administration. Most professional programs are 2 years in length and follow 2 years of college study in chemistry, biology, the humanities, social sciences, languages, and philosophy. Students may take the preprofessional courses at Iowa State University and then transfer to a university offering the professional program or they may earn a bachelor's degree at Iowa State University before entering a health information management program.

Hospital and Health Administration

Administrators of health care organizations manage and guide the varied activities in hospitals, clinics, nursing homes, and mental health facilities. The professional requirement may be for a master's degree or a bachelor's degree, depending upon the size of the institution and whether an upper or middle entry-level position is desired. Students at Iowa State may take general education courses for two or more years and then transfer to a university offering a bachelor's degree in health administration, or they may spend four years earning a bachelor's degree in any department before entering a master's degree program at the University of Iowa or other university. Courses required for admission to master's degree programs in hospital and health administration vary, but may include introductory accounting, management, statistics, and economics.

Human Medicine

Physicians study, diagnose, and treat illness and injury. They may work in offices, clinics, hospitals, or laboratories, in private practice or for government or industry. Their professional training usually consists of 4 years of study in a college of medicine to earn the doctor of medicine (M.D.) degree, and then 3 or more years in hospital residency learning a specialty such as family medicine, pediatrics, surgery, obstetrics, or psychiatry. A degree of doctor of osteopathy (D.O.) is awarded to those students who complete 4 years in a college of osteopathic medicine before their residency. All medical schools recommend a broad preprofessional education that includes courses in biology, chemistry, physics, mathematics, English, the social sciences, arts and humanities. The degree of a premedical student can be from any college and in any curriculum or major offered by the university. The major should reflect the student's interests and provide appropriate preparation for an alternative career.

Law

An attorney offers assistance, often where a third-party neutral arbiter is required to resolve conflicts. Many attorneys work in private practice, but others secure positions in the public sector, e.g., federal or state governmental agencies. At least 3 years (a J.D. is completed in 3 years, with 90 credits. It may be completed earlier if the student attends summer school) are needed to complete a law degree, a Doctor of Jurisprudence (J.D.). A bachelor's degree is required for admission to all accredited law schools. A student planning to enter law school may major in any discipline. Courses taken as an undergraduate should be designed to assist the student in the development of critical thinking skills, including analytical written and oral skills. An understanding of social structures and institutions is invaluable. Perhaps most valuable are courses in philosophy, English language and literature, the social sciences, including political science, psychology, criminal justice, economics, and history. Courses in mathematics, particularly statistics, are also helpful in developing analytical skills.

Library and Information Science

Librarians are essential in educational institutions, medical facilities, government agencies, industries, and public information centers. The professional preparation for library administration is provided by master's degree programs. Admission requirements for the University of Iowa's program, for example, include a bachelor's degree with at least 85 semester credits in the arts and humanities and the natural and social sciences. Iowa State students may choose majors that reflect their own interests and that may provide a foundation for working in medical, law, or other specialized libraries.

Nursing

A professional nurse may do clinical nursing, teaching, or research, in hospitals, private practice, public health centers, schools, or industry. Although becoming a registered nurse (R.N.) does not require a bachelor's degree, the student who completes the bachelor of science degree in nursing (B.S.N.) has college-level preparation for clinical nursing and an essential base for graduate study. Iowa State University does not offer a nursing degree. Students may take prenursing courses for two years at Iowa State University and, if accepted, transfer to the BSN program at another college or university.

Occupational Therapy

Occupational therapists provide purposeful activities to help those who have been disabled by physical illness or injury, birth defects, emotional disorder, aging, drug abuse, or other problems to learn to cope with everyday living. Therapists treat patients in hospitals, school systems, and rehabilitation centers. Students may complete a bachelor's degree in a related area at Iowa State University, and then enter a certification, master's or doctoral degree program at another university; or they may complete 1 or 2 years of preoccupational therapy courses at Iowa State and then transfer to another university to complete the requirements for a bachelor's degree in occupational therapy. The prerequisites for admission to an occupational therapy program usually include

English, art, biology, chemistry, physics, psychology, sociology, anthropology, and statistics, but vary from one school to another.

Optometry

Optometrists examine, diagnose, treat and manage diseases of the visual system, the eye and associated structures. Treatment may include corrective glasses or contacts, vision therapy and therapeutic drugs. Optometrists usually set up their own offices or work in group practice. Professional study requires 4 years in a school or college of optometry and leads to the doctor of optometry (O.D.) degree. All optometry schools require at least 90 semester credits of preprofessional courses, including biology, chemistry, physics, mathematics, and English. Certain optometry schools require a bachelor's degree. Students wishing to earn the bachelor's degree from Iowa State University may choose any major and take the courses required for graduation with that major as they take the courses required for admission to a professional optometry program.

Pharmacy

Pharmacists prepare and dispense therapeutic drugs; educate health care professionals, patients and the general public about the appropriate use of drugs; conduct pharmaceutical research and work in industrial settings which involve the manufacture, marketing and advertising of pharmaceutical. Students may complete prepharmacy courses within two years at Iowa State University. Upon admission, the student will then transfer to a Pharm. D. program of study which will entail three or four years of study.

Physical Therapy

Physical therapists work with people who have been disabled by injury, illness, or birth defects. They assist in evaluating the physical problems and administer therapeutic agents such as massage and exercise, heat, baths, ultrasonics, and electricity; they work in hospitals, clinics, nursing homes, schools, rehabilitation centers, and private practice. Students may complete three years of undergraduate courses including prerequisites before transferring to a three-year professional curriculum such as the master's degree program at St. Ambrose University or the doctoral degree program at Creighton University. Usually, students earn a bachelor's degree in a related field at ISU before entering professional school to earn a master's degree or doctoral. Admission to the master's degree program at the University of Iowa requires a bachelor's degree. The bachelor's degree from ISU may be earned in any department, provided that the physical therapy prerequisites are completed. Earning a bachelor's degree prior to entering professional school allows a student to apply to a range of graduate level programs and builds a strong liberal arts foundation. Courses required for admission to a professional program include biology, chemistry, physics, psychology, mathematics, and statistics.

Physician Assistant

A physician assistant provides medical services under the supervision of a licensed physician. PAs conduct physical examinations, order and interpret laboratory tests, make diagnostic and treatment decisions, and are allowed to prescribe medication in most states. Certification as a physician assistant requires 2 years in a professional program at the master's or bachelor's degree level. Students applying to a bachelor's degree program must have completed at least 60 semester credits of college work including general and organic chemistry, zoology, behavioral science, and humanities. Applicants who have had health-care experience with direct patient contact are preferred. Admission to a master's degree program requires similar coursework and clinical experience in addition to a bachelor's degree.

Podiatry

Podiatrists diagnose, and treat diseases and disorders of the human foot and ankle. They treat patients in private and group practice, hospitals, and, increasingly, in industrial and sports-related positions. Professional training requires 4 years in a college of podiatric medicine and leads to the degree of doctor of podiatric medicine (D.P.M.). This is usually followed by 1 to 3 years in a hospital residency. All podiatric colleges require at least 3 years of preprofessional study, including courses in biology, general and organic chemistry, physics, and English. Most entrants have a bachelor's degree, which may be in any major. A few students may complete the admission requirements and most of the bachelor's degree requirements in 3 years. If so, a maximum of 32 semester credits may be transferred to Iowa State University from the first year in an accredited podiatric college in order to complete the requirements for the bachelor's degree.

Theology or Religious Studies

The professional education of a student of religion can follow one of two paths. The path to a profession as a pastor, priest, rabbi or other leadership position in a religious tradition usually requires 3 years in a program leading to the master of divinity (M.Div.) offered at a school of divinity or of theology. The path to a profession as a teacher of religious studies at the college level requires 4-7 years in a program leading to the Ph.D. at a graduate school of Religious Studies. Both seminaries and graduate schools require a bachelor's degree for admission. The American Association of Theological Schools recommends the following areas of study as the best preparation for theological studies: English language and literature; history, including non-Western culture; philosophy; natural sciences, social sciences, especially psychology, sociology and anthropology; the fine arts; Biblical and modern languages; and religion, both Western and Eastern. Although students in a variety of major fields may qualify for admission to a theological school, interested persons are advised to review their proposed programs with a representative of the Religious Studies Program in the Department of Philosophy and Religious Studies.

Veterinary Medicine

About 75% of all veterinarians are engaged in private practice. In a mixed practice, they diagnose and treat health problems among a variety of animals. Others specialize in one species (e.g., feline, pet bird) and still others specialize in a specific discipline within veterinary medicine (e.g., cardiology, ophthalmology). Veterinarians may also choose public and corporate practice (e.g., public health, education, research, food safety, industry, laboratory animal medicine, aquatic animal medicine, poultry medicine, and military veterinary medicine).

The professional program requires four years at a college of veterinary medicine and leads to the doctor of veterinary medicine degree (D.V.M.).

Admission to a veterinary college involves at least two years of preprofessional college education. Candidates must take courses in biology, chemistry, genetics, physics, English, humanities, social sciences, speech, anatomy and physiology, and biochemistry. (For Iowa State University see *Veterinary Medicine, Admission Requirements*; for most recent information, consult the College of Veterinary Medicine Web site: www.vetmed.iastate.edu.)

Students may pursue their preveterinary preparation in any college at Iowa State University. A major (preveterinary medicine is not a major) should be selected that is allied to each student's vocational interests in veterinary medicine or that otherwise offers vocational satisfaction in the event that plans for entry into the College of Veterinary Medicine change. Students are encouraged to pursue a bachelor's degree; the most effective progress toward a bachelor's degree is made when a major is selected upon entry and no change occurs before graduation. However, students who have not even considered a career other than veterinary medicine may need some time to explore possibilities before selection of a major.

To assist students who have indicated interest in the preveterinary program for the College of Veterinary Medicine and are undecided about a major, an advising category is available known as GENPV (General Undergraduate Studies Pre Vet). Orientation and advising services for these students are designed to help students fulfill preveterinary course requirements, to introduce available majors and careers allied to veterinary medicine, and to introduce career options in veterinary medicine. GENPV students must select a major by the end of their second semester. Some Iowa State University majors allow, by careful planning, the opportunity for a student to earn the bachelor's degree by combining credits from three years of preprofessional study and one year of professional study in the College of Veterinary Medicine.

Professional Agriculture

www.proag.iastate.edu/

(Interdepartmental Program administered by the Department of Agricultural Education and Studies)

Graduate Study

The Professional Agriculture major is an off-campus non-thesis program leading to the Master of Agriculture (M.Ag.) degree. It is available to students wishing to pursue graduate studies in agriculture, or natural resources through distance education. It is considered to be a professional degree and not preparation for a doctoral program. The program emphasizes agriculture/natural resource information and technology transfer in a variety of settings including education, extension, agencies, and industry training/development.

Graduates have a broad base of knowledge in one or more agriculture disciplines. They have the ability to communicate effectively and make decisions based on knowledge. To earn the 32 credits necessary for graduation, students must complete 28 semester credits of formal coursework, and 4 credits of creative component. Courses are delivered through distance education via the WWW and DVD. On-campus workshops are offered during summer sessions. Specific courses offered in the program are listed on the College of Agriculture's distance education website: www.agde.iastate.edu/.

Psychology

www.psychology.iastate.edu/

Douglas Bonett, Chair of Department

Distinguished Professors: Anderson, Wells

Distinguished Professor (Emeritus): Ahmann

University Professor: Lorenz

University Professor (Emeritus): Brown

Professors: Andre, D. Bonett, Cutrona, Dark, Larson, Phye, Prieto

Professors (Emeritus): Bath, Borgen, Charles, Edwards, Hannum, Hughes, Karas, Layton, Lewis, Peters, Strahan, Wolins, Zytowski

Professors (Collaborators): Conger, Gerrard

Associate Professors: Cooper, Cross, Cunnick, Madon, Scott, Venkatagiri, Vogel, Wei, West

Assistant Professors: Armstrong, Blankenship, Carpenter, Chan, Gentile, Guyll, Krizan, Morris, Wade, Weber

Assistant Professor (Adjunct): Mason

Assistant Professor (Collaborators): Day

Senior Lecturers: R. Bonett, Hanisch, Konar, Phillips, Scheel

Lecturers: Gilbert, Harms, Jenks, Shi, Sweet

Undergraduate Study

For college-level requirements in undergraduate curricula leading to the degrees of bachelor of arts and bachelor of science, see Liberal Arts and Sciences, Curriculum.

An undergraduate major in psychology may be taken as liberal arts education, as preparation for graduate study in psychology, or as background for professional education in law and in the health professions. A student with a bachelor's degree in psychology may qualify for a variety of positions including those in social sciences, mental health, corrections, rehabilitation, developmental disability centers, business, management, and public opinion surveying. Depending on professional goals, a minor in another discipline may be desirable. Students should consult with their academic advisers early in their undergraduate curriculum. The requirements of the program enable graduates to understand and apply the scientific principles, facts, and basic methods of psychology in their personal and professional activities. Graduates learn to think scientifically about human behaviors and mental processes. They can communicate effectively in speech and in writing, respect individual and cultural differences in behaviors, and appreciate ethical issues in both the science and practice of psychology. Professional work with a job title of psychologist in academic, business, clinical, government, and school settings requires graduate degrees.

The major must include the following psychology courses: 101, 102, 111, 201, 301, and 440, each with a minimum grade of C-. The major also must include four courses distributed across at least four of the following five areas: Area A – 230, 250; Area B – 280, 380; Area C – 310, 315; Area D – 312, 313, 316, 318(x); Area E – 360, 460. Three additional 3-credit courses in psychology must be taken. Area courses may be used to meet this requirement, but variable credit courses (470, 490, 491, and 492) may not. In accordance with college requirements, a C or better average is required in the courses used to satisfy the major.

Departmental requirements for the B.A. and B.S. include the following supporting courses: six credits in philosophy including 201; two of the following: Biol 101, 155 or 211; Chem 163; Gen 260 or Biol 258; one of the following: Stat 101, 104 or 226, with a minimum grade of C-; and a Math course, excluding 105, acceptable in LAS General Education Natural Sciences and Mathematics Discipline Area.

Students electing a B.S. degree also must complete Psych 302 with a minimum grade of C- and a minimum of 10 additional supporting credits in supporting courses from the list of courses in the LAS Gen Ed Natural Sciences and Mathematical Disciplines Area (or approved departmental list) as follows: three credits in mathematics, six credits in natural sciences, and one additional credit in a laboratory course.

Students electing a B.A. degree also must complete an ISU approved minor.

The department offers a minor in psychology. The minor requires completing 18 credits in psychology, including 101 and 301, each with a minimum grade of C-. At least 9 of the 18 credits must be in 300 level courses (or above), but no more than three credits total may be from Psych 490, 491, and 492. A C- or better is required in each course used to satisfy the minor and a C average or better is required in courses used to satisfy the minor. Contact the psychology advising office for more information.

Communication Proficiency requirement: The department requires a grade of C- or better in Engl 150 and in Engl 250 (or 250H) and a C- or better in Psych 302 or Psych 490 (2 credits minimum) or Engl 302, 309, or 314.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy in psychology, and for a minor for students with a major in other departments.

Within the major of psychology, the department offers a doctoral specialization in counseling psychology (APA accredited) and doctoral areas of concentration in cognitive psychology and social psychology.

Students seeking a graduate major in psychology must have graduated from an accredited college in a curriculum substantially equivalent to the undergraduate curriculum in Liberal Arts and Sciences at Iowa State University. Prerequisite to admission is at least 15 credits of basic psychology, which should include a laboratory course, a measurement course, and a statistics course.

Graduates function as academic psychologists in higher education or as professional psychologists in applied settings. They have an extensive knowledge of psychological principles and the conceptual and quantitative skills to conduct psychological research, communicating the results to the scientific community, students in the classroom, and the general public. Graduates in applied programs have specialized knowledge in counseling and program development. They are skilled in delivering such programs and services to diverse clientele in a variety of settings.

The department also participates in the interdepartmental programs in human computer interaction and neuroscience, and in the interdepartmental minor in gerontology (see Index).

A formal class and a supervised practicum in the teaching of psychology is recommended for all doctoral students whose future plans may include teaching at the college level. A 12-month internship in a training site or agency approved by the faculty is required of all doctoral students in counseling psychology.

Communication Disorders (CmDis)

(Administered by the Department of Psychology)

Courses primarily for undergraduate students

CmDis 170. Speech Improvement for Nonnative Speakers. (2-0) Cr. 2. For nonnative speakers of English only. Development of effective English vowel and consonant productions, accommodation processes that occur in context, intelligibility in conversational English, and appropriate stress patterns. Satisfactory-fail only.

CmDis 275. Introduction to Communication Disorders. (Cross-listed with Ling). (3-0) Cr. 3. Survey of nature, causes, and types of major communication disorders including phonological, adult and child language, voice, cleft palate, fluency, and hearing disorders.

CmDis 286. Basic Sign Language. (Cross-listed with Ling). (3-0) Cr. 3. Development of basic skills in the use and understanding of signed English, a modification of American Sign Language. Overview of the types, causes and consequences of hearing impairment, deaf culture and the education of hearing-impaired children.

CmDis 371. Phonetics and Phonology. (Cross-listed with Ling). (3-0) Cr. 3. *Prereq: 275 or Engl 219.* Analysis of speech through study of individual sounds, their variations, and relationships in context; English phonology; practice in auditory discrimination and transcription of sounds of American English; description of speech sounds in terms of their production, transmission, and perception.

CmDis 471. Language Development. (Cross-listed with Ling). (3-0) Cr. 3. *Prereq: 275 or Psych 230 or Engl 219.* Definition of components of language. Overview of theories and developmental processes related to each component of linguistic skill (semantics, lexicon, syntax, morphology, phonology, pragmatics). Overview of normative information available for infants, children, adolescents, and adults. Attention to metalinguistic skills and the complementary nonlinguistic and paralinguistic skills. Nonmajor graduate credit.

Courses primarily for undergraduate students

Psych 101. Introduction to Psychology. (3-0) Cr. 3. F.S.SS. Fundamental psychological concepts derived from the application of the scientific method to the study of behavior and mental processes. Applications of psychology.
H. Honors section. (2-2) F. (For students in the University Honors Program only.)

Psych 102. Laboratory in Introductory Psychology. (0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in 101.* Laboratory to accompany 101.

Psych 111. Orientation to Psychology. Cr. 0.5. F.S. Program requirements and degree/career options. Required of psychology majors. Satisfactory-fail only.

Psych 131. Academic Learning Skills. (0-2) Cr. 1. F.S. Efficient methods of study and reading. Satisfactory-fail only.

Psych 230. Developmental Psychology. (3-0) Cr. 3. F.S.SS. Life-span development of physical traits, cognition, intelligence, social and emotional behavior, personality, and adjustment.

Psych 280. Social Psychology. (3-0) Cr. 3. F.S.SS. Individual human behavior in social contexts. Emphasis on social judgments and decisions, attitudes, perceptions of others, social influence, aggression, stereotypes, and helping.

Psych 301. Research Design and Methodology. (3-0) Cr. 3. F.S.SS. *Prereq: Stat 101; 1 course in psychology.* Survey of the principal research techniques used in psychology with an emphasis on the statistical analysis of psychological data.

Psych 302. Research Methods in Psychology. (2-2) Cr. 3. F.S. *Prereq: 301.* Discussion of and experience in designing research studies, collecting and analyzing data, and preparing research reports in psychology.

Psych 310. Brain and Behavior. (3-0) Cr. 3. F.S. *Prereq: 101.* Survey of basic concepts in the neurosciences with emphasis on brain mechanisms mediating sensory processes, arousal, motivation, learning, and abnormal behavior.

Psych 312. Sensation and Perception. (3-0) Cr. 3. F.S. *Prereq: 101.* Survey of the physiology and psychology of human sensory systems including vision, audition, smell, taste, the skin senses, and the vestibular senses.

Psych 313. Learning and Memory. (3-0) Cr. 3. F.S. *Prereq: 101.* Fundamental concepts and theories of learning and memory derived from human and animal research.

Psych 314. Motivation. (3-0) Cr. 3. F.S. *Prereq: 101.* Concepts and topics of motivation including curiosity, pain, emotion, sex, aggression, love, play, addiction, sleep, fatigue, and work.

Psych 315. Drugs and Behavior. (3-0) Cr. 3. F.S. *Prereq: 101, Biol 155 or 211.* A biological perspective on fundamentals of psychoactive drugs and their use in experimental, therapeutic, and social settings.

Psych 316. Cognitive Processes. (3-0) Cr. 3. F.S. *Prereq: 101.* The study of the human mind, addressing the processes by which people perceive the world, remember information, access and use knowledge, understand language, make decisions, reason, learn and solve problems.

Psych 333. Educational Psychology. (Cross-listed with C I). (3-0) Cr. 3. F.S. *Prereq: Psych 230 or HD FS 102, application to the teacher education program or major in psychology.* Classroom learning with emphasis on theories of learning and cognition, and instructional techniques. Major emphasis on measurement theory and the classroom assessment of learning outcomes.

Psych 346. Psychology of Women. (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: 2 courses in psychology including 101.* Survey of psychological literature relating to biological, developmental, interpersonal, and societal determinants of the behavior of women.

Psych 348. Psychology of Religion. (Cross-listed with Relig). (3-0) Cr. 3. *Prereq: Nine credits in psychology.* Survey of psychological theory and research investigating religious and spiritual attitudes, beliefs and practices.

Psych 360. Psychology of Normal Personality. (3-0) Cr. 3. F.S.SS. *Prereq: 101.* Theories and research in the study of development and functioning of normal personality.

Psych 380. Social Cognition. (3-0) Cr. 3. *Prereq: 101 or 280.* How people understand themselves and others, including attribution, social categories and schemas, the self, social inference, stereotypes, and prejudice.

Psych 381. Social Psychology of Small Group Behavior. (Cross-listed with Soc). (3-0) Cr. 3. S. *Prereq: 280 or Soc 305.* A survey of small group theory and research from an interdisciplinary, social psychological perspective.

Psych 401. History of Psychology. (3-0) Cr. 3. F.S. *Prereq: 4 courses in psychology.* Philosophy and science backgrounds of psychology. Development of theories and causes of events in academic and applied psychology. Nonmajor graduate credit.

Psych 411. Evolutionary Psychology. (3-0) Cr. 3. S. *Prereq: Junior classification, three courses in psychology; biology 211.* This course examines the application of the principles of evolutionary biology to the understanding of human behavior. Evolutionary perspectives on brain development, cognition, language, mating behavior, sex differences, altruism, artistic behavior, and criminal behavior are explored. Arguments by those critical of the evolutionary approach to psychology are examined as well.

Psych 413. Psychology of Language. (Cross-listed with Ling). (3-0) Cr. 3. *Prereq: Psych 101.* Introduction to psycholinguistics. Topics may include origin of language, speech perception, language comprehension, reading, bilingualism, brain bases of language, and computational modeling of language processes. Nonmajor graduate credit.

Psych 422. Counseling Theories and Techniques. (3-0) Cr. 3. F. *Prereq: 3 courses in psychology.* Overview of the major counseling theories and techniques, with emphasis on the key concepts of each theory, the role of the counselor, therapetuic goals, and the main techniques derived from each theory. Nonmajor graduate credit.

Psych 422L. Laboratory in Counseling Theory and Techniques. (0-2) Cr. 1. F. *Prereq: Three classes in psychology and credit or enrollment in Psych 422..* Learn basic counseling skills such as active listening, reflecting feelings, empathy, confrontation, immediacy and self-disclosure. Supervised practice using basic counseling skills.

Psych 440. Psychological Measurement I. (2-2) Cr. 3. F.S.SS. *Prereq: 301 and 9 credits in psychology, Stat 101.* Principles of psychological measurement, including concepts of reliability and validity; interpretation of scores; factors influencing performance; construction and use of measures of ability, achievement, and personality. Nonmajor graduate credit.

Psych 450. Industrial Psychology. (3-0) Cr. 3. F.S. *Prereq: 2 courses in psychology including 101, Stat 101.* Content and methods of industrial psychology including the different approaches used to select employees, how to conduct performance appraisals, and how to train employees in organizations. Work attitudes and behaviors of employees, work schedules, safety and human factors as well as relevant legal issues are discussed. Statistics including regression and correlation are used in the course. Nonmajor graduate credit.

Psych 460. Abnormal Psychology. (3-0) Cr. 3. F.S.SS. *Prereq: 3 courses in psychology including 101.* Description of major forms of maladaptation including anxiety, mood disorders, personality disorders, substance dependence, and schizophrenia. Factors in the development of behavior deviations. Research pertinent to the description, development, and maintenance of abnormal behavior. Nonmajor graduate credit.

Psych 470. Seminar in Psychology. (1-0) Cr. arr. Repeatable. *Prereq: 12 credits in psychology.* Current topics in psychological research and practice.
A. Counseling
B. Experimental
C. Individual Differences
D. Social

Psych 484. Psychology of Close Relationships. (3-0) Cr. 3. *Prereq: 9 credits in psychology including 280.* Theories and research concerning the functions, development, and deterioration of close relationships. Influence of psychological processes on friendship, romantic, marital, and family relationships. Topics include mate selection, interdependence, trust and commitment, power and dominance in relationships, sexuality, divorce, gender roles, and family interaction. Nonmajor graduate credit.

Psych 485. Health Psychology. (3-0) Cr. 3. F. *Prereq: Junior classification, 6 credits in psychology.* Application of psychological theory and research methods to issues in physical health. Psychological factors in illness prevention, health maintenance, treatment of illness, recovery from injury and illness, and adjustment to chronic illness. Nonmajor graduate credit.

Psych 488. Cultural Psychology. (3-0) Cr. 3. *Prereq: 280 and 301; junior classification.* Examination of the ways that cultural beliefs, values, and ideologies shape cognitive, developmental, social and other psychological phenomena. Nonmajor graduate credit.

Psych 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior classification, 6 credits in psychology, and permission of instructor.* Supervised reading in an area of psychology. Writing requirement.

No more than 9 credits of Psych 490 may be counted toward a degree in psychology.

Psych 491. Research Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior classification, permission of instructor, and credit or enrollment in 301.* Supervised research in an area of psychology. Primarily for students intending to pursue graduate education. No more than 9 credits of Psych 491 may be counted toward a degree in psychology.

Psych 492. Fieldwork Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: Junior classification, 12 credits in psychology, and permission of instructor.* Supervised fieldwork in a human service agency or other appropriate setting. No more than 9 credits of Psych 492 may be counted toward a degree in psychology. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Psych 508. Research Methods in Applied Psychology. (3-0) Cr. 3. *Prereq: 440, Stat 401.* Methods and issues in applied psychological research. Role of theory in research, fidelity of measurement, selection of subjects, sampling, ethical issues, experimenter bias, data collection methods, power analysis, and professional standards for writing research articles. Emphasis on research methodological issues, not statistical issues.

Psych 512. Advanced Perception. (3-0) Cr. 3. *Prereq: 312.* Survey of current theory and research in perception with an emphasis on vision.

Psych 514. Advanced Human Learning and Memory. (3-0) Cr. 3. *Prereq: 313 or 316 and Stat 101.* Theoretical and empirical research in human learning and memory.

Psych 516. Advanced Cognition. (3-0) Cr. 3. F.S. *Prereq: 316.* Theoretical models and empirical research in human cognition within the domains of perception, attention, memory, language, concepts/categorization and spatial cognition.

Psych 517. Psychopharmacology. (3-0) Cr. 3. *Prereq: 310, 315, or equivalent and permission of instructor.* Fundamentals of drug-behavior interactions with emphasis on psychoactive drugs and their use in experimental, therapeutic, and social settings.

Psych 519. Cognitive Neuropsychology. (3-0) Cr. 3. *Prereq: 310 and 316 or 313.* Psychological models and related neurological substrates underlying cognition in normal and brain-damaged individuals.

Psych 521. Cognitive Psychology of Human Computer Interaction. (Cross-listed with HCI). (3-0) Cr. 3. *Prereq: Graduate classification or instructor approval.* Biological, behavioral, perceptual, cognitive and social issues relevant to human computer interactions.

Psych 522. Scientific Methods in Human Computer Interaction. (Cross-listed with HCI). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Psych 521 and Stat 101 or equivalent.* Basics of hypothesis testing, experimental design, analysis and interpretation of data, and the ethical principles of human research as they apply to research in human computer interaction.

Psych 530. Advanced Developmental Psychology. (3-0) Cr. 3. *Prereq: Psych 230, 301, 302 and Stat 401, or graduate classification.* Theory and research on infant and child development, with an emphasis on perceptual development, cognitive development and social development.

Psych 533. Educational Psychology of Learning Cognition, and Motivation. (Cross-listed with C I). (3-0) Cr. 3. F. *Prereq: 333 or teacher licensure.* Learning, cognition, and memory in educational/training settings.

Psych 538. Developmental Disabilities in Children. (Cross-listed with HD FS). (3-0) Cr. 3. F. *Prereq: 9 credits in human development and family studies or psychology.* Theories, research, and current issues regarding development in children with disabilities. Investigation of interventions with children and families.

Psych 542. Introduction to Psychological Assessment. (3-0) Cr. 3. F. *Prereq: 440.* Theory and research concerning assessment of intelligence and achievement with emphasis on developmental patterns and diagnosis of learning problems. Critical examination of current assessment practices in clinical and educational settings.

Psych 544. Practicum in Assessment. (2-1) Cr. 2. *Prereq: 542 and admission into the PhD program in counseling psychology.* Supervised practice in designing and implementing observational systems and in administering, scoring, interpreting, and reporting individual tests.
A. Behavioral Assessment
B. Individual Tests: Children
C. Testing: Adult Ages

Psych 550. Advanced Industrial and Organizational Psychology. (3-0) Cr. 3. *Prereq: 440, Stat 402.* Critical examination of theories, methods, and applications in industrial and organizational psychology. History and legal issues, predictor and criteria relationships, employee attitudes and behaviors, employee training and motivation, and human factors.

Psych 560. Advanced Personality Psychology. (3-0) Cr. 3. *Prereq: 4 courses in psychology, including 360.* Analysis of theories of personality, concepts, methods, and current research issues.

Psych 561. Psychopathology and Behavior Deviations. (3-0) Cr. 3. *Prereq: 460.* Examination of theoretical perspectives and current research pertinent to the major forms of adult dysfunction including: adjustment, anxiety, mood, somatoform, dissociative, sexual and gender identity, personality, schizophrenic, eating, and substance abuse disorders.

Psych 562. Personality Assessment. (3-0) Cr. 3. *Prereq: 360, 440, 542, and Stat 401 and admission to the PhD program in counseling psychology.* Principles, concepts, and methods of personality assessment. Though not a practicum course, exposure is given to a variety of objective, projective, and situational tests.

Psych 563. Developmental Psychopathology. (3-0) Cr. 3. *Prereq: 230 and 460 or graduate classification.* Theory and research related to major disorders of childhood and adolescence with an emphasis on assessment, etiology, and developmental processes, and multimodal interventions.

Psych 580. Advanced Social Psychology: Psychological Perspectives. (3-0) Cr. 3. *Prereq: 4 courses in psychology, including 280.* Current theories, methods, and research in social psychology with an emphasis on cognitive and interpersonal processes such as attribution, social cognition, attitude change, attraction, aggression, and social comparison.

Psych 581. Applications of social Psychology Theories. (3-0) Cr. 3. *Prereq: 12 credits in psychology, including 280.* Application of social psychological theory to various applied topics, including physical and mental health, stress, and coping.

Psych 586. Research Methods in Social Psychology. (3-0) Cr. 3. *Prereq: Stat 402 and permission of instructor.* Ethical issues, generating testable hypotheses, operationalizing independent and dependent variables, sampling and design issues, laboratory procedures, and interpretation of results in experimental research. Issues in analysis of variance, Bayesian reasoning, and effect size estimation will be emphasized, as will writing and publication strategies.

Psych 590. Special Topics. Cr. arr. Repeatable. *Prereq: 12 credits in psychology, and permission of instructor.* Guided reading on special topics or individual research projects.
A. Counseling
Q. Cognitive
R. Social
Z. General

Psych 592. Seminar in Psychology. (1-0) Cr. arr. Repeatable. *Prereq: 12 hours in psychology. Psych 592A also requires admission into the doctoral program in counseling psychology.*
A. Counseling
B. Industrial-Organizational
M. Professional Issues and Ethics
P. Research Methods and Psychometrics
Q. Cognitive
R. Social
Z. General

Psych 597. Internship in Psychology. Cr. R. *Prereq: M.S. degree candidacy; permission of instructor.* Full-time, non-clinical, supervised experience in a setting relevant to psychology. Intended for master's degree level internships.

Psych 599. Creative Component. Cr. arr. Satisfactory-fail only.

Courses for graduate students

Psych 601. History of Philosophy of Psychology. (3-0) Cr. 3. *Prereq: 4 courses in psychology.* Origins of psychology in philosophical, medical, and related thought. Development as an independent discipline in the nineteenth and twentieth centuries as a science and as a practice including traditional and contemporary theory and philosophy.

Psych 605. Multi-level Modeling for social and Behavioral Sciences. (Cross-listed with HD FS). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 404.* Rationale for and interpretation of random coefficient models. Strategies for the analysis of multi-level and panel data including models for random intercepts, random slopes, and growth curves. Applications including HLM, SAS, PROCMIX, and MPLUS.

Psych 621. Psychological Counseling: Theory and Process. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Overview of major counseling theories with emphases upon: key concepts of theories, the role of the counselor, and applications of theory in fostering client change.

Psych 621L. Techniques in Counseling. (0-6) Cr. 3. F. *Prereq: 621 or concurrent enrollment in 621 and admission into the doctoral program in counseling psychology.* Development of basic counseling skills and techniques through observation, role-playing, case studies, and supervised counseling sessions.

Psych 623. Vocational Behavior. (3-0) Cr. 3. *Prereq: 3 courses in psychology and admission to the PhD program in counseling psychology.* Theoretical views, research, and issues in career development through the life span. Methods of career counseling, including appraisal interviewing, assessment, test interpretation, and use of information sources.

Psych 626. Group Counseling. (2-2) Cr. 3. *Prereq: 621L, 691A and admission to the PhD program in counseling psychology.* Theory, research, ethical issues, and therapeutic considerations relevant to group counseling. Participation in lab exercises for development of group counseling skills and observation of ongoing groups.

Psych 633. Teaching of Psychology. (3-0) Cr. 3. *Prereq: Enrollment in doctoral degree program in psychology, completion of at least 1 year of graduate study, permission of instructor.* Orientation to teaching of psychology at college level: academic issues and problems, instructional and evaluative techniques.

Psych 635. Interventions with Children and Adolescents. (3-0) Cr. 3. *Prereq: Graduate classification.* Research and theory underlying application of behavioral and cognitive psychology to the treatment of childhood and adolescent psychopathology with an emphasis on internalizing disorders, developmental processes, and multimodal interventions.

Psych 691. Practicum in Psychology. Cr. arr. *Prereq: Permission of instructor.* Supervised practice and experience in the following fields of specialization in applied psychology:
A. Counseling (Beginning).
B. Intermediate Counseling.
E. Group Counseling. Prereq: 626, 691A
F. Advanced Counseling. Prereq: 691A
T. Teaching. Prereq: 633 (satisfactory-fail basis grading only)
Z. General

Psych 692. Research Seminar. (1-0) Cr. arr. Repeatable. *Prereq: Permission of instructor.*

A. Counseling
Q. Cognitive
R. Social
Z. General

Psych 697. Internship in Counseling Psychology. Cr. R. *Prereq: Ph.D. candidacy in the Counseling Psychology program, approved dissertation proposal, and permission of instructor.* Full time supervised predoctoral internship experience in a setting relevant to counseling psychology.

Psych 699. Research. Cr. arr. Repeatable. Satisfactory-fail only.

Seed Technology and Business

(Interdepartmental Graduate Major)

www.seeds.iastate.edu/

Manjit Misra. Seed Science Center Director (Administration), Gary Munkvold, Program Chair; Paul Christensen, Program Coordinator

Advisory Committee: David Acker, Sanjeev Agarwal, Paul Christensen, Ana Correia, Michael Crum, Susana Goggi, Kendall Lamkey, Jeff Iles, Manjit Misra, Gary Munkvold, Gaylan Scofield

Faculty: Sanjeev Agarwal, Rajeev Arora, Jennifer Blackhurst, Paul Christensen, Anne Clem, Ana Correia, Michael Crum, Fredrick Dark, David Dornbos, Susana Goggi, Brian Mennecke, Manjit Misra, Gary Munkvold, Russell Mullen, Brad Shrader, James Werbel, John Wong

On-Line Graduate Study

The Graduate Program in Seed Technology and Business offers students advanced study in the seed science and technology and business management appropriate for application in the seed sector. The program is offered by nine departments in the Colleges of Business and Agriculture and Life Sciences: Accounting; Agronomy; Finance; Horticulture; Logistics, Operations, and Management Information Systems; Management; Marketing; and Plant Pathology. This multidisciplinary program offers a focused on-line curriculum for a Master of Science in Seed Technology and Business, along with Graduate Certificates in Seed Science and Technology and in Seed Business Management. Courses are available to students in other majors.

The curriculum offers a set of scientific and technical courses that are focused on seed, with a set of basic management courses, similar to those in the core courses of an MBA program. The business courses will use examples drawn from the seed industry. A creative component is required for the Master of Science degree.

Prerequisite for the program is a bachelor's degree in business, agriculture, other biological discipline, or related degrees. Graduate training in these disciplines will also be considered.

Graduates of the Graduate Program in Seed Technology and Business will be prepared for roles in management and leadership within private and public seed and seed-related organizations.

All of the courses listed below are required for the Master of Science degree, and the students are expected to go through the curriculum in order. The pace of the course sequence is designed to allow the students with work and other commitments to participate. Students will complete the creative component under the guidance of their Program of Study Committee. In many cases, the creative component topic will be associated with the student's work.

Graduates of the Master of Science curriculum will be prepared for roles in management and leadership within seed related organizations, private and public.

The program offers two graduate certificates: a graduate certificate in Seed Science and Technology, which consists of 9 courses (STB/Agron 535, STB/Agron 536, STB/Agron 510, STB/Hort 543, STB/Pl P 592, STB/Agron 547, STB/Agron 534, STB/Agron 539, and STB/Agron 595), and a graduate certificate in Seed Business Management, which consists of 7 courses (STB/Agron 535, BusAd 501, BusAd 503, BusAd 504, BusAd 507, BusAd 508, and BusAd 509). Graduate certificate courses may be applied to the Master of Science in Seed Technology and Business. Those interested in these graduate certificates should contact the Program for details.

Information on application procedures and specific requirements of the major can be obtained from the following internet addresses: http://www.seedgrad.iastate.edu, or http://www.distance.iastate.edu/ or by writing to seedgrad@iastate.edu.

Courses for graduate students

STB 510. Crop Improvement. (Cross-listed with Agron). (3-0) Cr. 3. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* A study of the basic principles and methods in the genetic improvement of crop plants. Methods used in manipulating genomes through the use of biotechnology. Methods of cultivar development. Quantitative procedures for describing response to selection. Analysis of the relationship of reproductive characters and growth characteristics to response to selection.

STB 534. Seed and Variety, Testing and Technology. (Cross-listed with Agron). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* The components of seed quality and how they are assessed in the laboratory, including traits derived from modern biotechnology. The impact of new technologies on seed quality testing. Variety maintenance procedures and breeder seed. Variety identification: phenotype and grow-out trials, isozyme testing, and DNA marker testing. Procedures for evaluating varieties. The variance tests appropriate for fixed effects analysis of variance. Statistical inference and stratification for yield trials. Use of strip plot testing.

STB 535. Introduction to the Seed Industry. (Cross-listed with Agron). Cr. 1. *Prereq: Curriculum requires undergraduate specialization in a business or biological science.* An analysis of the defining characteristics of the seed industry and introduction to the Master in Seed Technology and Business curriculum. The tasks of crop improvement and seed production will be analytically related to basic management functions and classifications of management activities that are used in the study of business administration. Management tasks and roles will be analyzed in related to the public policy issues that shape the seed industry, including ethical and economical approaches to biotechnology, intellectual property, and corporate responsibility.

STB 536. Quantitative Methods for Seed. (Cross-listed with Agron). (1-0) Cr. 1. F. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Quantitative Methods for analyzing and interpreting agronomic and business information for the seed industry. Principles of experimental design and hypothesis testing, regression, correlation and graphical representation of data. Use of spreadsheets for manipulating, analyzing and presenting data.

STB 539. Seed Conditioning and Storage. (Cross-listed with Agron). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* The technical operations which may be carried out on a seed lot from harvest until it is ready for marketing and use. The opportunities for quality improvement and the risks of deterioration which are present during that time. Analysis of the costs of and benefits of operations. Evaluation of equipment based on benefits to the customer and producer. Interpretation of the role of the conditioning plant and store as a focal points within the overall operations of a seed company.

STB 543. Seed Physiology. (Cross-listed with Hort). (2-0) Cr. 2. Alt. F., offered 2010. *Prereq: Admission to the Graduate Seed Technology and Business Program or approval of the instructor.* Brief introduction to plant physiology. Physiological aspects of seed development, maturation, longevity, dormancy and germination. Links between physiology and seed quality.

STB 547. Seed Production. (Cross-listed with Agron). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Survey of crop production; including management of soil fertility, planting dates, populations, weed control, and insect control. Analysis of the principles of seed multiplication and the key practices which are used to ensure high quality in the products. Field inspection procedures and production aspects that differ from other crop production. Foundation seed production. Analysis of the typical organization of field production tasks. Resources and capabilities required. Survey of differences in seed production strategies between crops and impact of differences on management of seed production.

STB 592. Seed Health Management. (Cross-listed with Pl P). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: Admission to the Graduate Program in Seed Technology and Business/Consent of instructor.* Occurrence and management of diseases during seed production, harvest, conditioning, storage, and planting. Emphasis on epidemiology, disease management in the field, seed treatment, effects of conditioning on seed health, and seed health testing.

STB 595. Seed Quality, Production, and Research Management. (Cross-listed with Agron). (3-0) Cr. 3. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor.* Advanced survey of the organization, staff capabilities and management characteristics typical in seed production and crop improvement in seed enterprises. Analysis of the use of quality information in the management of seed operations and sales. Process management applications for seed. Production planning for existing capacity. Analysis of the manager's tasks in the annual cycle and how the tasks of these managers relate to the general categories of business management roles. Difference in management strategies used with different situations and groups of employees.

STB 599. Creative Component. Cr. arr. *Prereq: Admission to the Master's in Seed Technology and Business degree program and permission of the instructor.* A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

Sociology

www.soc.iastate.edu

R. Paul Lasley, Chair of Department

Distinguished Professor: C. Flora

Distinguished Professor (Emeritus): Beal

University Professors: Lorenz, Woodman

University Professor (Emeritus): Goudy

Professors: Besser, Dobratz, J. Flora, Jones-Johnson, Keith, Korsching, Lasley, Sapp, Sawyer, Wells

Professors (Emeritus): Blake, Bruton, Butler, Cohen, Hoiberg, Hraba, Klonglan, Miller, Mulford, Oulman, Padgitt, Ryan, Schafer, Tait

Professor (Collaborator): Simons

Associate Professors: Allen, Bird, Cast, Delisi, Harrod, Hochstetler, Mazur, Morton, Roberts, Schweingruber, Stewart

Associate Professor (Adjunct): Waggoner

Assistant Professors: Arbuckle, Bain, Downing-Matibag, Krier, Maldonado-Pabon, Monahan, Peters, Prokos

Assistant Professor (Adjunct): Emery

Lecturer: Conis, Reger

Undergraduate Study

Sociology graduates will understand and demonstrate: 1) general knowledge of sociology; 2) research methods in sociology; 3) critical thinking skills; 4) application of sociology to pressing social issues; 5) sociological and professional values; 6) information technology; 7) communication skills; and 8) personal and career development.

The department offers course work leading to either a bachelor of arts or bachelor of science in sociology. Additionally, a bachelor of science in Public Service and Administration in Agriculture is offered. The department offers course work for the Interdisciplinary Studies major in Criminology and Criminal Justice and a minor in Criminal Justice Studies. Programs of study in sociology offered in both the College of Agriculture and the College of Liberal Arts and Sciences are outlined in this section. For the undergraduate curriculum in Liberal Arts and Sciences, with a major in sociology leading to the degrees of bachelor of arts and bachelor of science, see Liberal Arts and Sciences, Curricula. For the undergraduate curriculum in agriculture, with major in public service and administration in agriculture, leading to the degree bachelor of science, see Agriculture, Curriculum in Public Service and Administration in Agriculture. For the undergraduate curriculum in Liberal Arts and Sciences, with a minor in criminal justice studies, see Liberal Arts and Sciences, Curriculum.

Graduates understand how social institutions, communities, and organizations work and change; they can examine the causes and consequences of conformity, deviance, and inequality. They can apply sociological understanding of human behavior to practical work situations and everyday life. Graduates can read critically, think independently, and communicate effectively about social issues and social policy.

College of Liberal Arts and Sciences—Sociology

A major in sociology can serve as a liberal arts education; as preparation for various positions in social service and related occupations in business and industry; as background for professional education in such areas as law and theology or as a basis for graduate professional training as a sociologist in academic, government, business, and industrial settings.

Departmental requirements for sociology majors include the following supporting course: Philosophy including 230 and one upper level Philosophy course; English 302 or 309 or 314; One of the following courses: Statistics101 or 104; At least three additional credits with a Mathematics designator.

A program of study that meets the needs and interests of the student and department requirements will be developed in consultation with the major adviser. Programs of study will include 115; 130 or 134; 202; three credits from 310, 380 or 420; 302; 305; three credits from 327, 330, 331 or 332; 401; 9 credits of upper level electives. Majors must receive grades of C or better in Engl 150 and 250, and a grade of C or better in either Engl 302 or 309 or 314. Programs leading to a bachelor of arts degree will emphasize additional coursework in groups I, II and IV of the general education requirements. Programs leading to a bachelor of science degree will emphasize additional coursework in groups III and IV of the general education requirements. Some of the possible fields of concentration are criminal justice systems, community (urban and rural) sociology, family sociology, sociology of work, social science teaching, research methods and statistics, social change and development, complex organizations, human population and ecology, social inequality, social psychology, and sociological theory.

In consultation with their advisers, students may gain work experience and develop their skills in their field of concentration through the field observation and practice options of 460.

The department offers a minor in sociology which may be earned by completing 15 credits in sociology including: Sociology 130 or 134; 3 credits from 310, 380 or 420; 3 credits from 264, 305 or 381; an additional 6 credits in sociology courses. At least 9 of the 15 credits must be at the 300 level or higher, 6 of these credits must be taken at ISU with a minimal grade of C.

College of Agriculture—Public Service and Administration in Agriculture

The curriculum in public service and administration in agriculture is designed for students who desire an interdisciplinary education to pursue a career with agriculturally related governmental and nonprofit agencies, or with businesses and industries that are concerned with public services in agriculture, natural resources or rural communities. Students will explore the planning and implementing of rural and agriculturally related programs in organizations, communities (town, city, or county), multicounty areas, states, regions, and at the federal level.

The curriculum has a broad base of general education subjects including credits in communications, mathematics, physical and biological sciences, social sciences, and humanities. The technical subjects represent a combination of sociology, economics, public administration and agriculture, with emphases on social and economic change, history of public services, complex organizations, interagency relationships, community leadership, community action, adoption and diffusion, group dynamics, and political and legal behavior as they relate to agriculture and rural areas. For the Interdisciplinary Studies major in Criminology and Criminal Justice, see *Liberal Arts and Sciences, Curriculum*.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in sociology and rural sociology and minor work for students majoring in other departments. For M.S. and Ph.D. departmental requirements, see Program of Graduate Study for Degrees in Sociology and Rural Sociology, available from the department office. The department offers concentrations in a number of areas, e.g., community studies and development; sociology of families, inequality, food systems, agriculture and environment; methodology; social change and development; criminology; the economy, organizations and work; and social psychology. The Department of Sociology does not offer a nonthesis master's program.

Graduates have a broad understanding of sociology, address complex societal problems, and communicate effectively with scientific colleagues and the general public in both formal and informal settings. They understand sociological theory, conduct research, and are prepared to educate college students and contribute to public policy. Although the department stipulates no language requirement for either the degree master of science or the degree doctor of philosophy, specifying competence in one or more languages may be desirable in some instances.

The department also participates in the interdepartmental program in interdepartmental majors in sustainable agriculture, transportation and water resources, and interdepartmental minors in gerontology (see *Index*).

Courses primarily for undergraduate students

Soc 110. Orientation to Public Service and Administration in Agriculture. Cr. R. F. Survey of public service and administration in agriculture. Exploration of career tracks and career planning. Recommended during first semester of freshman year or as soon as possible after transfer into the department.

Soc 115. Orientation to Sociology. Cr. R. F.S. Orientation to sociology. A familiarization with University and LAS College requirements and procedures. Occupational tracks and career options open to sociology; introduction to career planning. Recommended during first semester of freshman year, or as soon as possible after transfer into the department. Satisfactory-fail only.

Soc 130. Rural Institutions and Organizations. (3-0) Cr. 3. F.S. An introductory analysis of sociological concepts and theories as they relate to rural institutions and organizations. Emphasis on the static structure and function of these institutions and organizations and on their dynamic adaptation to changing societal, environmental, and economic conditions. General sociological principles and perspectives. Credit for only Soc 130 or 134 may be applied toward graduation.

Soc 134. Introduction to Sociology. (3-0) Cr. 3. F.S.SS. Social interaction and group behavior with emphasis on the scientific study of contemporary U.S. society, including issues relating to socialization, inequality, and changing rural and urban communities. Analysis of relationships among the institutions of family, religion, political participation, work, and leisure. Credit for only Soc 130 or 134 may be applied toward graduation.
H. Honors.

Soc 202. Introduction to Research Methods. (3-0) Cr. 3. F.S. *Prereq: 130 or 134, credit in Stat 101 or concurrent enrollment in Stat 101.* A survey of the principal research methods used in sociological analysis.

Soc 219. Sociology of Intimate Relationships. (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* Analysis of intimate relationships among couples using a sociological perspective. Attention is given to singlehood; dating and courtship; sexuality; mate selection, cohabitation, and marriage. Relationship quality, communication, conflict and dissolution of these types of relationship will also be explored.

Soc 235. Social Problems and American Values. (3-0) Cr. 3. F.S. *Prereq: 130 or 134.* Sociological concepts, theories and methods to analyze the causes and consequences of social problems. Social problems discussed may include crime, substance abuse, income inequalities, discrimination, poverty, race relations, health care, family issues, and the environment. How American culture and values shape societal conditions, public discourse and policy.

Soc 241. Youth and Crime. (Cross-listed with CJ St). (3-0) Cr. 3. F. *Prereq: 130 or 134.* An examination of delinquency that focuses on the relationship between youth as victims and as offenders, social and etiological features of delinquency, the role of the criminal justice system, delinquents' rights, and traditional and alternative ways of dealing with juvenile crime.

Soc 264. Small Group Dynamics. (3-0) Cr. 3. F.S. *Prereq: 130 or 134.* An introduction to intra- and intergroup dynamics in small groups. Group decision-making, coalitions, conformity, intergroup relations, status and role effects, leadership, group development and group conflict. Includes student participation in small group processes.

Soc 302. Advanced Research Methods. (3-0) Cr. 3. F.S.Alt. SS., offered 2010. *Prereq: 202; Stat 101; Sociology or PSA Major.* Experience in designing research projects, collecting and analyzing data and reporting results.

Soc 305. Social Psychology: A Sociological Perspective. (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* Examination of human behavior in a social environment with emphasis on development of the self, interpersonal relations, attitudes, and small groups.

Soc 310. Community. (3-0) Cr. 3. F.S. *Prereq: 130 or 134.* Analysis of evolving theory and research of community as an ideal type, an ecological system, a political economy, and an interactional field; examination of the impact of economic, cultural, social and political infrastructures on community power structures and change processes in a global era.

Soc 325. Transition in Agriculture. (3-0) Cr. 3. S. *Prereq: 130 or 134 or permission of instructor.* The impacts of agricultural changes on farm families, rural communities, and consumers. Past, present, and future trends in family farms and their social implications.

Soc 327. Sex and Gender in Society. (Cross-listed with W S). (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* How the biological fact of sex is transformed into a system of gender stratification. The demographics and social positions of women and men in the family, education, media, politics, and the economy. Theories of the social-psychological and sociological bases for behavior and attitudes of women and men. The relationship between gender, class, and race.

Soc 328. Sociology of Masculinities and Manhood. (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: Soc 130, 134, or W S 201.* Examination of socially constructed and idealized images of manhood, the nature of social hierarchies and relations constructed on the basis of imagery, ideologies, and norms of masculinity. Theories on gender (sociological, psychological, and biological). Particular attention given to theory and research on gender variations among men by race, class, ethnicity, sexual orientation, physical ability and age.

Soc 330. Ethnic and Race Relations. (Cross-listed with Af Am). (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* Analysis of ethnic and race relations, particularly in America; emphasis on the sociology and psychology of race and ethnic relations.

Soc 331. Social Class and Inequality. (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* Social stratification and processes resulting in social and economic inequalities; implications of status, class, and poverty for people of different races, ethnicities, and gender.

Soc 332. The Latino/Latina Experience in U.S. Society. (3-0) Cr. 3. F. *Prereq: 130 or 134.* Examination of the social, historical, economic and political experience of varied Latino ethnic groups in the U.S. - primarily focusing on Mexican, Puerto Ricans, and Cubans.

Soc 334. Politics and Society. (Cross-listed with Pol S). (3-0) Cr. 3. F. *Prereq: A course in political science or sociology.* The relationship between politics and society with emphasis on American society. Discussion of theories of inequality, power, social movements, elites, ruling classes, democracy, and capitalism.

Soc 340. Deviant and Criminal Behavior. (Cross-listed with CJ St). (3-0) Cr. 3. S.SS. *Prereq: 130 or 134.* Theory and research on the etiology of types of social deviance; issues relating to crime, antisocial behavior and social policies designed to control deviant behavior.

Soc 341. Criminology. (Cross-listed with CJ St). (3-0) Cr. 3. F. *Prereq: 130 or 134.* The nature of crime and criminology; the concept of crime; statistics and theories of criminality; major forms of crime; official responses to crime and control of crime.

Soc 345. Population and Society. (Cross-listed with Env S). (3-0) Cr. 3. F. *Prereq: 130 or 134.* Human population growth and structure; impact on food, environment, and resources; gender issues; trends of births, deaths, and migration; projecting future population; population policies and laws; comparison of the United States with other societies throughout the world.

Soc 351. Police and Society. (Cross-listed with CJ St). (3-0) Cr. 3. F.S. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of law enforcement in the United States. Theory and research on police history, function, and organization; constitutional issues of policing; and critical topics, such as community policing, officer discretion and decision-making, corruption, use of force, and racial profiling. The course illustrates the interconnections between communities, police organizations, citizens, and criminal offenders.

Soc 352. Punishment, Corrections, and Society. (Cross-listed with CJ St). (3-0) Cr. 3. F.S. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of corrections in the United States. Theory and research on probation, parole, intermediate sanctions, prison, inmate society, inmate behavior and misconduct, capital punishment, recidivism, correctional treatment, rehabilitation, and offender reintegration into society.

Soc 362. Applied Ethics in Agriculture. (Cross-listed with Econ). (3-0) Cr. 3. F. *Prereq: Econ 101 or Soc 130 or Soc 134, junior or senior status in the College of Agriculture.* Identify major ethical issues and dilemmas in the conduct of agricultural and agribusiness management and decision making. Discuss and debate proper ethical behavior in these issues and situations and the relationship between business and personal ethical behavior.

Soc 377. Social Dimensions of Religion. (Cross-listed with Relig). (3-0) Cr. 3. *Prereq: Prior course work in Religious Studies or Sociology required.* The influence of religion in society, both as a conservator of values and as a force for social change. Nonmajor graduate credit.

Soc 380. Sociology of Work. (3-0) Cr. 3. F.S. *Prereq: 130 or 134.* Inequalities (gender, race, class) related to jobs, occupations, firms, and industries. Satisfactions, rewards, alienation, discrimination, and other topics of importance to workers are examined.

Soc 381. Social Psychology of Small Group Behavior. (Cross-listed with Psych). (3-0) Cr. 3. S. *Prereq: Soc 305 or Psych 280.* A survey of small group theory and research from an interdisciplinary, social psychological perspective.

Soc 382. Environmental Sociology. (Cross-listed with Env S). (3-0) Cr. 3. F.S. *Prereq: Soc 130, 134 or 3 credits of Env S.* Environment-society relations; social construction of nature and the environment; social and environmental impacts of resource extraction, production, and consumption; environmental inequality; environmental mobilization and movements; U.S. and international examples.

Soc 401. Contemporary Sociological Theories. (3-0) Cr. 3. F.S.SS. *Prereq: 9 credits in sociology.* Both historical and modern social theories as applied to understanding and researching the social world. Nonmajor graduate credit.

Soc 402. White-Collar Crime. (Cross-listed with CJ St). (3-0) Cr. 3. S. *Prereq: Soc 241 or CJ St 240.* Introduction and overview of white-collar crime as a form of deviance. Theory and research on occupational, corporate, and organizational offending; prevalence, costs, and consequences of white-collar crime; predictors and correlates of white-collar crime; and political, business, and public policy responses to white-collar crime.

Soc 411. Social Change in Developing Countries. (3-0) Cr. 3. S. *Prereq: 130 or 134 plus 3 credits in social sciences.* Social change and development in developing countries; international interdependence; causes and consequences of persistent problems in agriculture, city growth, employment, gender equality, basic needs; local and worldwide efforts to foster social change and international development. Nonmajor graduate credit.

Soc 412. Senior Seminar on Career Development. (1-0) Cr. 1. F. *Prereq: Most of major core courses, senior classification.* Transition from student to professional. Career development procedures including self-assessment, short- and long-term goals, strategies for the job search, development of contacts and sources, resumes and interviews. Enrollment preferred in first semester as senior. Satisfactory-fail only.

Soc 415. Sociology of Technology. (3-0) Cr. 3. F. *Prereq: 130 or 134 plus 3 credits in social sciences.* Review of physical, biological, and social approaches to technology evaluation. Examination of public responses to complex and controversial technology. Strategies for gaining adoption/rejection of technology. Applications to topics in agriculture, development, and marketing. Credit for only Soc 415 or 515 may be applied toward graduation. Nonmajor graduate credit.

Soc 420. Complex Organizations. (3-0) Cr. 3. F.SS. *Prereq: 130 or 134 plus 3 credits in social sciences.* Study of bureaucracies and other large organizations as social systems through the perspective of basis social processes and structural variables. Incorporates topics of organizational effectiveness, power and change. Nonmajor graduate credit.

Soc 431. Chicanos/Chicanas in Contemporary Society. (3-0) Cr. 3. S. *Prereq: 130 or 134.* An interdisciplinary examination of Chicanos/as, the largest U.S. Latino ethnic group. Special attention will be given to social conflict and social transformation as it relates to contemporary Chicano/a issues, particularly in the Midwest.

Soc 435. Urban Society. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 130 or 134 plus 3 credits in social sciences.* Development of cities and urban systems; human and spatial ecology; urban transformation, decline, and revitalization; poverty; immigration; homelessness; residential segregation; housing policy; urban social movements; local governance; alternative solutions and planning for cities; international comparisons.

Soc 460. Criminal and Juvenile Justice Practicum. (Cross-listed with CJ St). Cr. arr. Repeatable. F.S.SS. *Prereq: Junior or senior classification; permission of criminal justice studies coordinator; major or minor in sociology, or criminal justice studies minor.* Study of the criminal and juvenile justice systems and social control processes. Supervised placement in a police department, prosecutor's office, court, probation and parole department, penitentiary, juvenile correctional institution, community-based rehabilitation program, or related agency. Not more than a total of 12 credits of field experience (Soc 454 and 460) may be counted toward graduation. No credits in Soc 460 may be used to satisfy minimum sociology requirements for sociology majors. Satisfactory-fail only.

Soc 464. Community Action and Leadership. (3-0) Cr. 3. S.SS. *Prereq: 6 credits in sociology.* Methods of planning, organizing, and conducting planned social change and other action programs in communities. Strategies of change, change agent roles, client need identification, community organization strategies, citizen participation, leadership identification and development, program planning and evaluation.

Soc 484. Topical Studies in Criminal and Juvenile Justice. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits in sociology and permission from instructor.* Thematic or topical issues and studies dealing with the sociology of police, judiciary, institutional and community-based corrections, gender/ethnicity and crime/delinquency, criminal and delinquent gangs, and crime and delinquency prevention.

Soc 485. Sociology of the Family. (3-0) Cr. 3. S. *Prereq: 6 credits in sociology.* The contemporary family in developing, industrial, and post-industrial societies. Effects of modernization, cultural change, and family policies on family dynamics, structures, and functions.

Soc 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in sociology and permission of instructor.* Students in the College of Agriculture must be of junior or senior classification and may use no more than 6 credits of Soc 490 toward the total of

128 credits required for graduation. Students in the College of Liberal Arts and Sciences may count no more than 9 credits of 490 toward graduation.
A. General Sociology
B. Rural Sociology
H. Honors E. Senior Seminar

Courses primarily for graduate students, open to qualified undergraduate students

Soc 505. History of social Thought. (3-0) Cr. 3. F. *Prereq: 401.* Reviews the historical origins of social ideas about society how social thought has evolved throughout history, and how these affect modern sociological thinking.

Soc 506. Classical Sociological Theory. (3-0) Cr. 3. S. *Prereq: Soc 401 or 505.* The origins of the canonical works of sociology in the mid-Industrial Revolution period including Karl Marx, Max Weber, Emile Durkheim and others.

Soc 509. Agroecosystem Analysis. (Cross-listed with Agron, Anthr, SusAg). (3-4) Cr. 3. F. *Prereq: Senior or above classification.* Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (agronomic, economic, ecological, social, etc.), and scales of operation.

Soc 511. Intermediate Research Methods. (3-0) Cr. 3. S. *Prereq: 302 and Stat 401.* Research methods in sociology including problem selection, research design, hypothesis formulation, sampling, alternative data collection techniques. Designing a research strategy appropriate for a variety of social science questions, and assessing the appropriateness, validity, and generalizability of published sociological research.

Soc 512. Factor Analysis. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Soc 511 and Stat 401.* Reliability and validity for observed and latent variables. Exploratory and confirmatory factor analysis in the construction and evaluation of measurement models. Second-level factor analysis; factor analysis with means and intercepts; multi-trait, multi-method models. Applications using SPSS, SAS, LSIREL, AMOS, R, and Mplus.

Soc 513. Qualitative Research Methods. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 511.* Applied qualitative research methods in sociology. Design and implementation of a course-based research project including data collection, analysis, and presentation of results. Qualitative data gathering techniques using observational, historical, in-depth interviewing or content analysis approaches. Laboratory emphasis on completion of data gathering, analysis, and report writing.

Soc 515. Sociology of Technology. (3-0) Cr. 3. *Prereq: 6 hours of social science.* Off campus and non majors only - offered as demand warrants. Linkages among science, technology, and society. Physical, life, and social science approaches to technology evaluation. Public responses to complex and controversial technologies. Strategies for gaining adoption/rejection of technology. Required in the Master of Agriculture program. Only one of Soc 415 or 515 may be counted toward graduation credits.

Soc 520. Social Psychology: A Sociological Perspective. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 305 or Psych 280.* Examination of cognitive, symbolic interaction, exchange, role-reference group, and dramaturgical approaches. Assessment of contemporary issues in social psychology.

Soc 525. Seminar in Social Psychology. (3-0) Cr. 3. Alt F., offered 2009. *Prereq: 305 or Psych 280.* Examination of alternative theoretical models and methods of studying small groups.
A. Small Groups
B. Attitudes and Attitude Change

Soc 527. Seminar in Social Inequality. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 credits in sociology.* Analysis of racial and ethnic inequality in the United States and the world; focus on the implications of the changing world social and economic order for differences in racial and ethnic groups relative to wealth, status, and power; a critical examination of majority-group domination of minority groups in various societies.
A. Sociology of Race and Ethnicity
B. Sociology of Gender

Soc 533. Models of Community. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in sociology.* Emphasis on different models or frames of reference used in community analysis. Theoretical and methodological tools, current views of community problems, and explanation of social and cultural change are presented for each model.

Soc 534. Race, Class and Gender Inequality. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits in sociology.* Critical examination of the causes and consequences of social stratification and inequality; classical theories, contemporary frameworks, and recent empirical studies; international stratification patterns.

Soc 536. Seminar in Community Studies and Development. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in sociology.*
A. Urban Sociology
B. Strategies of Community Engagement

Soc 540. Comparative Social Change. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 graduate credits in sociology.* Contemporary theories of social change, modernization, dependency, and development are critically examined; methodological issues identified; supporting research explored; applicability of theoretical models, concepts, and strategies to current national and international needs are evaluated.

Soc 543. Seminar in Social Change and Development. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in sociology.*
A. Rural Development in Industrialized Countries
B. Sociology of Adoption and Diffusion
C. Technological Innovation, Social Change and Development

Soc 544. Sociology of Food and Agricultural Systems. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in sociology.* Social organization of food and fiber production, processing, and distribution systems. Sociological comparison of conventional and alternative production systems; gender roles in agriculture and food systems; local, national and global food systems; perspectives on food and agricultural research and policy.

Soc 549. Sociology of the Environment. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in sociology.* Social causes and social consequences of environmental problems. Interrelationship between social inequality and environmental inequality. Social construction and social experience of the environment. Contemporary developments in the social theory of the environment. International and domestic implications.

Soc 550. Sociology of Economic Life. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 6 credits in sociology.* Social construction of economic activity in non-industrial and industrial societies with special attention on variations of industrial societies (capitalism and socialism), economic globalization, and economic development. Interaction of economic systems with human values, ideology, organizations, work and individual welfare.

Soc 551. Seminar in Economy, Organization, and Work. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in sociology.*
A. Sociology of Work
B. Complex Organizations

Soc 582. Theories of social Deviance. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits in sociology.* Theory and research regarding causes of and reactions to deviant behavior. Mental illness, homicide, family violence, and property crime are among the types of deviant behavior considered.

Soc 584. Current Issues in Crime and Justice. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in sociology.* Discussion of current research and theory in crime and delinquency; topics include the purpose and role of law in social life; emerging theoretical directions in criminology; recent work on specific forms of criminality; controversies in the criminal justice system.

Soc 585. Current Research in Family Sociology. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in sociology.* Course presents a general overview of the field of family sociology. Topics to be covered include demographic trends, family theory and empirical research, as well as current debates in the discipline.

Soc 590. Special Topics. Cr. arr. Repeatable. *Prereq: 6 credits in sociology; senior or graduate classification.*
A. General Sociology
B. Rural Sociology

Soc 591. Orientation to Sociology. (1-0) Cr. 1. F. *Prereq: Formal admission into the sociology graduate program.* Introduction to the department, current graduate student policies at department and university levels, departmental administrative procedures. Required of graduate students. Satisfactory-fail only.

Soc 599. Research for Master's Thesis. Cr. arr. Repeatable.
A. General Sociology
B. Rural Sociology

Courses for graduate students

Soc 607. Contemporary Sociological Theory. (3-0) Cr. 3. S. *Prereq: 6 graduate credits in sociology.* Provides a review of modern sociological thought, issues, and controversies as they affect current research and discourse in the discipline.

Soc 610. Foundations of Sustainable Agriculture. (Cross-listed with SusAg, A E, Agron, Anthr). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging systems of agriculture in terms of core concepts of sustainability and their theoretical contexts.

Soc 613. Advanced Theory Construction and Causal Modeling. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 512 and Stat 404.* Formal strategies of research design and analysis using structural equations with latent variables. Strategies for the analysis of multi-informant and panel data, with emphasis on distributional problems and diagnostics. Applications using SPSS, SAS, LISREL, AMOS, R, and Mplus.

Soc 675. Current Topics in Family Sociology. (3-0) Cr. 3. Repeatable. Alt. S., offered 2011. Current developments in a selected field in the sociology of family and the life course.

Soc 698. Seminars in Sociology. (3-0) Cr. 3.

L. Community Studies and Development
M. Criminology
N. The Economy, Organizations, and Work
O. Food Systems, Agriculture, and the Environment
P. Methodology
Q. Social Change and Development
R. Social Inequality
S. Social Psychology
T. Sociology of Families
U. Theory

Soc 699. Dissertation Research. Cr. arr. Repeatable.
A. General Sociology
B. Rural Sociology

Software Engineering

www.se.iastate.edu

(A joint program administered by the Department of Electrical and Computer Engineering and the Department of Computer Science.)

Undergraduate Study

For the undergraduate curriculum in software engineering leading to the degree bachelor of science, see College of Engineering and College of Liberal Arts and Sciences.

This curriculum is jointly administered by the Electrical and Computer Engineering Department and the Computer Science Department at Iowa State University and it provides undergraduate students with the opportunity to learn software engineering fundamentals, to study applications of the state-of-the art software technologies, and to prepare for the practice of software engineering. The student-faculty interaction necessary to realize this opportunity occurs within an environment that is motivated by the principle that excellence in undergraduate education is enhanced by an integrated commitment to successful, long-term research and outreach programs.

The software engineering curriculum offers emphasis areas in software engineering principles, process, and practice. Students may also take elective courses in computer engineering and computer science.

The objective of the software engineering program at Iowa State University is that its graduates should demonstrate expertise, engagement, learning, leadership, and teamwork within five years after graduation.

• Expertise: Graduates should establish peer-recognized expertise together with the ability to articulate that expertise and use it for problem solving in the planning, design, development, validation, and evolution of software using contemporary practices.

• Engagement: Graduates should be engaged in the professional practice, locally and globally, contributing through the ethical, competent, and creative practice of Software engineering in industry, academia, or the public sector, or graduates may use the program as a foundation for interdisciplinary careers in business, law, medicine, or public service.

• Learning: Graduates should demonstrate sustained learning through graduate work or professional improvement opportunities and through self study, and they should demonstrate the ability to adapt to rapid technological changes.

• Leadership: Graduates should exhibit leadership and initiative to advance professional and organizational goals, facilitate the achievements of others, and obtain results.

• Teamwork: Graduates should demonstrate effective teaming and commitment to working with others of diverse cultural and interdisciplinary background by applying software engineering abilities, communication skills, and knowledge of contemporary and global issues.

As a complement to the instructional activity, the Electrical and Computer Engineering and Computer Science Departments provide opportunities for each student to have experience with broadening activities. Through the cooperative education and internship program, students have the opportunity to gain practical industry experience. See College of Engineering, Cooperative Programs. Students have the opportunity to participate in advanced research activities; and through international exchange programs, students learn about engineering practices in other parts of the world.

Courses primarily for undergraduate students

S E 101. Software Engineering Orientation. Cr. R. Introduction to the procedures, policies, and resources of Iowa State University and the department of Computer Science and Electrical and Computer Engineering. Information on engineering and computer-based professions.

S E 166. Careers in Software Engineering. Cr. R. Overview of the nature and scope of the software engineering profession. Relationship of coursework to careers. Departmental rules, student services operations, degree requirements, program of study planning, career options, and student organizations.

S E 185. Problem Solving in Software Engineering. (3-1) Cr. 3. *Prereq: Credit or enrollment in Math 142.* Introduction to software engineering and computer programming. Systematic thinking process for problem solving in the context of software engineering. Group problem solving. Solving software engineering problems and presenting solutions through computer programs, written documents and oral presentations. Introduction to principles of programming, software design, and extensive practice in design, writing, running, debugging, and reasoning about programs.

S E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department and Career Services.* First professional work period in the cooperative education program. Students must register for this course before commencing work.

S E 319. Software Construction and User Interfaces. (Cross-listed with Com S). (3-0) Cr. 3. F. *Prereq: Com S 228.* Basic theory of grammars, parsing. Language paradigms. State-transition and table-based software design. Rapid system prototyping. Review of principles of object orientation, object oriented analysis using UML. Event-driven and clock-driven simulation. Software construction methods. Frameworks and APIs. User interface architecture, evaluation of user interface. Design of windows, menus, and commands. Introduction to format specification and model-based software design. Introduction to domain-specific software engineering. Nonmajor graduate credit.

S E 329. Software Project Management. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Com S 309.* Process-based software development. Capability Maturity Model (CMM), Project planning, cost estimation, and scheduling. Project management tools. Factors influencing productivity and success. Productivity metrics. Analysis of options and risks. Version control and configuration management. Inspections and reviews. Managing the testing process. Software quality metrics. Modern software engineering techniques and practices. Nonmajor graduate credit.

S E 339. Software Architecture and Design. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: S E 319.* Modeling and design of software at the architectural level. Architectural styles. Basics of model-driven architecture. Object-oriented design and analysis. Iterative development and unified process. Design patterns. Design by contract. Component based design. Product families. Measurement theory and appropriate use of metrics in design. Designing for qualities such as performance, safety, security, reliability, reusability, etc. Analysis and evaluation of software architectures. Introduction to architecture definition languages. Basics of software evolution, reengineering, and reverse engineering. Case studies. Introduction to distributed system software. Nonmajor graduate credit.

S E 396. Summer Internship. Cr. R. Repeatable. SS. *Prereq: Permission of department and Career Services.* Summer professional work period.

S E 397. Software Engineering Internship. Cr. R. Repeatable. F.S. *Prereq: Permission of department and Career Services.* One semester maximum per academic year professional work period.

S E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: 298, permission of department and Career Services.* Second professional work period in the cooperative education program. Students must register for this course before commencing work.

S E 409. Software Requirements Engineering. (Cross-listed with Com S). (3-0) Cr. 3. *Prereq: Com S 309, 319.* The requirements engineering process, including identification of stakeholders, requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Non-functional requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports, and oral presentations will be required. Nonmajor graduate credit.

S E 412. Formal Aspects of Specification and Verification. (Cross-listed with Com S, Cpr E). (3-0) Cr. 3. *Prereq: 319, Com S 309.* Introduction to prepositional/predicate/temporal logic, program verification using theorem proving, model-based verification using model checking, and tools for verification. Nonmajor graduate credit.

S E 416. Software Evolution and Maintenance. (Cross-listed with Cpr E). (3-0) Cr. 3. *Prereq: Com S 309, 319.* Fundamental concepts in software evolution and maintenance; practical software evolution processes; legacy systems, program comprehension, impact analysis, program migration and transformation, refactoring. Tools for software evolution and maintenance. Case studies, experimental software projects. Written reports and oral presentation. Nonmajor graduate credit.

S E 417. Software Testing. (Cross-listed with Com S). (3-0) Cr. 3. *Prereq: Com S 309, 319.* Comprehensive study of software testing, principles, methodologies, management strategies and techniques. Test models, test design techniques (black box and white-box testing techniques), integration, regression, system testing methods, and software testing tools. Nonmajor graduate credit.

S E 490. Independent Study. Cr. arr. Repeatable. *Prereq: Senior classification in software engineering.* Investigation of an approved topic.

S E 491. Senior Design Project I and Professionalism. (2-3) Cr. 3. *Prereq: 329, completion of 29 credits in the S E core professional program, Engl 314.* Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; project poster. First of two-semester team-oriented, project design and implementation experience.

S E 492. Senior Design Project II. (1-3) Cr. 2. *Prereq: 491.* Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in S E 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements.

S E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. *Prereq: 398, permission of department and Career Services.* Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Speech Communication

(Administered by the College of Liberal Arts and Sciences)

www/Engl.iastate.edu/programs/speech_comm

Program Faculty: Goodwin, LaWare, Ringlee, Slagell

As a unit within the LAS College, the Program in Speech Communication provides students opportunities to develop their understanding and appreciation of the human communication process and to enhance their oral and written communication practice. More specifically, speech communication students develop an awareness of the importance of oral communication and listening for success in their personal, civic, and professional lives; become familiar with behavioral research in persuasion; understand how language is used to create social change; develop competent delivery skills; assess the quality of arguments; evaluate information found in research and public discourse; and cultivate rhetorical sensitivity in order to better connect with individuals and audiences. In this way, the program contributes to the humanistic, aesthetic, and critical development of liberally educated students in order to prepare them for full and effective participation in society.

Undergraduate Study

The cross-disciplinary program in speech communication offers introductory courses designed for all students as part of their general education and as a complement to professional training. It also offers a major or minor in speech communication as well as an additional endorsement for secondary teachers who already have an endorsement in another content area.

Students who major or minor in speech communication will prepare themselves for a wide variety of employment opportunities in business, industry and government, as well as in non-profit and educational organizations. With their effective oral communication, listening, teamwork, problem-solving and leadership skills, speech communication students find positions in general business management: human resources, benefits, sales and marketing and serve various organizations as recruiters, trainers, promotions managers, communication specialists, community outreach personnel and event planners. The program also prepares students for the study of law, theology, and for graduate level work in speech communication or related disciplines.

The program participates in the following interdisciplinary undergraduate minor programs: the interdisciplinary program in linguistics and the interdisciplinary program in technology and social change.

Speech Communication Major

A student electing to major in speech communication must earn at least 120 credits with 45 credits at the 300/400 level. A minimum of 33 of those credits must be earned in Speech Communication courses where the student earns a grade of C or better. Our flexible curriculum with few prerequisites can help you meet the 33 hour requirement in a timely way.

Core Requirements (18 credits)
3 ComSt 101 Intro to Communication
3 Sp Cm 212 Fundamentals of Public Speaking
3 Sp Cm 305 Language, Thought and Action
3 Sp Cm 327 Persuasion
3 Sp Cm 412 Rhetorical Criticism
3 Sp Cm 497 Capstone Course

Additional Coursework (Choose at least 5 of the following for 15 credits)
3 Sp Cm 110 Listening
3 Sp Cm 205 Popular Culture Analysis
3 Sp Cm 213 Computers in the Study of English--NO LONGER OFFERED (2-09)
3 Sp Cm 312 Business and Professional Speaking
3 Sp Cm 313 Communication for the Classroom Teacher
3 Sp Cm 322 Argumentation, Debate and Critical Thinking
3 Sp Cm 323 Gender and Communication
3 Sp Cm 324 Legal Communication
3 Sp Cm 325 Nonverbal Communication
3 Sp Cm 350 Rhetoric and the History of Ideas
3 Sp Cm 410 Persuasion in the Athenian Democracy
3 Sp Cm 416 American Public Address
3 Sp Cm 417 Campaign Rhetoric

Credits in Sp Cm 290, 499, or 590 cannot be applied toward the minimum required credits for the major.

The Communication Proficiency requirement may be met by (1) completion of Engl 150, 250 (or 250H), or its equivalent, with a grade in each of C or better; (2) one additional writing course beyond Engl 250 with a grade of C or better from the following approved list: Engl 302, 303, 304, 305, 309, 314, 415; JI MC 201.

Speech Communication Minor

The area's courses also provide a minor concentration for students in various majors such as business, English, journalism, world languages and cultures, and the social sciences. The requirements for a minor in speech communication may be fulfilled by credit in Sp Cm 212 plus at least 15 additional hours from the lists above, of which 9 credits are in courses numbered 300 or above. No credits in 290, 490, 499, and 590 may apply toward the minor.

Speech Communication Education

Students seeking a secondary endorsement in speech communication as an additional area prepare to teach speech, dramatic arts, and media at the secondary school level. In addition, they prepare to direct co-curricular and extra curricular activities such as drama, speech and debate.

Each student seeking an additional endorsement in speech communication must meet a 29 hour requirement by taking the following courses: Sp Cm 110 or ComSt 102, Sp CM 212, Sp Cm 313, Sp Cm 322, Sp Cm 412, Sp Cm 495A, Sp Cm 495B, Thtre 255, Thtre 358 and JI MC 101.

Graduate Study

The program offers courses for a graduate minor in speech communication as well as supporting work for other disciplines. The Program of Speech Communication also participates in the interdepartmental program leading to a master's degree in Interdisciplinary Graduate Studies.

Courses open for nonmajor graduate credit: Sp Cm 305, 323, 324, 327, 412, 416, and 417.

Speech Communication (Sp Cm)

Courses primarily for undergraduate students

Sp Cm 110. Listening. (3-0) Cr. 3. F.S.SS. Theory, principles, and competency development in comprehensive, therapeutic, critical, consumer, and appreciative listening. The impact of listening in relationships and partnerships.

Sp Cm 205. Popular Culture Analysis. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Credit in or exemption from Engl 150.* Analysis of how information and entertainment forms persuade and manipulate audiences. Study of several forms that may include newspapers, speeches, television, film, advertising, fiction, and magazines. Special attention to verbal and visual devices.

Sp Cm 212. Fundamentals of Public Speaking. (3-0) Cr. 3. F.S.SS. Theory and practice of basic speech communication principles applied to public speaking. Practice in the preparation and delivery of extemporaneous speeches.

Sp Cm 223. Intercollegiate Debate and Forensics. Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor.* Participation in intramural and intercollegiate debate and other forensic events.

Sp Cm 290. Special Projects. Cr. arr. Repeatable. F.S.SS. *Prereq: 3 credits in speech communication; permission of department chair.*

Sp Cm 305. Language, Thought and Action. (Cross-listed with Ling, ComSt). (3-0) Cr. 3. F.S.SS. *Prereq: Engl 250.* The study of symbolic processes and how meaning is conveyed in words, sentences, and utterances; discussion of modern theories of meaning; and an exploration of relationships among language, thought and action. Nonmajor graduate credit.

Sp Cm 312. Business and Professional Speaking. (3-0) Cr. 3. F.S.SS. *Prereq: 212.* Theory, principles, and competency development in the creation of coherent, articulate business and professional oral presentations.

Sp Cm 313. Communication for the Classroom Teacher. (3-0) Cr. 3. *Prereq: 212.* Communication in the teaching profession; training in classroom-oriented communication activities; use of video recorder for analysis of presentation.

Sp Cm 322. Argumentation, Debate, and Critical Thinking. (3-0) Cr. 3. *Prereq: 212.* Practice in preparing and presenting argumentative and debate speeches; emphasis on critical thinking and ethical and logical duties of the advocate; analysis, evidence, reasoning, attack, defense, research, case construction, and judging.

Sp Cm 323. Gender and Communication. (Cross-listed with W S, ComSt). (3-0) Cr. 3. *Prereq: 212.* The rhetorical strategies women and men use to succeed in oral communication; the theory, principles, and practice of effective gender communication in a variety of settings. Nonmajor graduate credit.

Sp Cm 324. Legal Communication. (3-0) Cr. 3. *Prereq: 212.* Speech communication in the legal system inside and outside the trial process: interviewing and counseling, negotiating and bargaining, voir dire, opening statements, examination of witnesses, closing arguments, judge's instructions, jury behavior, and appellate advocacy. Nonmajor graduate credit.

Sp Cm 325. Nonverbal Communication. (Cross-listed with ComSt). (3-0) Cr. 3. *Prereq: ComSt 101 or 102, 203, 301.* Theory and research in nonverbal communication; exploration of nonverbal subcodes; function of nonverbal communication in various contexts; student-designed investigations.

Sp Cm 327. Persuasion. (3-0) Cr. 3. F.S.SS. *Prereq: 212.* Examination of persuasive theories, strategies and research in persuasion. Emphasis on application and analysis; logical, emotional, and ethical proofs. Nonmajor graduate credit.

Sp Cm 350. Rhetorical Theories and Issues in Context. (Cross-listed with Engl, Cl St). (3-0) Cr. 3. S. *Prereq: Engl 250.* Ideas about the relationship between rhetoric and society in contemporary and historical contexts. An exploration of classical and contemporary rhetorical theories in relation to selected topics that may include politics, gender, race, ethics, education, science, or technology.

Sp Cm 404. Seminar. (Dual-listed with 504). Cr. 3. Repeatable. *Prereq: 15 credits in speech communication.*
A. Speech Communication
B. Speech Education

Sp Cm 412. Rhetorical Criticism. (3-0) Cr. 3. S. *Prereq: 212 and 6 credits in speech communication.* Development of rhetorical theory and practice from Corax to modern times. Application of principles of criticism to current public speaking practices. Nonmajor graduate credit.

Sp Cm 416. American Public Address. (3-0) Cr. 3. S. Relationship between public persuasions and leaders; process of preparing major public addresses; selected speakers and speeches as linked with political or historical events. Nonmajor graduate credit.

Sp Cm 417. Campaign Rhetoric. (Cross-listed with Pol S). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Sp Cm 212.* Backgrounds of candidates for state and national elections; selected speeches and issues; persuasive strategies and techniques of individual speakers. Nonmajor graduate credit.

Sp Cm 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: 18 credits in speech communication, junior classification, permission of department chair.* Only one independent study enrollment is permitted within the department per semester.

Sp Cm 495A. Directing Speech Activities. (1-0) Cr. 1. S. *Prereq: C I 301; 9 credits in speech communication; minimum grade point of 2.5 in speech communication courses.* Problems, methods, and materials related to directing speech activities in secondary schools.

Sp Cm 495B. Teaching Speech. (Cross-listed with C I). (3-0) Cr. 3. F. *Prereq: Sp Cm 313; 9 credits in speech communication; minimum grade point average of 2.5 in speech communication courses.* Problems, methods, and materials related to teaching speech, theatre, and media in secondary schools.

Sp Cm 497. Capstone Seminar. (3-0) Cr. 3. *Prereq: 15 credits in speech communication; junior or senior classification.* Students synthesize relevant theory and research culminating in a capstone project/paper.

Sp Cm 499. Communication Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: 18 credits in speech communication courses, other courses deemed appropriate by faculty adviser; 2nd semester junior or senior standing; cumulative GPA of at least 2.5 overall and 3.0 in speech communication; and permission of the internship committee.* Applications should be submitted in the term prior to the term in which the internship is desired. Supervised application of speech communication in professional settings.

Courses primarily for graduate students, open to qualified undergraduate students

Sp Cm 504. Seminar. (Dual-listed with 404). (3-0) Cr. 3. Repeatable. F.S.SS. Topics may include the following:
A. Speech Communication
B. Speech Education

Sp Cm 513. Proseminar: Teaching Fundamentals of Public Speaking. (1-0) Cr. 1. Repeatable, maximum of 3 credits. F. Required of all new Speech Communication 212 teaching assistants. Introduction to the teaching of public speaking. Support and supervision of teaching assistants of Sp Cm 212. Discussion of lesson planning, teaching methods, development of speaking assignments, and evaluation of student speaking.

Sp Cm 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of department chair.*

Statistics

www.stat.iastate.edu

Kenneth Koehler, Chair of Department

Distinguished Professors: Athreya, Meeker

Distinguished Professors (Emeritus): H. A. David, Fuller

University Professors: Koehler, Lorenz, Shelley, Stephenson, Vardeman

University Professors (Emeritus): D. Cox, Herbert T. David, Groeneveld, Hinz

Professors: Bailey, Bonett, Brendel, Carriquiry, Chen, Cook, Dixon, Isaacson, Kaiser, Morris, Nettleton, Nusser, Rollins

Professors (Emeritus): C. Cox, Harville, Hickman, Hotchkiss, Kennedy, Pollak, Strahan, Wolins

Professor (Collaborator): Therneau

Associate Professors: Adams, Dorman, Froelich, Hofmann, Kim, Larsen, Maiti, Maitra, Marasinghe, Roberts, Shao, Sherman, Wilson, Wu

Associate Professor (Emeritus): Sukhatme

Assistant Professors: Caragea, Ghosh, Liu, Nordman, Roy, Yu

Assistant Professors (Collaborators): Sargent, Sloan

Lecturers: Bhattacharyya, Genschel, Meyers

Undergraduate Study

For the undergraduate curriculum in liberal arts and sciences, major in statistics, leading to the degree bachelor of science, see *Liberal Arts and Sciences, Curriculum*.

The curriculum in liberal arts and sciences with a major in statistics is designed to prepare students for (1) entry level statistics positions requiring the B.S. degree in statistics in business, industry or commerce, nonprofit institutions, and in state or federal government; (2) graduate study in statistics. Entry-level positions include the following types of work: statistical design, analysis and interpretation of experiments and surveys; data processing and analysis using modern computation facilities and statistical computing systems; application of statistical principles and methods in commercial areas such as finance, insurance, industrial research, marketing, manufacturing, and quality control. Nonprofit organizations such as large health study institutions have entry-level positions for B.S. graduates in statistics. Also, there are opportunities for work in statistics that require a major in a subject-matter field and a minor in statistics.

Students completing the undergraduate degree in statistics should have a broad understanding of the discipline of statistics. They should have a clear comprehension of the theoretical basis of statistical reasoning and should be proficient in the use of modern statistical methods and computing. Such graduates should have an ability to apply and convey statistical concepts and knowledge in oral and written form. They should be aware of ethical issues associated with polling and surveys and in the summarization of the outcomes of statistical studies.

Undergraduate majors in this department usually include in their programs: (a) Statistics 101 or an alternative introductory course (104 or 226), (b) Mathematics 165, 166, 265 (or 165H, 166H, 265H), 307 (or 317) and Computer Science 207, and (c) Statistics 341, 342, 401, 402, 421, 479, 480.

These courses plus at least two additional courses in statistics at the 400 level or above constitute the major. With the permission of the department, I E/Stat 361 may be substituted for one of these 400 level courses. It is advisable to have a minor in a field of application.

The department offers a minor in statistics which may be earned by completing an introductory course in statistics plus additional courses from 341, 342, 361, and 400 level or above to yield a total of at least 15 credits in statistics courses.

English and Speech proficiency requirement: The department requires a grade of C– or better in each of Engl 150 and 250 (or 250H), and completion of one of Engl 302 or 314 with a grade of C- or better. The department requires a passing grade in ComSt 102 or Sp Cm 212.

Students intending to do graduate work in statistics normally will take additional courses in mathematics.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with a major in statistics, and for a minor for students majoring in other departments. Within the statistics major the student choose to emphasize topics such as experimental design, probability, statistical methods, statistical theory, statistical computing, survey sampling, quality control, spatial statistics, time series, reliability, or applied statistics (e.g., bioinformatics, biometrics, econometrics, environmental statistics, psychometrics, sociometrics, etc.). A major in operations research leading to a master of science degree is offered in cooperation with the Department of Industrial and Manufacturing Systems Engineering. The doctor of philosophy degree is offered as a co-major with other graduate programs. Such programs have included graduate majors in Agronomy, Animal Ecology, Animal Science, Bioinformatics, Chemical and Biological Engineering, Computer Science, Electrical Engineering, Ecology, Evolution and Organismal Biology (EEOB), Economics, Educational Leadership and Policy Studies, Food Science and Human Nutrition, Genetics, Development and Cell Biology (GDCB), Industrial and Manufacturing Systems Engineering, Mathematics, Meteorology, Psychology and Sociology.

M.S. graduates have a basic understanding of statistical theory and methods. Elective courses in statistics provide the opportunity for the student to emphasize particular areas within the field of statistics, based on interest and future career goals. Communication skills are developed through course projects, assistantship duties and creative components. Ph.D. graduates study advanced theory and methods and are able to do independent research in statistics and collaborative research outside of statistics.

Prerequisite to major graduate work is the completion of an undergraduate curriculum essentially equivalent to the curriculum in liberal arts and sciences at this institution including at least a year of calculus.

The degree master of science may be earned on either a thesis or nonthesis basis. The nonthesis option requires the completion of at least 34 credits of acceptable graduate work, including the completion of a creative component and satisfactory performance on a written examination. The thesis option requires the completion of 30 credits of acceptable graduate work, including the completion of a thesis and satisfactory performance on a written examination. Ph.D. candidates must complete at least 72 semester credits (half or more from Iowa State) with a minimum 3.0 (B) average and submit an original thesis representing a substantial contribution to statistics as a science.

The department encourages students to prepare themselves in foreign languages and in computer languages, but specific requirements for the degrees master of science and doctor of philosophy are at the discretion of the student's advisory committee.

The department participates in the interdepartmental programs in bioinformatics and computational biology, ecology and evolutionary biology, forensic research, genetics, human computer interaction, and nutrition.

Courses primarily for undergraduate students

Stat 100. Orientation in Statistics. (1-0) Cr. R. F. Opportunities, challenges, and the scope of the curriculum in statistics. For students planning or considering a career in this area.

Stat 101. Principles of Statistics. (3-2) Cr. 4. F.S.SS. *Prereq: 1 1/2 years of high school algebra.* Statistical concepts in modern society; descriptive statistics and graphical displays of data; the normal distribution; data collection (sampling and designing experiments); elementary probability; elements of statistical inference; estimation and hypothesis testing; linear regression and correlation; contingency tables. Credit for only one of the following courses may be applied toward graduation: Stat 101, 104, 105, 226.

Stat 104. Introduction to Statistics. (2-2) Cr. 3. F.S.SS. *Prereq: 1 1/2 years of high school algebra.* Statistical concepts and their use in science; collecting, organizing and drawing conclusions from data; elementary probability; binomial and normal distributions; regression; estimation and hypothesis testing. For students in the agricultural and biological sciences. Credit for only one of the following courses may be applied toward graduation: Stat 101, 104, 105, 226.

Stat 105. Introduction to Statistics for Engineers. (3-0) Cr. 3. F.S. *Prereq: Math 165 (or 165H).* Statistical concepts with emphasis on engineering applications. Data collection; descriptive statistics; probability distributions and their properties; elements of statistical inference; regression; statistical quality control charts; use of statistical software; team project involving data collection, description and analysis. Credit for only one of the following courses may be applied toward graduation: Stat 101, 104, 105, 226. Credit for both Stat 105 and 305 may not be applied for graduation.

Stat 226. Introduction to Business Statistics I. (3-0) Cr. 3. F.S.SS. *Prereq: Math 150 or 165.* Obtaining, presenting, and organizing statistical data; measures of location and dispersion; the Normal distribution; sampling and sampling distributions; elements of statistical inference; estimation and confidence intervals; hypothesis testing; inference for simple linear regression analysis; use of computers to visualize and analyze data. Credit for only one of the following courses may be applied toward graduation: Stat 101, 104, 105, 226.

Stat 231. Probability and Statistical Inference for Engineers. (4-0) Cr. 4. F.S. *Prereq: Credit or enrollment in Math 265.* Emphasis on engineering applications. Basic probability; random variables and probability distributions; joint and sampling distributions. Descriptive statistics; confidence intervals; hypothesis testing; simple linear regression; multiple linear regression; one way analysis of variance; use of statistical software.

Stat 305. Engineering Statistics. (3-0) Cr. 3. F.S.SS. *Prereq: Math 165 (or 165H).* Statistics for engineering problem solving. Principles of engineering data collection; descriptive statistics; elementary probability distributions; principles of experimentation; confidence intervals and significance tests; one-, two-, and multi-sample studies; regression analysis; use of statistical software; team project involving engineering experimentation and data analysis. Credit for both Stat 105 and 305 may not be applied for graduation.

Stat 322. Probabilistic Methods for Electrical Engineers. (Cross-listed with E E). (3-0) Cr. 3. F.S. *Prereq: E E 224.* Introduction to probability with applications to electrical engineering. Sets and events, probability space, conditional probability, total probability and Bayes' rule. Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, moments, moment generating functions, multiple random variables, functions of random variables. Elements of statistics, hypothesis testing, confidence intervals, least squares. Introduction to random processes.

Stat 326. Introduction to Business Statistics II. (2-2) Cr. 3. F.S. *Prereq: 226.* Multiple regression analysis; regression diagnostics; model building; applications in analysis of variance and time series; random variables; distributions; conditional probability; statistical process control methods; use of computers to visualize and analyze data.

Stat 330. Probability and Statistics for Computer Science. (3-0) Cr. 3. F.S. *Prereq: Math 166.* Topics from probability and statistics applicable to computer science. Basic probability; Random variables and their distributions; Elementary probabilistic simulation; Queuing models; Basic statistical inference; Introduction to regression. Nonmajor graduate credit.

Stat 332. Visual Communication of Quantitative Information. (Cross-listed with Engl). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Stat 101, 104 or 226; Engl 250.* Communicating quantitative information using visual displays; visualizing data; interactive and dynamic data displays; evaluating current examples in the media; color, perception, and representation in graphs; interpreting data displays. Nonmajor graduate credit.

Stat 341. Introduction to the Theory of Probability and Statistics I. (Cross-listed with Math). (3-0) Cr. 3. F.S. *Prereq: Math 265 (or 265H).* Probability; distribution functions and their properties; classical discrete and continuous distribution functions; multivariate probability distributions and their properties; moment generating functions; simulation of random variables and use of the R statistical package. Credit for both Stat 341 and 447 may not be applied toward graduation.

Stat 342. Introduction to the Theory of Probability and Statistics II. (Cross-listed with Math). (3-0) Cr. 3. S. *Prereq: Stat 341; Math 307 or 317.* Transformations of random variables; sampling distributions; confidence intervals and hypothesis testing; theory of estimation and hypothesis tests; linear model theory; enumerative data; use of the R statistical package for simulation and data analysis.

Stat 361. Statistical Quality Assurance. (Cross-listed with I E). (2-2) Cr. 3. F.S. *Prereq: Stat 231 or 401.* Statistical methods for process improvement. Simple quality assurance principles and tools. Measurement system precision and accuracy assessment. Control charts. Process capability assessment. Experimental design and analysis for process improvement. Significant external project in process improvement. Nonmajor graduate credit.

Stat 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair.* Off-campus work periods for undergraduate students in a field of statistics.

Stat 401. Statistical Methods for Research Workers. (3-2) Cr. 4. F.S.SS. *Prereq: 101 or 104 or 105 or 226.* Graduate students without an equivalent course should contact the department. Methods of analyzing and interpreting experimental and survey data. Statistical concepts and models; estimation; hypothesis tests with continuous and discrete data; simple and multiple linear regression and correlation; introduction to analysis of variance and blocking. Nonmajor graduate credit.

Stat 402. Statistical Design and the Analysis of Experiments. (3-0) Cr. 3. F.S. *Prereq: 401.* The role of statistics in research and the principles of experimental design. Experimental units, randomization, replication, blocking, subdividing and repeatedly measuring experimental units; factorial treatment designs and confounding; extensions of the analysis of variance to cover general crossed and nested classifications and models that include both classificatory and continuous factors. Determining sample size. Nonmajor graduate credit.

Stat 404. Regression for social and Behavioral Research. (2-2) Cr. 3. F. *Prereq: 401.* Lorenz, Roberts. Applications of generalized linear regression models to social science data. Assumptions of regression; diagnostics and transformations; analysis of variance and covariance; path analysis; logistic, multinomial and Poisson regression. Nonmajor graduate credit.

Stat 406. Statistical Methods for Spatial Data. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Six hours of statistics at the 400-level.* The analysis of spatial data; geostatistical methods and spatial prediction; discrete index random fields and Markov random field models; models for spatial point processes. Emphasis on application and practical use of spatial statistical analysis. Nonmajor graduate credit.

Stat 407. Methods of Multivariate Analysis. (2-2) Cr. 3. F. *Prereq: 401, knowledge of matrix algebra.* Carriquiry, Cook. Techniques for displaying and analyzing multivariate data including plotting high-dimensional data using interactive graphics, comparing group mean vectors using Hotelling's T2, multivariate analysis of variance, reducing variable dimension with principal components, grouping/classifying observations with cluster analysis and discriminant analysis. Imputation of missing multivariate observations. Nonmajor graduate credit.

Stat 415. Advanced Statistical Methods for Research Workers. (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 401.* Advanced statistical methods using modern computer methods for modeling and analyzing data. Examples from a wide variety of scientific and engineering disciplines. Nonmajor graduate credit.

Stat 416. Statistical Design and Analysis of Microarray Experiments. (3-0) Cr. 3. S. *Prereq: Stat 401.* Introduction to two-color microarray technology and single-channel platforms (Affymetrix GeneChips); the role of blocking, randomization, and biological and technical replication in microarray experiments; design of single-channel and two-color microarray experiments with factorial treatment structure; normalization methods for single-channel and two-color microarray data; methods for identifying differentially expressed genes including mixed linear model analyses, empirical Bayes analyses, and resampling based approaches; procedures for controlling false discovery rate for multiple testing; clustering and classification problems for microarray data; testing gene categories; emphasis on practical use of methods. Nonmajor graduate credit.

Stat 421. Survey Sampling Techniques. (2-2) Cr. 3. S. *Prereq: 231 or 328 or 401.* Concepts of sample surveys and the survey process; methods of designing sample surveys, including: simple random, stratified, and multistage sampling designs; methods of analyzing sample surveys including ratio, regression, domain estimation and nonresponse. Nonmajor graduate credit.

Stat 430. Empirical Methods for Computer Science. (3-0) Cr. 3. F. *Prereq: Stat 330 or an equivalent course, Math 166, knowledge of linear algebra..* Programs and systems as objects of empirical studies; exploratory data analysis; selected topics from analysis of designed experiments - analysis of variance, hypothesis testing, interaction among variables; linear regression, logistic regression, Poisson regression; parameter estimation, prediction, confidence regions, dimension reduction techniques, model diagnostics and sensitivity analysis; Markov chains and processes; simulation techniques and bootstrap methods; applications to performance assessment - comparison of multiple systems; communicating results of empirical studies. Statistical software: R. Nonmajor graduate credit.

Stat 432. Applied Probability Models. (3-0) Cr. 3. F. *Prereq: 231 or 341 or 447.* Probabilistic models in biological, engineering and the physical sciences. Markov chains; Poisson, birth-and-death, renewal, branching and queing processes; applications to bioinformatics and other quantitative problems. Nonmajor graduate credit.

Stat 447. Statistical Theory for Research Workers. (4-0) Cr. 4. F.S.SS. *Prereq: Math 151 and permission of instructor, or Math 265.* Primarily for graduate students not majoring in statistics. Emphasis on aspects of the theory underlying statistical methods. Probability, probability density and mass functions, distribution functions, moment generating functions, sampling distributions, point and interval estimation, maximum likelihood and likelihood ratio tests, introduction to posterior distributions and Bayesian analysis, linear model theory, use of simulation. Credit for both Stat 341 and 447 may not be applied toward graduation. Nonmajor graduate credit.

Stat 451. Applied Time Series. (3-0) Cr. 3. S. *Prereq: 231 or 328 or 401.* Meeker. Methods for analyzing data collected over time; review of multiple regression analysis. Elementary forecasting methods: moving averages and exponential smoothing. Autoregressive-moving average (Box-Jenkins) models: identification, estimation, diagnostic checking, and forecasting. Transfer function models and intervention analysis. Introduction to multivariate time series methods. Nonmajor graduate credit.

Stat 457. Applied Categorical Data Analysis. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Stat 401 (or equivalent).* Statistical methods for the analysis of categorical data: estimation of proportions, chi-square tests, sample size determination, measures of association and relative risk, measures of agreement, logistic regression, Poisson regression and log-linear models, matched-pair and repeated measures designs, conditional inference. Applications to social, behavioral, and health sciences. Nonmajor graduate credit.

Stat 479. Computer Processing of Statistical Data. (3-0) Cr. 3. F. *Prereq: 401.* Marasinghe. Structure, content and programming aspects of the Statistical Analysis System (SAS) software package. Advanced techniques in the use of SAS for data analysis including statistical graphics, regression diagnostics, and complex analysis of variance models. If time permits, the SAS macro programming language will be introduced. Nonmajor graduate credit.

Stat 480. Statistical Computing Applications. (3-0) Cr. 3. S. *Prereq: 231 or 328 or 401.* Modern statistical computing. Data management; spread sheets, verifying data accuracy, transferring data between software packages. Data and graphical analysis with statistical software packages. Algorithmic programming concepts and applications. Simulation. Software reliability. Nonmajor graduate credit.

Stat 490. Independent Study. Cr. arr. Repeatable. *Prereq: 10 credits in statistics.* No more than 9 credits in Stat 490 may be counted toward graduation. H. Honors.

Stat 493. Workshop in Statistics. (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: 101 or 104 or 226.* Off-Campus only. Introduction to methods for analyzing data from surveys and experiments. Summarizing data, analysis of data from simple random samples and more complex survey designs, experimental design, estimation and hypothesis testing for data from simple experiments, good and bad graphical presentations of results. Designed for master of agriculture program only. Nonmajor graduate credit.

Stat 495. Applied Statistics for Industry I. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 101 or 104 or 105 or 226; Math 166 (or 166H).* Graduate students without an equivalent course should consult the department. Statistical thinking applied to industrial processes. Assessing, monitoring and improving processes using statistical methods. Analytic/enumerative studies; graphical displays of data; fundamentals of six sigma; process monitoring; control charts; capability analysis. Nonmajor graduate credit.

Stat 496. Applied Statistics for Industry II. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 495.* Statistical design and analysis of industrial experiments. Concepts of control, randomization and replication. Simple and multiple regression; factorial and fractional factorial experiments; application of ideas of six sigma; reliability; analysis of lifetime data. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Stat 500. Statistical Methods. (3-2) Cr. 4. F. *Prereq: 101.* Introduction to methods for analyzing data from experiments and observational data. Design-based and model-based inference. Estimation, hypothesis testing, and model assessment for 2 group and k group studies. Experimental design and the use of pairing/blocking. Analysis of discrete data. Correlation and regression, prediction, model selection and diagnostics. Simple mixed models including nested random effects and split plot experimental designs. Use of the SAS statistical software.

Stat 501. Multivariate Statistical Methods. (3-0) Cr. 3. S. *Prereq: 500 or 402; 447 or 542; knowledge of matrix algebra.* Statistical methods for analyzing and displaying multivariate data: simultaneous analysis of multiple responses, multivariate analysis of variance; summarizing high dimensional data with principal components, factor analysis, canonical correlations, multidimensional scaling; grouping similar items with cluster analysis; classification methods; dynamic graphics. Statistical software: SAS, S-Plus or R, and GGobi.

Stat 503. Exploratory Methods and Data Mining. (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 401, 341 or 447.* Approaches to finding the unexpected in data; pattern recognition, classification, association rules, graphical methods, classical and computer-intensive statistical techniques, and problem solving. Emphasis is on data-centered, non-inferential statistics for large or high-dimensional data, topical problems, and building report writing skills.

Stat 505. Environmental Statistics. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 341 or 447; 401.* Statistical methods and models for environmental applications. Emphasis on environmental toxicology. Analysis of data with below detection-limit values. Dose-response curve modeling, including overdispersion and estimation of safe doses. Trend analysis; analysis of autocorrelated data. Equivalence testing.

Stat 506. Statistical Methods for Spatial Data. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 447 or 542.* The analysis of spatial data; geostatistical methods and spatial prediction; discrete index random fields and Markkov random field models; models for spatial point processes.

Stat 511. Statistical Methods. (3-0) Cr. 3. S. *Prereq: 500 or 402 or 404; 447 or 542 and current enrollment in 543; knowledge of matrix algebra.* Introduction to the general theory of linear models, least squares and maximum likelihood estimation, hypothesis testing, interval estimation and prediction, analysis of unbalanced designs. Models with both fixed and random factors. Introduction to non-linear and generalized linear models, bootstrap estimation, local smoothing methods. Requires use of R statistical software.

Stat 512. Design of Experiments. (3-0) Cr. 3. F. *Prereq: 511.* Basic ideas of experimental design and analysis; completely randomized, randomized complete block, and Latin Square designs; factorial experiments, confounding, fractional replication; split-plot and incomplete block designs.

Stat 513. Response Surface Methodology. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 402 or 512, knowledge of elementary matrix theory and matrix formulation of regression.* Morris. Analysis techniques for locating optimum and near-optimum operating conditions: standard experimental designs for first- and second-order response surface models; design performance criteria; use of data transformations; mixture experiments; optimization for multiple-response problems. Requires use of statistical software with matrix functions.

Stat 515. Theory and Applications of Nonlinear Models. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 447 or 543, 511.* Construction of nonlinear statistical models; random and systematic model components, additive error nonlinear regression with constant and non-constant error variances, generalized linear models, transform both sides models. Iterative algorithms for estimation and asymptotic inference. Basic random parameter models, beta-binomial and gamma-Poisson mixtures. Requires use of instructor-supplied and student-written R functions.

Stat 516. Statistical Design and Analysis of Microarray Experiments. (3-0) Cr. 3. S. *Prereq: Stat 500; 447 or 542.* Introduction to two-color microarray technology including cDNA and oligo microarrays; introduction to single-channel platforms (Affymetrix GeneChips); the role of blocking, randomization, and biological and technical replication in microarray experiments; design of single-channel and two-color microarray experiments with factorial treatment structure; normalization methods; methods for identifying differentially expressed genes including mixed linear model analyses, empirical Bayes analyses, and resampling based approaches; adjustments for multiple testing; clustering and classification problems for microarray data; emphasis on current research topics in microarray statistics.

Stat 521. Theory and Applications of Sample Surveys. (3-0) Cr. 3. S. *Prereq: 401; 447 or 542.* Practical aspects and basic theory of design and estimation in sample surveys for finite populations. Simple random, systematic, stratified, cluster multistage and unequal-probability sampling. Horvitz-Thompson estimation of totals and functions of totals: means, proportions, regression coefficients. Linearization technique for variance estimation. Model-assisted ratio and regression estimation. Two-phase sampling and sampling on two occasions. Non-response effects. Imputation.

Stat 522. Advanced Applied Survey Sampling. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 521 or both Stat 421 and Stat 477.* Advanced topics in survey sampling and methodology: clustering and stratification in practice, adjustments and imputation for missing data, variance estimation in complex surveys, methods of panel and/or longitudinal surveys, procedures to increase response rates, and computing. Examples are taken from large, well-known surveys in various subject areas. Prior exposure to mathematical statistics, probability, and at least one course in survey sampling theory is assumed.

Stat 528. Applied Business Statistics. (2-2) Cr. 3. F.SS. *Prereq: enrollment in MBA program, not for STAT majors.* Application of statistical methods to problems in business and economics; simple and multiple linear regression; residual analysis; model building; analysis of variance; introduction to experimental design concepts; time series analysis and forecasting.

Stat 531. Quality Control and Engineering Statistics. (Cross-listed with I E). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Stat 401; 342 or 447.* Wu. Statistical methods and theory applicable to problems of industrial process monitoring and improvement. Statistical issues in industrial measurement; Shewhart, CUSUM, and other control charts; feedback control; process characterization studies; estimation of product and process characteristics; acceptance sampling, continuous sampling and sequential sampling; economic and decision theoretic arguments in industrial statistics.

Stat 533. Reliability. (Cross-listed with I E). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 342 or 432 or 447.* Meeker. Probabilistic modeling and inference in engineering reliability; lifetime models, product limit estimator, probability plotting, maximum likelihood estimation for censored data, Bayesian methods in reliability, system reliability models, competing risk analysis, acceleration models and analysis of accelerated test data; analysis of recurrence data; planning studies to obtain reliability data.

Stat 534. Ecological Statistics. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 447 or 542.* Dixon. Statistical methods for non-standard problems, illustrated using questions and data from ecological field studies. Specific topics include: Estimation of abundance and survival from mark-recapture studies. Deterministic and stochastic matrix models of population trends. Estimation of species richness and diversity. Ordination and analysis of complex multivariate data. Statistical methods discussed will include randomization and permutation tests, spatial point processes, bootstrap estimation of standard error, partial likelihood and Empirical Bayes methods.

Stat 536. Statistics for Population Genetics. (Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 401, 447; Gen 320 or Biol 313.* Statistical models for population genetics covering: selection, mutation, migration, population structure, and linkage disequilibrium. Applications to gene mapping (case-control, TDT), inference about population structure, DNA and protein sequence analysis, and forensic and paternity identification.

Stat 537. Statistics for Molecular Genetics. (Cross-listed with GDCB). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 401, 447; Gen 320 or Biol 313.* Statistical models, inference, and computational tools for linkage analysis, quantitative trait analysis, and molecular evolution. Topics include; quantitative trait models, variance component mapping, interval and composite-interval mapping, and phylogenetic tree reconstruction.

Stat 542. Theory of Probability and Statistics I. (4-0) Cr. 4. F. *Prereq: 341; Math 414 or 465.* Sample spaces, probability, conditional probability; Random variables, univariate distributions, expectation, median, and other characteristics of distributions, moment generating functions; Joint distributions, conditional distributions and independence, correlation and covariance; Probability laws and transformations; Introduction to the Multivariate Normal distribution; Sampling distributions, order statistics; Convergence concepts, the law of large numbers, the central limit theorem and delta method; Basics of stochastic simulation.

Stat 543. Theory of Probability and Statistics II. (3-0) Cr. 3. S. *Prereq: 542.* Point estimation including method of moments, maximum likelihood estimation, exponential family, Bayes estimators, Loss function and Bayesian optimality, unbiasedness, sufficiency, completeness, Basu s theorem; Interval estimation including confidence intervals, prediction intervals, Bayesian interval estimation; Hypothesis testing including Neyman-Pearson Lemma, uniformly most powerful tests, likelihood ratio tests; Bayesian tests; Nonparametric methods, bootstrap.

Stat 544. Bayesian Statistics. (3-0) Cr. 3. S. *Prereq: 543.* Specification of probability models; subjective, conjugate, and noninformative prior distributions; hierarchical models; analytical and computational techniques for obtaining posterior distributions; model checking, model selection, diagnostics; comparison of Bayesian and traditional methods.

Stat 546. Nonparametric Methods in Statistics. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 511, 542.* Chen, Opsomer. Overview of parametric versus nonparametric methods of inference; introduction to nonparametric smoothing methods for estimating density and regression functions; smoothing parameter selection; applications to semiparametric models and goodness-of-fit tests of a parametric model.

Stat 551. Time Series Analysis. (3-0) Cr. 3. F. *Prereq: 447 or 542.* Concepts of trend and dependence in time series data; stationarity and basic model structures for dealing with temporal dependence; moving average and autoregressive error structures; analysis in the time domain and the frequency domain; parameter estimation, prediction and forecasting; identification of appropriate model structure for actual data and model assessment techniques. Possible extended topics include dynamic models and linear filters.

Stat 554. Introduction to Stochastic Processes. (Cross-listed with Math). Cr. 3. F. *Prereq: Stat 542.* Markov chains on discrete spaces in discrete and continuous time (random walks, Poisson processes, birth and death processes) and their long-term behavior. Optional topics may include branching processes, renewal theory, introduction to Brownian motion.

Stat 557. Statistical Methods for Counts and Proportions. (3-0) Cr. 3. F. *Prereq: 500 or 401; 543 or 447.* Statistical methods for analyzing simple random samples when outcomes are counts or proportions; measures of association and relative risk, chi-squared tests, loglinear models, logistic regression and other generalized linear models, tree-based methods. Extensions to longitudinal studies and complex designs, models with fixed and random effects. Use of statistical software: SAS, S-Plus or R.

Stat 565. Methods in Biostatistics. (Cross-listed with Tox). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 500 or 401; Stat 543 or 447.* Statistical methods useful for biostatistical problems. Topics include analysis of cohort studies, case-control studies and randomized clinical trials, techniques in the analysis of survival data and longitudinal studies, approaches to handling missing data, and meta-analysis. Examples will come from recent studies in cancer, AIDS, heart disease, psychiatry and other human and animal health studies. Use of statistical software: SAS, S-Plus or R.

Stat 566. Survival Analysis for Biomedical Applications. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Stat 543 and Stat 511.* Statistical methods for analyzing time to event and survival data. Estimation of survivor and hazard functions, proportional hazards models, diagnostic procedures, time dependent covariates. Extensions to cases with multiple or correlated end points. Applications to medical studies involving cancer treatments, liver and bladder diseases, autoimmune disorders, bone fractures, surgery mortality rates. Implementation of SAS, S Plus, and R.

Stat 568. Bioinformatics II (Advanced Genome Informatics). (Cross-listed with BCB, GDCB, Com S). (3-0) Cr. 3. S. *Prereq: BCB 567, BBMB 301, Biol 315, Stat 430, credit or enrollment in Gen 411.* Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

Stat 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology). (Cross-listed with BCB, GDCB, Com S, Cpr E). (3-0) Cr. 3. S. *Prereq: BCB 567, Biol 315, Com S 311 and either 208 or 228, Gen 411, Stat 430.* Algorithmic and statistical approaches in computational functional genomics and systems biology. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Ontology-driven, network based, and probabilistic approaches to information integration.

Stat 579. An Introduction to R. (0-2) Cr. 1. F. *Prereq: Enrollment in 500.* An introduction to the logic of programming, numerical algorithms, and graphics. The R statistical programming environment will be used to demonstrate how data can be stored, manipulated, plotted, and analyzed using both built-in functions and user extensions. Concepts of modularization, looping, vectorization, conditional execution, and function construction will be emphasized.

Stat 580. Statistical Computing. (3-0) Cr. 3. S. *Prereq: 579 and 447 or 542.* Introduction to scientific computing for statistics using tools and concepts in R: programming tools, modern programming methodologies, modularization, design of statistical algorithms. Introduction to C programming for efficiency; interfacing R with C. Building statistical libraries. Use of algorithms in modern subroutine packages, optimization and integration. Implementation of simulation methods; inversion of probability integral transform, rejection sampling, importance sampling. Monte Carlo integration.

Stat 590. Special Topics. Cr. arr. Repeatable.
A. Theory
B. Methods
C. Design of Experiments
D. Sample Surveys

Stat 598. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department chair.* Off-campus work periods for graduate students in a field of statistics.

Stat 599. Creative Component. Cr. arr.

Courses for graduate students

Stat 601. Advanced Statistical Methods. (3-2) Cr. 4. F. *Prereq: 511, 543.* Emphasis on the approaches statisticians take toward the statistical formulation of scientific problems. Students should develop an understanding of the way that various concepts of probability are used in problem formulation, analysis, and inference, and the ability to develop one or more appropriate analyses for a variety of problems. Specific methodological topics include permutation procedures and design-based analysis; model building with single and multiple stochastic components; estimation based on least-squares, likelihood functions, modified likelihood functions, sample reuse, and Bayesian analysis; inference in the sample space, parameter space, and belief space. Development of various analyses for real problems, including statistical formulation and necessary computations.

Stat 606. Advanced Spatial Statistics. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 506, 642.* Consideration of advanced topics in spatial statistics, including areas of current research. Topics may include construction of nonstationary covariance structures including intrinsic random functions, examination of edge effects, general formulation of Markov random field models, spatial subsampling, use of pseudo-likelihood and empirical likelihood concepts in spatial analysis, the applicability of asymptotic frameworks for inference, and a discussion of appropriate measures for point processes.

Stat 611. Theory and Applications of Linear Models. (3-0) Cr. 3. F. *Prereq: 500 or 402 or 404, 542 or 447, a course in matrix algebra.* Wu. Matrix preliminaries, estimability, theory of least squares and of best linear unbiased estimation, analysis of variance and covariance, distribution of quadratic forms, extension of theory to mixed and random models, inference for variance components.

Stat 612. Advanced Design of Experiments. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 512.* General theory of factorial experiments. Design optimality criteria, approximate design and general equivalence theory, computational approaches to constructing optimal designs for linear models. Advanced topics of current interest in the design of experiments, including one or more of: distance based design criteria and construction of spatial process models, screening design strategies for high-dimensional problems, and design problems associated with computational experiments.

Stat 615. Mixed Models: Theory, Methods and Applications. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Stat 601 and Stat 611.* The linear mixed effects (LME) model, the generalized linear mixed effects model (GLMM), quasilikelihood estimation, generalized estimating equations, nonlinear mixed effects (NLME) model, application in longitudinal data analysis, growth curve analysis and small area estimation, method of model diagnostics and influential analysis. The knowledge of general statistical inference is assumed.

Stat 621. Advanced Theory of Survey Statistics. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 521.* Advanced topics of current interest in the design of surveys and analysis of survey data, including: asymptotic theory for design and model-based estimators, use of auxiliary information in estimation, variance estimation techniques, small area estimation, non-response modeling and imputation.

Stat 642. Advanced Probability Theory. (Cross-listed with Math). (4-0) Cr. 4. F. *Prereq: 542.* Measure spaces, extension theorem and construction of Lebesgue-Stieljes measures on Euclidean spaces, Lebesgue integration and the basic convergence theorems, Lp-spaces, absolute continuity of measures and the Radon Nikodym theorem, absolute continuity of functions on R and the fundamental theorem of Lebesgue integration, product spaces and Fubini-Tonelli Theorems, convolutions. Fourier series and transforms, probability spaces; Kolmogorov's existence theorem for stochastic processes; expectation; Jensen's inequality and applications, independence, Borel-Cantelli lemmas; weak and strong laws of large numbers and applications, renewal theory.

Stat 643. Advanced Theory of Statistical Inference. (4-0) Cr. 4. S. *Prereq: 543, 642.* Weak convergence; characteristic functions; continuity theorem; Lindberg-Feller central limit theorem and its ramifications; conditional expectation and probability; Martingale central limit theorems; sufficiency, completeness; Elements of decision theory; Statistical information; Neyman-Pearson theory of testing hypotheses. Uniformly most powerful tests, likelihood ratio tests. Goodness of fit tests. Asymptotic theory of maximum likelihood estimation and likelihood ratio tests; Bayesian models; Invariance.

Stat 645. Advanced Stochastic Processes. (Cross-listed with Math). (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Weak convergence. Random walks and Brownian motion. Martingales. Stochastic integration and Ito's Formula. Stochastic differential equations and applications.

Stat 647. Multivariate Analysis. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 543, knowledge of matrix algebra.* Multivariate normal distribution, estimation of the mean vector and the covariance matrix, multiple and partial correlation, Hotelling's T2 statistic, Wishart distribution, multivariate regression, principle components, discriminant analysis, high dimensional data analysis, latent variables.

Stat 648. Seminar on Theory of Statistics and Probability. Cr. arr. F. *Prereq: 643.*

Stat 651. Time Series. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 551, 642.* Stationary and nonstationary time series models, including ARMA, ARCH, and GARCH. Covariance and spectral representation of time series. Fourier and periodogram analyses. Predictions. CLT for mixing processes. Estimation and distribution theory. Long range dependence.

Stat 680. Advanced Statistical Computing. (3-0) Cr. 3. F. *Prereq: 543 and 580.* Normal approximations to likelihoods. The delta-method and propagation of errors. Topics in the use of the E-M algorithm including; its use in the exponential family, computation of standard errors, acceleration. Resampling methods: brief theory and application of the jackknife and the bootstrap. Randomization tests. Stochastic simulation: Markov Chain, Monte Carlo, Gibbs' sampling, Hastings-Metropolis algorithms, critical slowing-down and remedies, auxiliary variables, simulated tempering, reversible-jump MCMC and multi-grid methods.

Stat 690. Advanced Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.*
A. Theory
B. Methods
C. Design of Experiments
D. Sample Surveys
E. Statistical Computing
F. Graphics

Stat 699. Research. Cr. arr. Repeatable.

Supply Chain Management

(Administered by the Department of Logistics, Operations and Management Information Systems)

Graduate Study

The Department of Logistics, Operations, and Management Information Systems participates in three graduate degree programs: the M.S. in Business, the M.B.A. full-time and part-time programs and the Ph.D. program in Business and Technology. The M.S. degree in Business is a 30-credit curriculum culminating in a thesis. The M.B.A. program is a 48-credit, nonthesis, noncreative component curriculum. Twenty-four of the 48 credits are core courses and the remaining 24 are graduate electives. The Ph.D. program is a 56-credit curriculum that culminates in a dissertation. The department also participates in the interdepartmental transportation major.

Students can obtain a Specialization in Supply Chain Management in the MBA program by taking 12 credits of graduate courses from a selected set of courses.

Students can also obtain a Ph.D. in Business and Technology with Supply Chain Management as the major area of specialization. They need to take 9 credits of the Ph.D. core curriculum 12 credits of doctoral seminars in the area of specialization, 9 credits in a minor area of the student's choice, and 12 credits from a recommended list of research methods courses.

Supply chain management is a program of study concerned with the efficient and timely flow of materials, products, and information within and among organizations. It involves the integration of business processes across organizations, from material sources and suppliers through manufacturing and processing to the final customer. Supply chain management encompasses a wide variety of activities that have a significant influence on customer service, including the planning, control, and implementation of the processes used to transform inputs into finished goods and services, transportation, warehousing, facility location analysis, packaging, materials handling, parts and service support, and product returns.

The study of Supply Chain Management prepares students for professional careers with manufacturers, distributors, logistics service providers, transportation carriers, and consulting firms. The curriculum provides the required theoretical/conceptual base and analytical methods for making sound operational and strategic supply chain management decisions.

Courses primarily for graduate students, open to qualified undergraduate students

SCM 502. Supply Chain Management. (2-0) Cr. 2. Prereq*: Graduate classification.* Introduction to the fields of operations and logistics. The managerial issues and challenges of developing and implementing a firm's supply chain strategy. Inbound and outbound logistics, inventory, warehousing, manufacturing, materials handling, transportation and sourcing.

SCM 502. Supply Chain Management. (2-0) Cr. 2. *Prereq: Graduate classification.* Introduction to the fields of operations and logistics. The managerial issues and challenges of developing and implementing a firm's supply chain strategy. Inbound and outbound logistics, inventory, warehousing, manufacturing, materials handling, transportation and sourcing.

SCM 520. Decision Models for Supply Chain Management. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* The application of decision models for supply chain management. Topics include business applications of decision theory, inventory theory, business forecasting, optimization models, transportation and network models, routing problems, and project management.

SCM 522. Supply Chain Planning and Control Systems. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* An integrated analysis of planning and control systems for supply chains. Master production scheduling, material requirements planning, enterprise resource planning, capacity planning, shop floor control, competitive analyses of modern supply chain systems, and implementation of information technologies related to these topics.

SCM 524. Strategic Process Analysis and Improvement. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* Analysis, management, and improvement of the business processes used to produce and deliver products and services that satisfy customer needs. Process attributes that managers can control to influence the key operational performance measures of throughput time, inventory, cost, quality, and flexibility are discussed. Topics such as theory of constraints, lean production, and six sigma are included.

SCM 560. Strategic Logistics Management. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* Positions logistics vis-a-vis supply chain management (SCM). Presents different perspectives on SCM vs. logistics. Describes primary logistics functions: transportation, warehousing, facility location, customer service, order processing, inventory management and packaging. Benefits of and obstacles to the integration of these functions.

SCM 561. Transportation Management and Policy. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* Analysis of contemporary issues and strategies in transportation management and policy. Emphasis on evaluation of the impacts of transportation policies, new technologies, and strategic carrier and shipper management practices on the freight transportation industry and logistics systems.

SCM 563. Purchasing and Supply Management. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* Mechanics, procedures and tools used in purchasing. Recruiting, selecting, developing and managing supply chain partners in order to achieve competitive advantage via superior supply chain management. Factors and information needs for making supply management decisions.

SCM 585. Strategic Demand Planning. (3-0) Cr. 3. *Prereq: SCM 502 or permission of instructor.* Synchronizes demand with manufacturing and distribution. Emphasis on the strategic advantages of linking business plans and demand forecasts, both vertically within the organization and collaboratively among supply chain partners.

SCM 590. Special Topics. Cr. arr. Repeatable. *Prereq: Graduate classification and permission of instructor.* For students who wish to do individual research in a particular area of supply chain management.

SCM 601. Theoretical Foundations of Supply Chain Management. (3-0) Cr. 3. *Prereq: Mgmt 601 or permission of instructor.* An overview of the development of supply chain management (SCM) theory, including review of seminal articles in logistics, operations, and purchasing management and theories from allied disciplines (e.g., economics, marketing, sociology, strategic management). Analysis of trends in SCM research topics and methodologies. Identification of emerging and future areas for research and theory development.

SCM 602. Seminar in Supply Chain Strategy. (3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment.* Review of research literature on supply chain strategy, including the impact of technology, global economic and social factors, and intra- and inter-organizational integration on supply chain strategy formation. The role of SCM in overall corporate strategy and the impact of SCM on firm performance will also be addressed.

SCM 603. Seminar in Purchasing. (3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment.* Review of classic purchasing theories. Discussion of contemporary supply management strategy; the role of supply management and its relationship with other functional areas; its impact on logistics and transportation issues; management of supply uncertainties.

SCM 604. Seminar in Logistics Management. (3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment.* Integration of network, economic, and systems theory in the design, management, and control of logistics systems in the context of integrated supply chain management. Functional areas addressed include transportation, inventory order fulfillment, distribution, and warehousing. Facility location analysis will also be covered.

SCM 605. Seminar in Operations Management. (3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment.* Review of the research literature on methods of organizing, planning, controlling, and improving manufacturing systems to achieve the desired performance objectives related to cost, quality, speed, and flexibility. The relationship between the performance of the manufacturing system and the performance of the supply chain system will also be discussed.

SCM 650. Research Practicum I. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

SCM 651. Research Practicum II. (1-0) Cr. 1. *Prereq: enrollment in the PhD program.* Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

SCM 699. Dissertation. Cr. 12. *Prereq: Graduate classification, permission of dissertation supervisor.* Research.

Sustainable Agriculture

(Interdepartmental Graduate Major)

www.sust.ag.iastate.edu/gpsa/

Program Leadership: M. Duffy, Chair and Director of Graduate Education.

The Graduate Faculty Members in Sustainable Agriculture: Al-Kaisi, Allen, Anderson, Anex, Asbjornsen, Bain, Bhandari, Brumm, Cambardella, Clapp, Colletti, Cruse, Danielson, de Laplante, Delate, Deutsch, DeWitt, Duffy, C. Flora, J. Flora, Ford, Gardner, Gleason, Goggi, Grudens-Schuck, Hatfield, Hayes, Helmers, Honeyman, Hurburgh, Kaleita, Kanwar, Karlen, Kirschenmann, Kliebenstein, Liebman, Logsdon, Loynachan, Maldonado, Mallarino, Martin, Mazur, Miller, Miranowski, Morton, Mullen, Nutter, O'Neal, Owusu, Potoski, Randall, Robertson, Russell, Sandor, Sauer, Schulte, Schultz, Soupir, Steward, Thompson, Tyndall, Urbatsch, Wang, Wells, Wiedenhoeft, Wolf, Xin, Yang.

The graduate program in sustainable agriculture is an interdepartmental major offered through faculty in sixteen participating departments: Agricultural and Biosystems Engineering; Agricultural Education and Studies; Agronomy; Animal Science; Community and Regional Planning; Ecology, Evolution and Organismal Biology; Economics; Entomology; Food Science and Human Nutrition; Horticulture; Landscape Architecture; Natural Resource Ecology and Management; Philosophy and Religious Studies; Plant Pathology; Political Science; and Sociology. Both M.S. and Ph.D. degrees are offered within the major.

Master's students must have a bachelor's degree in one of the life, social, or engineering sciences, or a bachelor's degree plus equivalent experience in these areas. Doctoral students must have a master's degree and either an undergraduate or master's degree in one of the majors in the College of Agriculture and Life Sciences or its equivalent. Graduates of the program will be able to design and manage agricultural systems that increase food security, enhance human communities, and protect environmental quality. To acquire these abilities, students learn agroecological principles, study social relations underlying sustainable farming and food systems, and gain experience with practical techniques of sustainable agriculture. The program seeks to balance depth in disciplinary knowledge and perspectives with broader, system-level thinking. It integrates technical and social sciences through a sequence of team-taught interdisciplinary core courses emphasizing higher-order critical thinking skills and active, collaborative approaches to learning.

Graduates of the program are qualified to work in a variety of settings, including university research, education, extension, agribusiness, governmental and non-governmental organizations, and farming.

Information on applications procedures, research interests of the faculty, and specific requirements of the major may be obtained at http://www.sust.ag.iastate.edu/gpsa/ or by contacting gpsa@iastate.edu.

Courses for graduate students

SusAg 509. Agroecosystem Analysis. (Cross-listed with Agron, Anthr, Soc). (3-4) Cr. 4. F. *Prereq: Senior or above classification.* Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (agronomic, economic, ecological, social, etc), and scales of operation.

SusAg 515. Integrated Crop and Livestock Production Systems. (Cross-listed with A E, Agron, An S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: SusAg 509.* Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

SusAg 530. Ecologically Based Pest Management Strategies. (Cross-listed with Agron, Ent, Pl P). (3-0) Cr. 3. Alt. F., offered 2010. Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

SusAg 546. Organizational Strategies for Diversified Farming Systems. (Cross-listed with Agron, Hort, Soc). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: SusAg 509.* Examination of the organization and operation of complex, diversified farming systems using tools and perspectives drawn from ecology, agronomy, and sociology. The course includes a significant field component focused on an Iowa farm.

SusAg 571. Agroforestry Systems. (Cross-listed with NREM). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 6 credits in biological science at 300-level or above.* Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry.

SusAg 584. Organic Agricultural Theory and Practice. (Cross-listed with Agron, Hort). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 9 cr. in biological or physical sciences.* Delate & DeWitt. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

SusAg 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification, permission of instructor.* For students wishing to conduct in-depth study of a particular topic in sustainable agriculture.

SusAg 599. Creative Component. Cr. arr. F.S.SS. Pre-enrollment contract required. For MS students pursuing the non-thesis degree option. Final product is a creative component.

SusAg 600. Sustainable Agriculture Colloquium. (1-0) Cr. 1. Repeatable. F.S. Weekly seminar for graduate students in the Sustainable Agriculture program.

SusAg 610. Foundations of Sustainable Agriculture. (Cross-listed with Agron, A E, Anthr, Soc). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging agricultural systems in terms of the core concepts of sustainability and their theoretical contexts.

SusAg 699. Research. Cr. arr. Repeatable. F.S.SS. MS and PhD thesis and dissertation research.

Systems Engineering

(Interdepartmental Graduate Major)

Supervisory Committee: D. Gemmill (Chair), D. Jacobson, and A. Mann

Work is offered for the master of engineering with a major in systems engineering. The graduate major in Systems Engineering is primarily an off-campus program. It is an interdisciplinary program that allows students to take courses across a variety of departments. Graduates of the program will possess the analytical abilities needed to design, evaluate, and build complex systems involving many components and demanding specifications. They will have the ability to work across disciplinary boundaries, as the practice of modern engineering often requires. Graduates will have developed management capabilities and extended their disciplinary knowledge.

The program is broadly based and uses courses in the various departments of the College of Engineering and courses in other departments of the university. The 30 credits necessary for graduation includes 27 semester credits of formal coursework and 3 credits for a creative component. Completion of the program requires two courses in systems engineering, two courses in the major discipline of the student, three engineering courses with a systems engineering emphasis, two courses outside of the college, and a creative component. Courses are delivered to off-campus students both with the instructor present and through various distance education systems, including video-streaming, podcasting, ftp downloading and CD-ROMs.

The program of study committee, in consultation with the student, determines the courses to be taken and the acceptability of transfer credits. The major professor should be selected from the discipline where a concentration of coursework will be taken.

Admission to the program requires a baccalaureate degree in engineering and admission to the graduate college. Students with degrees in other areas will be considered on an individual basis.

The degree awarded is a Master of Engineering in Systems Engineering.

For additional information students should contact the Chair of the Supervisory Committee, 2019 Black Engineering Building, ISU, Ames, Iowa 50011.

Teacher Education

David Whaley, Associate Dean, Teacher Education

Teacher Education Faculty: Geoff Abelson (C I), Linda Quinn Allen (WLC), Thomas Andre (C I), Alex Andreotti (C I), Janice Baker (KIN), EunJin Bang (CI), Leslie Bloom (C I), Jackie Blount (C I), Warren Blumenfield (C I), Mary Jane Brotherson (HD FS), Katherine Richardson Bruna (C I), Patricia Carlson (C I), Mike Clough (C I), James Colbert (BIO), Karen Colbert (HD FS), Ana Correia (C I), Sedahlia Crase (HD FS), Corey Drake (C I), Dianne Draper (HD FS), Rich Engelhorn (KIN), Levon Esters (AgEds), Anne Foegen (C I), Michael Golemo (Music), Thomas Greenbowe (Chem), Connie Hargrave (C I), Cheryl Hausafus (AESHM), Sue Hegland (HD FS), Beth Herbel-Eisenmann (C I), Kere Hughes (HD FS), Leah Keino (AESHM), Mimi Lee (CI), Patricia Leigh (C I), John Levis (Engl), Gayle Luze (HD FS), Robert Martin (AgEds), James McShay (C I), Donna Merkley (C I), Greg Miller (AgEds), Wade Miller (AgEds), Kouider Mokhtari (CI), Susan Maude (HD FS), Sylvia Munsen (Music), Donna Niday (Engl), Dale Niederhauser (C I), Lori Norton-Meier (C I), Joanne Olson (C I), Carla Peterson (HD FS), Gary Phye (C I), Mark Rectanus (WLC), Michael Retallick (Music), James Rodde (Music), Connie Ringlee (Engl), Marcia Rosenbusch (C I), Elizabeth Schabel (Engl), Frank Schabel (KIN), Kevin Schilling (Music), Denise Schmidt (C I), Jennifer Seymour (C I), Carl Smith (C I), Katherine Thomas (KIN), Ann Thompson (C I), Margaret Torrie (HD FS), Robert Tremmel (Engl), Michael Tremmel (Engl), Roberta Vann (Engl), Kerry Whisnant (Phys), Kenneth Windom (Geol)

The mission of University Teacher Education is to develop educators who are caring, competent, and certified. Students who successfully complete the requirements for any of the endorsement areas offered at ISU must demonstrate the skills and knowledge required of beginning teachers. (See Iowa Teaching Standards and Criteria section.)

University Teacher Education is a shared responsibility that spans three colleges. For most licensure areas, students major in a content area while taking additional education courses. All students who are recommended by Iowa State University for teacher licensure must meet the requirements of University Teacher Education and be recommended by their department, college, and the ISU recommending official.

Undergraduate Teacher Licensure Areas

An undergraduate student seeking a bachelor's degree must be enrolled in the department in which he or she plans to major and must meet the graduation requirements of that department and college.

Currently, there are sixteen undergraduate teacher licensure areas offered at Iowa State University. These areas and their corresponding grade levels are listed below:

Early Childhood Education (birth-grade 3)
Elementary Education (grades K-6)
Agricultural Education (grades 5-12)
Biology (grades 5-12)
Chemistry (grades 5-12)
Earth Science (grades 5-12)
English (grades 5-12)
Family and Consumer Sciences (grades 5-12)
Health Education (grades 5-12)
History-Social Sciences (grades 5-12)
Mathematics (grades 5-12)
Music (grades K-12)
Physical Education (grades K-12)
Physical Science (grades 5-12)
Physics (grades 5-12)
World Languages and Cultures (French, German, Latin, Russian, and Spanish) (grades 5-12)

Additional Endorsements

Students must fulfill the requirements for one of the licensure areas listed above to add any of the following endorsements:

Art (K-8)
Basic Science (K-8)
Coaching Interscholastic Athletics (grades K-12)
English and Language Arts (K-8)
English as a Second Language (grades K-12)
General Science (grades 5-12)
Health (K-8)
History (K-8)
Instructional Strategist I: Mild/Moderate Disabilities (grades K-8 or 5-12)
Instructional Strategist II: Behavior Disorders/Learning Disabilities (K-12)
Mathematics (K-8)
Middle School (5-8)
Reading (grades K-8 or 5-12)
Social Sciences (K-8)
Speech Communication (grades 5-12)
World Languages and Cultures (French, German, Latin, Russian, and Spanish) (grades K-8)

Post-Bachelor's Teacher Licensure Areas

Students already holding an appropriate bachelor's degree may pursue teacher licensure in any of the undergraduate licensure areas listed above. Interested students should consult with the coordinator of the area in which they plan to specialize so that an individualized program of study can be developed.

Graduate Teacher Licensure Areas

Currently, there are five graduate initial teacher licensure programs. These programs are designed for students who do not currently hold a teaching license. The programs are listed below:

Agricultural Education (M.S.)

Family and Consumer Sciences Education (M.Ed. or M.S.)

Mathematics Education (M.Ed.)

Physical Education (M.S.)

Secondary Sciences Education (M.A.T.)

Iowa State University also offers Master's programs for practicing teachers. The Mathematics Department offers a Masters in School Mathematics. (See Mathematics in Courses and Programs section of this catalog.) The Curriculum and Instruction Department offers a Master's degree program and a certificate program that lead to a special education endorsement. (See Curriculum and Instruction in Courses and Programs section of this catalog.)

Graduate programs are also available for those who seek licensure in Educational Administration as PK-12 school principals or PK-12 superintendents. (See Educational Administration in Courses and Programs section of this catalog.)

Standards

University Teacher Education has a rigorous standards-based curriculum. Two sets of standards are used throughout the program, one that is targeted for pre-service teachers (Standards for University Teacher Education Programs/Candidates which originates from the Iowa Administrative Code, Chapter 79, Standards for Practitioner Preparation Programs) and the other set that is targeted for in-service teachers (the Iowa Teaching Standards and Model Criteria adopted by the State Board of Education). Both are listed below in full.

Standards for University Teacher Education Programs/Candidates

a. Content/subject matter specialization. The candidate demonstrates an understanding of the central concepts, tools of inquiry, and structure of the discipline(s) the candidate teaches, and creates learning experiences that make these aspects of the subject matter meaningful for students. This is evidenced by a completion of a 30-semester-hour teaching major which must minimally include the requirements for at least one of the basic endorsement areas, special education teaching endorsements, or secondary level occupational endorsements. Each elementary candidate must also complete a field of specialization in a single discipline or a formal interdisciplinary program of at least twelve semester hours.

b. Student learning. The candidate demonstrates an understanding of human growth and development and of how students learn, and receives learning opportunities that support intellectual, career, social and personal development.

c. Diverse learners. The candidate demonstrates an understanding of how students differ in their approaches to learning and creates instructional opportunities that are equitable and adaptable to diverse learners.

d. Instructional planning. The candidate plans instruction based upon knowledge of subject matter, students, the community, curriculum goals, and state curriculum models.

e. Instructional strategies. The candidate demonstrates an understanding and use of a variety of instructional strategies to encourage students development of critical and creative thinking, problem-solving, and performance skills.

f. Learning environment/classroom management. The candidate uses an understanding of individual and group motivation and behavior; creates a learning environment that encourages positive social interaction, active engagement in learning, and self-motivation; maintains effective classroom management; and is prepared to address behaviors related to substance abuse and other high-risk behaviors.

g. Communication. The candidate uses knowledge of effective verbal, nonverbal, and media communication techniques, and other forms of symbolic representation, to foster active inquiry, collaboration, and support interaction in the classroom.

h. Assessment. The candidate understands and uses formal and informal assessment strategies to evaluate the continuous intellectual, social, and physical development of the student, and effectively uses both formative and summative assessment of students, including student achievement data, to determine appropriate instruction.

i. Foundations, reflective practice and professional development. The candidate develops knowledge of the social, historical, and philosophical foundations of education. The candidate continually evaluates the effects of the candidate's choices and actions on students, parents, and other professionals in the learning community; actively seeks out opportunities to grow professionally; and demonstrates an understanding of teachers as consumers of research and as researchers in the classroom.

j. Collaboration, ethics and relationships. The candidate fosters relationships with parents, school colleagues, and organizations in the larger community to support students learning and development; demonstrates an understanding of

educational law and policy, ethics, and the profession of teaching, including the role of boards of education and education agencies; and demonstrates knowledge and dispositions for cooperation with other educators, especially in collaborative/co-teaching as well as in other educational team situations.

k. Technology. The candidate effectively integrates technology into instruction to support student learning.

Iowa Teaching Standards and Criteria

Standard 1: Demonstrates ability to enhance academic performance and support for implementation of the school district student achievement goals.

The teacher:

a. Provides evidence of student learning to students, families, and staff.

b. Implements strategies supporting student, building, and district goals.

c. Uses student performance data as a guide for decision-making.

d. Accepts and demonstrates responsibility for creating a classroom culture that supports the learning of every student.

e. Creates an environment of mutual respect, rapport, and fairness.

f. Participates in and contributes to a school culture that focuses on improved student learning.

g. Communicates with students, families, colleagues, and communities effectively and accurately.

Standard 2: Demonstrates competence in content knowledge appropriate to the teaching position.

The teacher:

a. Understands and uses key concepts, underlying themes, relationships, and different perspectives related to the content area.

b. Uses knowledge of student development to make learning experiences in the content area meaningful and accessible for every student.

c. Relates ideas and information within and across content areas.

d. Understands and uses instructional strategies that are appropriate to the content area.

Standard 3: Demonstrates competence in planning and preparing for instruction.

The teacher:

a. Uses student achievement data, local standards, and the district curriculum in planning for instruction.

b. Sets and communicates high expectations for social, behavioral, and academic success of all students.

c. Uses student developmental needs, background, and interests in planning for instruction.

d. Selects strategies to engage all students in learning.

e. Uses available resources, including technologies, in the development and sequencing of instruction.

Standard 4: Uses strategies to deliver instruction that meet the multiple learning needs of students.

The teacher:

a. Aligns classroom instruction with local standards and district curriculum.

b. Uses research-based instructional strategies that address the full range of cognitive levels.

c. Demonstrates flexibility and responsiveness in adjusting instruction to meet student needs.

d. Engages students in varied experiences that meet diverse needs and promote social, emotional, and academic growth.

e. Connects students' prior knowledge, life experiences, and interests in the instructional process.

f. Uses available resources, including technologies, in the delivery of instruction.

Standard 5: Uses a variety of methods to monitor student learning.

The teacher:

a. Aligns classroom assessment with instruction.

b. Communicates assessment criteria and standards to all students and parents.

c. Understands and uses the results of multiple assessments to guide planning and instruction.

d. Guides students in goal setting and assessing their own learning.

e. Provides substantive, timely, and constructive feedback to students and parents.

f. Works with other staff and building and district leadership in analysis of student progress.

Standard 6: Demonstrates competence in classroom management.

The teacher:

a. Creates a learning community that encourages positive social interaction, active engagement, and self-regulation for every student.

b. Establishes, communicates, models, and maintains standards of responsible student behavior.

c. Develops and implements classroom procedures and routines that support high expectations for student learning.

d. Uses instructional time effectively to maximize student achievement.

e. Creates a safe and purposeful learning environment.

Standard 7: Engages in professional growth.

The teacher:

a. Demonstrates habits and skills of continuous inquiry and learning.

b. Works collaboratively to improve professional practice and student learning.

c. Applies research, knowledge, and skills from professional development opportunities to improve practice.

d. Establishes and implements professional development plans based upon the teacher's needs aligned to the Iowa Teaching Standards and district/building student achievement goals.

Standard 8: Fulfills professional responsibilities established by the school district.

The teacher:

a. Adheres to board policies, district procedures, and contractual obligations.

b. Demonstrates professional and ethical conduct as defined by state law and individual district policy.

c. Contributes to efforts to achieve district and building goals.

d. Demonstrates an understanding of and respect for all learners and staff.

e. Collaborates with students, families, colleagues, and communities to enhance student learning.

Standards Assessments

The State Board of Education requires each teacher candidate to demonstrate acquisition of the knowledge, skills and dispositions designated by the standards above for an Iowa teaching license at a level appropriate for a novice teacher. See licensure area coordinator for requirements.

The General Education Requirement

All prospective teachers are required to meet general education requirements as a part of their preparation.

Undergraduate Students

Undergraduate students must complete studies in the following general education groups. General education courses may be found in many departments. Credits listed are minimum requirements. Specific departments and/or colleges may require additional credits. Credits used to satisfy these general education requirements typically satisfy department and college general education requirements. (See licensure area coordinator for more information.)

Cr.	
6	Natural sciences
3	Mathematics or Statistics
9	Social Sciences
6	Humanities
9	Communication Skills
0.5	Library Skills (Lib 160)
33.5	Total

The above requirements must include:

(1). Engl 150 and 250, or equivalent
(2). One course that develops interpersonal or group presentation
(3). HD FS 102 or Psych 230
(4). One course in American history or government (see approved list.)

Post-Bachelor's Students

Students holding an appropriate bachelor's degree who wish to pursue teaching licensure must have at least one course in each of the following five general education groups identified for undergraduate students in the preceding section: Natural Sciences, Mathematics or Statistics, Social Sciences, Humanities, and Communication Skills. Individual departments preparing teachers may require additional credits in general education. (See licensure area coordinator for more information.)

Master's Students

Each Master's program will determine what, if any, general education requirements Master's students must fulfill beyond a bachelor's degree from a regionally accredited institution. (See licensure area coordinator for more information.)

Professional Teacher Education Requirement (Professional Core)

Field Experience Requirement

All students must satisfactorily complete a minimum of 80 hours of pre-student teaching laboratory experience. This requirement may be met through a pre-student teaching course (e.g., C I 280, C I 480, C I 580) or, in certain endorsement areas, a course designated to provide an equivalent experience. Students complete a background check before initial placement in schools and other appropriate locations.

Undergraduate Students

Prospective teachers must complete certain studies related directly to the profession of teaching. All undergraduate students in teacher education must take the following courses prior to student

teaching, unless the student's licensure area has an approved content-area course deemed to be equivalent (see specific Licensure Area Requirements section below for details.)

Early Childhood Education and Elementary Education:

Cr.
3 CI 201-Digital Learning in the PK-6 Classroom
3 C I 204—Social Foundations of American Education
2 C I 245 —Strategies in Teaching
1 C I 268 —Strategies Practicum
3 C I 332 – Educational Psychology of Young Learners
3 CI 406-Multicultural Foundations of Schools and Society: Introduction
3 Sp Ed 250—Education of the Exceptional Learner in a Diverse Society
16 Student teaching (16 weeks)

Secondary Education and K-12:

Cr.

3 CI 202: Digital Learning in the 7-12 Classroom
3 C I 204—Social Foundations of American Education
3 C I 333 -- Educational Psychology
3 CI 406-Multicultural Foundations of Schools and Society: Introduction
3 Sp Ed 450 —Teaching Secondary Students with Exceptionalities in General Education Classrooms
14-16 Student teaching (minimum 14 weeks)
(See teacher licensure area coordinator for more information).

Students in K-12 licensure areas and secondary education (grades 5-12) licensure areas must also complete the course listed below unless the student's licensure area has an approved equivalent. Areas with approved equivalents include: Agricultural Education, Physical Education and all Secondary Sciences. (See licensure area coordinator for more information).

Cr.
3 C I 426—Principles of Secondary Education

Post-Bachelor's Students
Students who hold an appropriate bachelor's degree and seek a teaching license must complete the professional education requirements listed above through course work or examination.

Master's Students
Prospective teachers must complete certain studies related directly to the profession of teaching. All students enrolled in Master's programs that lead to initial licensure must take the following courses prior to student teaching, unless the student's licensure area has an approved content area course deemed to be equivalent. (See Master's Programs section below for details.)

Cr.
3 Sp Ed 501—Teaching Students with Exceptionalties in General Education
3 C I 505 —Using Technology in Learning and Teaching
3 HPC 504—Studies in the Foundations of American Education
3 C I 506—Multicultural Foundations of School and Society: Advanced
3 C I 526—Principles of Secondary Education
3 C I 529—Educational Psychology in the Secondary Classroom
14-16 Student teaching (minimum 14 weeks)
(See teacher licensure area coordinator for more information).

Admission to University Teacher Education (Checkpoint 1)

The University Teacher Education Office monitors the progress of teacher education students. Admission to University Teacher Education is the first of three checkpoints. At this time, the requirements listed below will be checked. Students will not be able to progress to Student Teaching (Checkpoint 2) and Licensure (Checkpoint 3) without full admission to University Teacher Education (Checkpoint 1). Departments may have higher eligibility requirements for each checkpoint (see licensure area coordinator for more information).

Students transferring from other institutions with a minimum of 2.50 GPA or above may be admitted tentatively; full admission may be granted upon completion of nine semester credits averaging 2.50 or above at Iowa State University. Students who receive tentative admission are required to reapply the following semester by using the application for admission. A minimum of 20 semester credits averaging 2.50 or above must be earned at Iowa State University to receive institution licensure approval (nine of the required 20 semester hours must precede student teaching).

A student seeking admission to University Teacher Education must be accepted by a selection committee for the specific licensure area which the student seeks to enter. Factors considered in evaluating applications (in addition to the requirements listed below) may include professional dispositions, scholarship, interest in teaching, character, interpersonal skills, and physical and mental health.

Recommendations by selection committees must be confirmed by the University Teacher Education Coordinating Council before admission is granted. Students may apply as early as four semesters before the one in which they plan to enroll for student teaching; however, they must be fully admitted into University Teacher Education at least one year prior to the semester they complete the Request for Student Teaching Placement. Students in accelerated graduate programs must be fully admitted by mid-semester prior to their planned student teaching semester.

Requirements for full admission to University Teacher Education as an undergraduate:

1. A minimum 2.5 cumulative grade point average.

2. Successful completion of one of the following basic skills tests:

A composite Praxis I (PPST) score of 522, with a minimum of 170 for each test (reading, writing, and mathematics.

Minimum scores for the basic skills tests may be subject to change. Details regarding the scores, dates and fees for these tests are available online: www.teacher.hs.iastate.edu.

3. Documented completion of ISU approved 10 hours of pre-student teaching field experience.

4. All Curriculum and Instruction (C I), Human Development and Family Studies (HD FS) and Special Education (Sp Ed) courses required for licensure have a minimum grade requirement of a C (pedagogy coursework). Courses in the department of the major specifically required for teacher licensure have a minimum grade requirement of a C- (content coursework).

5. A report from a criminal background check initiated by ISU's recommending official.

Requirements for full admission to University Teacher Education as a post-bachelor's student:

1. A bachelor's degree from a regionally accredited institution and a minimum 2.5 cumulative grade point average from that institution.

2. Successful completion of one of the following basic skills test:

—Minimum GRE scores (400 on each of the Verbal and Quantitative sections.)

OR

—A composite Praxis I (PPST) score of 522, with a minimum of 170 for each test (reading, writing, and mathematics.) Some licensure areas may require higher Praxis I scores.

Minimum scores for the basic skills tests may be subject to change. Details regarding the scores, dates and fees for these tests are available online: www.teacher.hs.iastate.edu

3. Documented completion of ISU approved 10 hours of pre-student teaching field experience.

4. All Curriculum and Instruction (C I), Human Development and Family Studies (HD FS) and Special Education (Sp Ed) courses required for licensure have a minimum grade requirement of a C (pedagogy coursework). Courses in the department of the major specifically required for teacher licensure have a minimum grade requirement of a C- (content coursework).

5. A report from a criminal background check initiated by ISU's recommending official.

Requirements for full admission to University Teacher Education as a Master's student:

1. Full admission to an appropriate Master's degree program.

2. Minimum GRE scores (400 on each of the Verbal and Quantitative sections).

3. Documented completion of ISU approved 10 hours of pre-student teaching field experience.

4. All Curriculum and Instruction (C I), Human Development and Family Studies (HD FS) and Special Education (Sp Ed) courses required for licensure have a minimum grade requirement of a C (pedagogy coursework). Courses in the department of the major specifically required for teacher licensure have a minimum grade requirement of a C- (content coursework).

5. A report from a criminal background check initiated by ISU's recommending official.

Students who do not meet the requirements for admission to University Teacher Education may choose to appeal to the University Teacher Education Coordinating Council. The description of the appeals process is available online: www. teacher.hs.iastate.edu.

Maintaining Program Eligibility

Standards Assessments: In order to be recommended for licensure, all students must have demonstrated satisfactory performance across the teacher education competencies, as defined by their specific area. (See the teacher licensure area coordinator for more information.) Students' progress is monitored throughout the program Standards are assessed multiple times. More information is available online: www.teacher.hs.iastate.edu.

GPA: All students admitted to the University Teacher Education Program must maintain a minimum of a 2.5 cumulative grade point average through completion of their licensure requirements.

Grades: For teacher education students, all Curriculum and Instruction (C I), Human Development and Family Studies (HD FS) and Special Education (Sp Ed) courses required for licensure have a minimum grade requirement of a C. Courses in the department of the major specifically required for teacher licensure have a minimum grade requirement of a C-. Note: Individual departments preparing teachers may have higher eligibility requirements (see teacher licensure area coordinator for more information).

Student Teaching (Checkpoint 2)

Student teaching is the culminating experience. To ensure that students are prepared for this experience, the following requirements must be met prior to submitting your "Request for Student Teaching Placement" form:

1. Full admission to University Teacher Education is required a minimum of 1 year before the start of the student teaching semester. Students in accelerated graduate programs must be fully admitted by mid-semester prior to the student teaching semester.

2. Completion of the "'Request for Student Teaching Placement" by the deadline in the fall semester for spring student teaching and by the deadline in the spring semester for fall student teaching. Details regarding this application are available in the University Teacher Education Office.

3. A minimum 2.5 cumulative grade point average.

4. A passing grade as determined by the licensure area must have been earned in all required professional teacher education requirement courses and selected courses in the student's licensure area. All Curriculum and Instruction (C I), Human Development and Family Studies (HD FS) and Special Education (Sp Ed) courses required for licensure have a minimum grade requirement of a C (pedagogy coursework). Courses in the department of the major specifically required for teacher licensure have a minimum grade requirement of a C- (content coursework).

Teacher Licensure (Checkpoint 3)

The Iowa Board of Educational Examiners issues teaching licenses that are valid for specific ages or grades (e.g., Birth-3 for early childhood teachers, K-6 for elementary teachers and 5-12 for secondary teachers). Endorsements on a teaching license indicate which subject areas a teacher is qualified to teach. Completion of student teaching and required coursework does NOT guarantee recommendation for a teaching license. The Iowa License may be recommended for students who hold a bachelor's degree from Iowa State University or another regionally accredited institution and who have completed the following:

1. All requirements of an approved licensure area, including the general education requirement and professional teacher education requirement listed above. Note: Specific courses to be used for licensure may not be taken pass/not pass.

2. Additional requirements as designated by the State of Iowa that include, but are not limited to, a special education component and 50 hours of pre-student teaching field experience, 40 of which are to be taken after admission to the University Teacher Education Program.

3. A minimum ISU cumulative grade point average of 2.50 or higher through graduation (or completion of the University Teacher Education Program). (Some licensure areas may require a higher cumulative grade point average.)

4. A minimum grade of C (not C-) must be earned in student teaching to be recommended for licensure.

5. Documentation from the student teaching supervisor that the student has successfully completed the final assessment documenting the student's mastery of the skills and knowledge included in the Iowa Teaching Standards.

Undergraduate and Post-Bachelor's (non-Master's) Teacher Licensure Area Requirements

Certain competencies are required of those who plan to teach at the early childhood, elementary or secondary level. Those preparing to teach at the secondary level must develop a depth of understanding in one or more subject matter areas. For full-time teaching in secondary schools a major in an endorsement area or an approved subject matter concentration of at least 30 semester hours is required. Students interested in adding an additional endorsement area should consult with the coordinator or adviser of the additional area (see the following website for the contact information for the adviser or coordinator that works with students on teacher licensure: www.teacher.hs.iastate.edu. Persons interested in teaching in one of the following endorsement areas should also consult with the appropriate adviser or coordinator. Specific requirements for each teacher licensure area are described below (these requirements are in addition to the General Education Requirements and the Professional Teacher Education Requirements that were listed earlier).

Agricultural Education

The Department of Agricultural Education and Studies is responsible for preparing Agricultural Education teachers for grades 5-12.

For specific content area requirements see Curriculum in Agricultural Education and Studies (Teacher Certification Option).

Required professional courses are: AgEdS 110A, 211A, 310, 401, 402, 416, 417 (14 Cr.)

Required content courses are: AgEdS 488; Agron 114 and 154; An S 101 and 114; Hort 221; Econ 101, 331; NREM 120; 6 credits in agriculture and life sciences; 6 credits in courses 300-level or above to be chosen from technology systems management, animal science, agronomy, agricultural economics, forestry, or horticulture.

Biology

The Biology Program and the Department of Curriculum and Instruction share the responsibility of preparing Biology teachers for grades 5-12.

Required professional courses are: C I 280M,

C I 347, C I 418, C I 419, C I 468J, C I 468K and C I/LAS 417D

Required content courses are: Biol 211, 211L, 212, 212L, 312, 313, 313L, 314, 314L, 315. Biol 366 or 330, or 454. Biol 335 or BMS 329, Micro 302.

Additional courses to obtain a total of 17 credits at the 300 level or above in a basic biological science. Supporting coursework must include 13 credits in chemistry, 8 in physics, and 6 in mathematics.

Chemistry

The Department of Chemistry and the Department of Curriculum and Instruction share the responsibility of preparing Chemistry teachers for grades 5-12.

Required professional courses are C I 280M, C I 347, C I 418, C I 419, C I 468J, C I 468K, and C I 417B.

Required content courses are: Chem 177, 177L, 178, 178L, 211, 211L, 301, 316, 316L, 324, 325, 321L or 322L, 331, 331L, 332, 332L; Phys 221, 222 or Phys 111, 112; Math 165, 166; a minimum of one course in Biol is required; Biol 211 and 211L are recommended.

Students with an endorsement in a natural science who seek approval to teach chemistry as an additional subject area must earn credits in the following courses (15 minimum credits):

Chem 177, 177L, 178, 178L, 211, 211L, 331, 331L, 332, 332L or Chem 163, 163L, 164, 164L, 211, 211L, 231, 231L.

Students with no natural science endorsement who seek approval to teach chemistry as an additional subject area must complete one of the two sets of courses listed above plus sufficient additional courses to total 24 chemistry credits chosen from:

Chem 316, 316L, 324, 325, 322L or BBMB 301, 311, 451.

Early Childhood Education

The Department of Curriculum and Instruction and the Department of Human Development and Family Studies in the College of Human Sciences share the responsibility for preparing teachers to work with children from birth to age 8 (PK-3 including special education).

For specific course requirements, see College of Human Sciences, Curriculum in Early Childhood Education.

Earth Sciences

The Department of Geological and Atmospheric Sciences and the Department of Curriculum and Instruction share the responsibility of preparing Earth Science teachers for grades.5-12

Required professional courses are: C I 280M, 347, 418, 419, 468J, 468K, C I 417J.

Required content courses are: Geol 100, 100L, 102, 102L, 302, 311, 356, 365, 368 and a three credit geology elective; Mteor 206; Astro 120, 150; Chem 177, 177L, 178, 178L; Phys 111, 112; Math 151 or 160 or 165 or 181; Stat 101 or 104 or Com S 107; and one three credit biology course.

Students with an endorsement in a natural science who seek approval to teach earth sciences as an additional subject area must earn credits in the following courses: Geol 100, 100L, 102, 102L, Mteor 206, Astro 120, Astro 150, and at least 3 credits at the 300-level or higher.

Students with no other natural science endorsement, but who seek endorsement in this area, must take Geol 100, 100L, 102, 102L, Mteor 206, Astro 120, Astro 150, plus any additional credits to produce a total of 24, at least 3 credits at the 300-level or higher. See licensure area coordinator for approval prior to taking courses.

Elementary Education

The Department of Curriculum and Instruction in the College of Human Sciences is responsible for preparing elementary (K-6) teachers.

For specific course requirements, see College of Human Sciences, Curriculum in Curriculum and Instruction. Several endorsements may be added to a K-6 teaching license. See an adviser for the most current list and the necessary additional requirements.

English

The Department of English prepares English teachers for grades 5-12

Required professional courses are: C I 280A, 395; Engl 396, 397, 417, and 494.

Required content courses are: see Curriculum, English.

Students seeking to add English as an additional endorsement area must earn 46 credits in the following courses:

3 Advanced Writing: Engl 302, 303, 304, 305, 306, 309, 314, 315, 316

3 Rhetoric: Engl 310

3 Language: Engl 220

18 Literature: Engl 260; Engl 225; Engl 226; Engl 227; Engl 228; Engl 340's OR Engl 353 OR Engl 354

19 English Education: CI 395; Engl 396; Engl 397 and CI 280a; Engl 494 and CI 280a; SpEd 450

Students must earn grades of C or better in all of the above courses.

Family and Consumer Sciences

The Family and Consumer Sciences Program in the Department of Apparel, Educational Studies and Hospitality Management prepares Family and Consumer Sciences teachers for grades 5-12

For specific content area course requirements, see Curriculum, Family and Consumer Sciences Education and Studies.

Required professional courses are: FCEdS 206, 306, 318, 403, 413, 417A, and 417B.

Required content courses are: HD FS 102; 220 or 221 or 223 or 226; 276, 349, 283, 341 or 483 or 488; FS HN 111 and 167; T C 121 or 131 or 165 or 204; HD FS 239 or T C 342.

Health Education

The Department of Kinesiology prepares Health teachers for grades 5-12.

Required professional courses are: H S 375 and 417.

Required content courses are: Kin 258; H S 105, 110, 215, 305, 310, 350, 390; FS HN 167; HD FS 276, 373 or 377; Biol 255, 255L.

Students seeking approval for health education as an additional endorsement area must earn credits in the following courses: FS HN 167, HD FS 276, H S 110, 215, 305, 310, 350, 375, 390; Biol 255, 255L.

History-Social Sciences

The Curriculum and Instruction Department and the History Department share the responsibility for preparing History-Social Sciences teachers for grades 5-12.

Contact the History Department for specific information.

History-Social Sciences Education students must earn grades of C or better in all content and pedagogical coursework required for teacher licensure.

Mathematics

The Mathematics Department and the Curriculum and Instruction Department share responsibility for the preparation of Mathematics teachers for grades 5-12

For specific content area course requirements, contact Curriculum and Instruction Advising Office. Required professional courses are: CI 219, 280L, 280A, 480C, 497, 417C

Required content courses are: Math 165, 166, 201, 265, 266 or 267, 301, 317, 341, 397, 435, 436, Com S 107 or 207 or 227, and Stat 101.

Students wishing to add mathematics as an additional endorsement area or as a non-mathematics major with a major in one of the mathematical sciences, physical sciences, or engineering seeking a license to teach mathematics must take the following:

Math 165, 166, 201, 301, 317, 341, 397, 435, 436, Com S 107 or 207 or 227, Stat 101 and CI 480C, and 497.

Music

The Music Department prepares Music teachers for grades K-12.

For specific content area course requirements, see Curriculum, in Music.

Required professional courses are: Music 248, 266, 366, 367 or 368 or 490A, 464 or 465, 466, Music/C I 417K and 417L, Music/C I 480K.

Required content courses are: see Curriculum, in Music.

Physical Education

The Kinesiology Department prepares Physical Education teachers for grades K-12.

Kinesiology and Health (instead of Health and Human Performance)

Required professional courses are: KIN 280, 281, 312, 355, 358, 365 or 366, 372, 375, 395, 417, 418, 470, 475.

Required content courses are: see Curriculum, Kinesiology and Health

Physics

The Physics and Astronomy Department and the Curriculum and Instruction Department share the responsibility for preparing Physics teachers for grades 5-12

For specific content area course requirements, see Curriculum, Physics.

Required professional courses are: C I 280M, 347, 418, 419, 468J, 468K, 417B.

Required content courses are: Phys 221, 222, 311T, 399, 321. Select 12 credits from the following: Phys 302, 304, 306, 310, 321, 321L, 322, 322L, 361, 364, 365, 496; Astro 342, 344L, 346; Chem 324, 325, E E 201, 230; E M 274, 345, 378; M E 330, 231.

Students with an endorsement in a natural science who seek approval to teach physics as an additional endorsement area must complete one of the following sets of courses:

Phys 221, 222, 311T, 321, 321L, 399 (2 cr.),

OR Phys 111, 112, 302, 311T, 399 (2 cr.)

Students with no other natural science endorsement who seek approval to teach physics as an additional endorsement area must complete one of the two sets of courses listed above plus sufficient additional credits from the following list of courses to total 24 credits:

Phys 221, 222, 302, 304, 306, 310, 321, 321L, 322, 322L; Astro 342, 344L, 346; Chem 321, 324, 325; E E 441; E M 274, 345, 378; M E 330, 332.

Physical Science

The Department of Physics and Astronomy and the Department of Curriculum and Instruction share the responsibility for preparing Physical Science teachers for grades 5-12

Required professional courses are: C I 280M, 347, 418, 419, 468J, 468K, 417B.

Required content courses are: Phys 111, 112 or Phys 221, 222; Chem 163, 163L, 231, 231L; Astro 120, 150 or 342, 346; Geol 100, 100L; Mteor 206; Math 151 or 160 or 165 or 181; one course in biology; one additional course numbered 300 and above in astronomy and astrophysics, chemistry, meteorology, physics, or geology.

Students with an endorsement in a natural science who seek approval to teach physical science as an additional area must earn credits in the courses listed below. Students with no other science endorsement, but who seek an additional endorsement in this area, must take the listed courses plus additional credits in the area to total at least 24. See coordinator for approval prior to taking additional courses.

Astro 120 or 150 or 342 or 346
Chem 163, 163L
Geol 100, 100L
Mteor 206
Phys 111, 112; or 221, 222

World Languages and Cultures

The Department of World Languages and Cultures prepares World Language teachers for grades 5-12

World Language teachers can earn an endorsement in French, German, Latin, Russian or Spanish.

For specific content area course requirements, see Curriculum, World Languages and Cultures.

Required professional courses are: C I 280L, WLC/C I 480, WLC 417 and WLC 487.

Students seeking approval to teach a world language as their first endorsement must have a major in the target language. For an additional endorsement in a world language, students must earn 25 credits in that language. Nine (9) credits must be at the 300 level or above with six (6) of these credits in composition and conversation. Courses at the 100 level are not counted in the 25 required credits. For an endorsement in Latin, 10 of the 25 credits must be at the 300 or 400 level and must include Hist 430 (Cl St 403). All students seeking to teach a world language must demonstrate their proficiency in the language by taking the ACTFL OPI (Oral Proficiency Interview). Students are responsible for the cost of the administration of the OPI and must request that their scores from the OPI be added to their transcript.

Requirements for Additional Endorsements

Students may elect to add additional endorsements to their teaching license by completing the necessary requirements. All "Undergraduate Teacher Licensure Areas" listed above can be pursued as an additional endorsement. Below are the additional endorsements only options that require students to pursue one of the undergraduate, post-bachelor's or graduate teacher licensure areas listed above. Detailed requirements for any endorsement may be obtained from the University Teacher Education Office.

Art (grades K-8)

Students seeking an additional endorsement in Art (K-8) should see an adviser in the Department of Curriculum and Instruction.

Basic Science (grades K-8)

Students seeking an additional endorsement in Basic Science (K-8) should see an adviser in the Department of Curriculum and Instruction.

Coaching Interscholastic Athletics (grades K-12)

The Department Kinesiology offers courses that can lead to a K-12 athletic coach endorsement.

Students seeking approval for the Iowa State University endorsement to coach interscholastic athletics must satisfy the requirements of an endorsement area listed above and earn credits in the following:

Biol 155, Psych 230, KIN 220, and KIN 315

English and Language Arts (grades K-8)

Students seeking an additional endorsement in English and Language Arts (K-8) should see an adviser in the Department of Curriculum and Instruction.

English as a Second Language (grades K-12)

The Department of English offers courses that can lead to a K-12 ESL Teacher endorsement.

To add a K-12 teaching endorsement in English as a Second Language, students must fulfill the requirements of an endorsement area listed above and earn credits in the following courses. In some cases, relevant special topics courses or experimental courses may be substituted. Some courses have prerequisites.

Engl/Ling 219 or Engl/Ling 511
Engl/Ling 220
Engl/Ling 425 or Engl/Ling 517
Engl/Ling 514 or C I 420/520
Engl/Ling 518 or Engl/Ling 524 and Engl/Ling 525
Engl/Ling 588

General Science (grades 5-12)

General Science is an interdepartmental additional area of endorsement for grades 5-12

Students seeking approval to teach general science must earn credits in the following courses:

Biol 211, 211L, 212, 212L
Chem 177, 177L, 178, 178L, 231, 231L
Geol 100, 100L
Phys 111, 112; or 221, 222
Math 151 or 160 or 165 or 181

At least 6 credits from courses numbered 300 or above in astronomy and astrophysics, biochemistry and biophysics, biology, botany, chemistry, genetics, geology, meteorology, microbiology, or physics.

Health (grades K-8)

Students seeking an additional endorsement in Health (K-8) should see an adviser in the Department of Curriculum and Instruction.

History (grades K-8)

Students seeking an additional endorsement in History (K-8) should see an adviser in the Department of Curriculum and Instruction.

Mathematics (grades K-8)

Students seeking an additional endorsement in mathematics (K-8) should see an adviser in the Department of Curriculum and Instruction.

Middle School (grades 5-8)

Students seeking an additional endorsement in Middle School (5-8) should see an adviser in the Department of Curriculum and Instruction.

Reading (grades K-8, 5-12)

The Curriculum and Instruction Department offers courses that can lead to a reading endorsement for grades K-8. This department collaborates with the English Department to offer the necessary coursework for a 5-12 reading endorsement.

Students seeking an additional endorsement to teach elementary reading (K-8) should see a Department of Curriculum and Instruction.adviser.

Students seeking endorsement to teach reading (5-12) as an additional endorsement must earn credits in the following courses:

Foundations of Reading and Reading in the Content Area: C I 395/595 or CI 551 and C I/Engl 494.

Practicum: C I 488/588

Language Development: Engl 219 or 511

Reading Assessment and Oral Communication: C I 452/552

Written Communication: C I 395/595 and Engl 397

Adolescent Nonfiction and Fiction: Engl 396 or C I 554

Reading Instructional Strategies: C I 456/556 or 553

Social Sciences (grades K-8)

Students seeking an additional endorsement in Social Sciences (K-8) should see an adviser in the Department of Curriculum and Instruction

Special Education (grades K-8, 5-12, K-12)

The Department of Curriculum and Instruction offers courses that can lead to special education endorsements (Instructional Strategist I: Mild/Moderate Disabilities (grades K-8 and grades 5-12) and Instructional Strategist II: Behavior Disorders/Learning Disabilities (K-12)). Students seeking 5-12 special education endorsement must have a current teaching license.

Students seeking an additional K-8 endorsement to teach special education should see an adviser in the Department of Curriculum and Instruction.

Speech Communication (grades 5-12)

The Department of Speech Communication offers courses that can lead to 5-12 speech/theatre endorsement.

Students seeking endorsement to teach speech as an additional area must earn credits in the following courses:

Sp Cm 110 or ComSt 102, Sp Cm 212, 313, 322, 412, 495A, 495B;

Thtre 255 or 360 or 455; Thtre 358; JI MC 101.

World Languages and Cultures (French, German, Latin, Russian, and Spanish) (grades K-8)

Students seeking an additional endorsement World Languages and Cultures (K-8) should see an adviser in the Department of Curriculum and Instruction.

Master's Programs that Lead to Initial Teacher Licensure

Agricultural Education

The Agricultural Education and Studies Department offers a Master's of Science program that prepares Agricultural Education teachers for grades 5-12

See coordinator for program requirements.

Mathematics

The Curriculum and Instruction Department offers a Master's of Education program that prepares Mathematics teachers for grades 5-12

See coordinator for program requirements.

Physical Education

The Department of Kinesiology offers a Master's of Science program that prepares Physical Education teachers for grades K-12.

See coordinator for program requirements.

Secondary Sciences

The Department of Curriculum and Instruction offers a Master's of Arts in Teaching program that prepares Secondary Science teachers for grades 5-12

See coordinator for program requirements.

Technology and Social Change

Advisory Committee: Eric Abbott, coordinator; Robert Mazur, graduate coordinator.

Undergraduate Study

Technology and social change is a cross-disciplinary program examining the relationships between technologies and the social and cultural environments. The program has a national and international perspective, with courses addressing the interrelationships, policies, and impacts created by the international exchange of technologies. Through T SC, students will better understand the institutional and sociocultural consequences of technological change from differing perspectives and will become sensitive to the issues attending the use of technology to improve people's lives. Work in the program can also serve as preparation for advanced study in this field.

The program requirement for a minor in technology and social change is a minimum of 15 credits. One of the courses must be T SC 341. An additional 3 credits must be taken from T SC cross-listed courses. The remaining 9 may be selected from T SC cross-listed courses or from the list of T SC approved courses. At least 9 of the 15 credits must be in courses numbered 300 or above. Because technology and social change is an interdisciplinary study, minor programs must include coursework in at least two departments. Students seeking a minor should develop a specific program of courses either with the T SC faculty representative in their department or with the T SC coordinator. The student's minor program must be approved by the T SC program coordinator.

T SC courses are listed below. The list of T SC approved courses is available from the program coordinators. Through the program coordinator, students may petition for approval of courses not on the approved list that address matters relevant to technology and social change.

Graduate Study

The graduate minor in technology and social change is a cross-disciplinary program that enables students to study the interactions between technologies and their users, on both societal and individual levels. The minor strengthens the ability of students to apply differing perspectives in understanding the effects of the global exchange of technologies and to heighten their sensitivity to the institutional and sociocultural issues attending the use of technology to improve people's lives.

Students choosing to minor in technology and social change will pursue a degree program in the major department. In consultation with their major professor, students are to identify a T SC Faculty member to serve on the committee guiding their program of study. This T SC Faculty member must be on the Graduate faculty and must be from a discipline outside the major field of study. With the agreement of the POS committee, the student declaring a minor in T SC will select a group of courses from the list of T SC approved courses available through the program coordinators. For the master's degree, this group should be at least 9 credits; for a doctoral degree, the group should be at least 15 credits. In either case, T SC 543 is required. Students may not include in their minor any courses from their own major. All programs of study that include a T SC minor must be approved by the T SC Program coordinator.

Courses primarily for undergraduate students

T SC 341. Technology: International, Social, and Human Issues. (3-0) Cr. 3. F. *Prereq: Junior classification.* An interdisciplinary study of the international significance of technology and of the societal and human issues attending its development and adoption.

T SC 342. World Food Issues: Past and Present. (Cross-listed with Agron, Env S FS HN). (3-0) Cr. 3. F.S. *Prereq: Junior classification.* Zdorkowski, Ford. Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects. Nonmajor graduate credit.
H. Honors Section. (Honors Program students only.)

T SC 343. Philosophy of Technology. (Cross-listed with Phil). (3-0) Cr. 3. F.S. *Prereq: 6 credits of social science or T SC 341 and 3 credits of social science.* Moral and other philosophical problems related to developments in technology. Topics may include conditions under which technological innovations contribute to human emancipation, relationship of technology and democracy, utility and limits of technical rationality, and problems of ensuring that benefits of technological advance are communally shared. Topics discussed with reference to such issues as contemporary developments in microelectronics, technology transfer to the Third World, etc. Nonmajor graduate credit.

T SC 474. Communication Technology and Social Change. (Cross-listed with JI MC). (3-0) Cr. 3. *Prereq: Junior classification.* Examination of historical and current communication technologies, including how they shape and are shaped by the cultural and social practices into which they are introduced.

T SC 490. Independent Study. Cr. arr. Repeatable. *Prereq: 341, permission of instructor and of T SC coordinator.*

Courses primarily for graduate students, open to qualified undergraduate students

T SC 543. Technological Innovation, Social Change, and Development. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 6 credits in social sciences.* Sources, theories and models of technological innovation; social and institutional contexts of technology transfer; appropriate/intermediate technology; issues and methods of impact assessment; planning technology related social change; democratic control of technological innovations and application; local and international case studies.

T SC 574. Communication Technologies and Social Change. (Cross-listed with JI MC). (3-0) Cr. 3. *Prereq: 6 credits in social science.* Personal, organizational, and social implications of the use of communication technologies. Includes theories and empirical research across the continuum of perspectives, from techno-utopianism through an anti-technology stance.

T SC 590. Special Topics: Technology and Social Change. Cr. arr. *Prereq: 541, permission of instructor and of T SC coordinator.* Individual study of topics concerning global and local implications of technological change.

Technology Systems Management

(Administered by the Department of Agricultural and Biosystems Engineering)

Rameshwar Kanwar, Chair of Department

Distinguished Professor: Brown

Distinguished Professor (Emeritus): H. Johnson

University Professor: Bern

University Professors (Emeritus): Baker

Professors: Chen, Downing, Glanville, Harmon, Hoff, Hurburgh, L. Johnson, Kanwar, Misra, Schwab, Van Leeuwen, Xin

Professors (Emeritus): Beer, Bekkum, Buchele, Bundy, Hazen, Hoerner, Keeney, Lovely, Maney, Mangold, Marley, Melvin, Miller, Pedersen, Riley, R. Smith

Professor (Collaborator): Laflen

Associate Professors: Anex, Bhandari, Birrell, Brumm, Burns, Freeman, Koziel, Mickelson, Raman, Steward, Tim

Associate Professors (Emeritus): Anderson, Greiner, Lorimor

Associate Professor (Collaborator): Han

Assistant Professors: , Grewell, Helmers, Kaleita-Forbes, Keren, Kim, Soupir, Tang, Yu

Assistant Professors (Emeritus): Boyd, Bradshaw

Assistant Professors (Adjunct): Inyang, Shahan, Tong

Assistant Professors (Collaborators): Dunn, Malone

Lecturer: Snell

Undergraduate Study

The Department of Agricultural and Biosystems Engineering offers work for the bachelor of science degree with majors in agricultural systems technology and industrial technology, (see *College of Agriculture, Curricula*).

Missions: The mission of the Agricultural Systems Technology program is to prepare women and men for careers that integrate and apply agricultural and biosystems engineering technology to manage human and natural resource systems for producing, processing, and marketing food and other biological products worldwide.

The mission of the Industrial Technology is to prepare women and men for careers that integrate and apply industrial technology to lead and manage human, manufacturing, and safety systems.

Objectives: At two to five years after undergraduate graduation, through the professional practice in technology, graduates should:
1. Have demonstrated competence in methods of analysis involving use of mathematics, fundamental physical and biological sciences, technology, and computation needed for the professional practice in the field of agricultural systems technology or industrial technology.

2. Have developed skills necessary to contribute to the design process; including the abilities to think creatively, to formulate problem statements, to communicate effectively, to synthesize information, and to evaluate and implement problem solutions.
3. Be capable of addressing issues of ethics, safety, professionalism, cultural diversity, globalization, environmental impact, and social and economic impact in professional practice.
4. Have demonstrated continuous professional and technical growth, with practical experience, so as to be licensed in their field or achieve that level of expertise, as applicable.
5. Have demonstrated the ability to:

a. be a successful leader of multi-disciplinary teams.
b. efficiently manage multiple simultaneous projects.
c. work collaboratively.
d. implement multi-disciplinary systems-based solutions.
e. to apply innovative solutions to problems through the use of new methods or technologies.
f. contribute to the business success of their employer, and
g. build community.

Outcomes: At the time of graduation, students of the Agricultural Systems Technology or Industrial Technology programs should have:

a) an ability to apply knowledge of mathematics, science, technology, and applied sciences;
b) an ability to design and conduct experiments, as well as to analyze and interpret data;
c) an ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
d) an ability to function on multi-disciplinary teams;
f) an understanding of professional and ethical responsibility;
g) an ability to communicate effectively;
h) the broad education necessary to understand the impact of solutions in a global, economic, environmental, and societal context;
i) a recognition of the need for, and an ability to engage in life-long learning;
j) a knowledge of contemporary issues; and
k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.

Graduates have developed and demonstrated workplace competencies, and have completed a professional internship. They are able to communicate effectively, have problem-solving skills and awareness of global, economic, environmental and societal issues.

Agricultural Systems Technology graduates have the ability to apply science and technology to problems related to agriculture; they manage complex agricultural systems for sustainability. They find careers within a variety of agriculturally-related industries, businesses, and organizations, including: agricultural machinery, environment, government, farm builders, grain, feed, seed, fertilizer, chemical, food, biorenewable resources, and production agriculture.

Industrial Technology graduates understand commonly-used manufacturing processes, lean manufacturing principles, continuous improvement, quality management, safety, regulatory issues affecting manufacturing, and the properties of manufacturing materials. They find careers within a variety of industries, businesses, and organizations focusing in manufacturing (e.g., quality control, production supervision, and process and facility planning) or occupational safety (e.g., development, management, and evaluation of safety programs and systems; and hazard identification and mitigation).

Certificate: The Department of Agricultural and Biosystems Engineering offers a undergraduate certificate in occupational safety which may be earned by completing a minimum of 20 credits of technology systems management courses, which includes TSM 27, 272,370, 372, 470, and 493D, plus an additional 6 credits from a departmentally approved list.

Minors: The Department of Agricultural and Biosystems Engineering offers a minor in agricultural systems technology which may be earned by completing a minimum of 15 credits of technology systems management courses, which includes TSM 115 and 210, plus an additional 9 credits from a departmentally approved list.

The Department of Agricultural and Biosystems Engineering also offers a minor in industrial technology which may be earned by completing a minimum of 18 credits of technology systems management courses, which includes TSM 115 and 210, plus an additional 12 credits from a departmentally approved list.

For the undergraduate curriculum in agricultural systems technology leading to the degree of bachelor of science or for the undergraduate curriculum in industrial technology leading to the degree of bachelor of science, see *College of Agriculture, Curricula*.

The department also offers an undergraduate curricula and courses in agricultural engineering, biological systems engineering, see *College of Engineering, Curricula*.

Graduate Study

The department offers work for the degrees master of science, and doctor of philosophy with a major in industrial and agricultural technology. It cooperates in the interdepartmental programs in professional agriculture, sustainable agriculture, environmental sciences, biorenewable resources and technology, and human computer interaction.

The master's program prepares advanced practicing professionals for industrial and/or agricultural technology positions in industry, business, and public service; it also provides a sound foundation for further graduate study. The doctoral program prepares exemplary industrial and/or agricultural technology professionals for learning, discovery, engagement, and leadership roles in education, industry, business, and public service organizations.

The department also offers work for the degrees master of science, master of engineering, and doctor of philosophy with a major in agricultural engineering. See *College of Engineering, Curricula*.

Visit our departmental website at www.abe.iastate.edu.

Courses primarily for undergraduate students.

TSM 110. Introduction to Technology. (1-0) Cr. 1. F. *Prereq: AST and I Tec majors only or permission of instructor.* Team-oriented introduction to agricultural systems technology and industrial technology. Report writing, internships, careers, competencies, academic success strategies, industry visits, transition to academic life.

TSM 111. Experiencing Technology. (0-2) Cr. 1. S. *Prereq: AST or I Tec majors only or permission of instructor.* Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of technology. Report writing, internships, competencies, portfolios, industry visits.

TSM 112. Orientation to Learning and Productive Team Membership. (Cross-listed with Aer E, FS HN, Hort, NREM). (2-0) Cr. 2. F. Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

TSM 114. Developing Responsible Learners and Effective Leaders. (Cross-listed with FS HN, Hort, NREM). (2-0) Cr. 2. S. Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

TSM 115. Solving Technology Problems. (2-2) Cr. 3. F.S. *Prereq: Math 140 or higher (can be taken concurrently).* Solving technology problems and presenting solutions through technical reports. Unit conversions, unit factor method, SI units, significant digits, graphing and curve fitting. Use of spreadsheet programs to solve and present technology problems. Solution of technology problems using computer programming languages.

TSM 116. Introduction to Design in Technology. (2-2) Cr. 3. F.S. 2D projections and 3D representations of objects, national and international standards for documentation, manufacturing processes, design projects, and teamwork. Free-hand sketching techniques and parametric solid modeling will be covered.

TSM 201. Entrepreneurship and Internship Seminar. (Cross-listed with A E, BSE). (1-0) Cr. 1. F.S. *Prereq: Sophomore classification in AE, AST, or I Tec.* 8 week course. Overview of the entrepreneurial process and its importance in the economy and the engineering/ technical workplace. Preparation for internship experiences. Relationship of workplace competencies to entrepreneurship, intrapreneurship, and internships; portfolios.

TSM 210. Fundamentals of Technology. (3-0) Cr. 3. F.S. *Prereq: 115 (may be taken concurrently) or equivalent, Math 140 or higher.* Introduction to problem solving related to fundamental agricultural and/or industrial technology systems. Basic laws of energy, force, and mass applied to technology systems such as: mechanical power transmission; equipment calibration; environmental and natural resources; heating, ventilation and air conditioning; electrical circuits. Using the time value of money to make economic decisions.

TSM 216. Advanced Technical Graphics, Interpretation, and CAD. (2-2) Cr. 3. F.S. *Prereq: 116.* Advanced design systems incorporating 2D and 3D design and productivity tools for use in manufacturing settings. Topics include: Geometric Dimensioning and Tolerancing, 3D models, welding symbols, advanced visualization, design modeling of parts and assemblies, feature based design. Use of AutoCAD and parametric modeling software.

TSM 240. Introduction to Manufacturing Processes. (1-4) Cr. 3. F. A study of selected materials and related processes used in manufacturing. Lecture and laboratory activities focus on materials, properties, and processes. This includes plastics and metals.

TSM 270. Principles of Injury Prevention. (3-0) Cr. 3. F. Basic foundations of injury causation and prevention in home, motor vehicle, public, and work environments.

TSM 272. Occupational Safety Management. (2-0) Cr. 2. F. Introduction to occupational safety and health administration and management. Focus on development and management of safety programs and obtaining employee involvement in occupational safety programs.

TSM 276. Fire Protection and Prevention. (3-0) Cr. 3. F. An overview of the current problems and technology in the fields of fire protection and fire prevention, with emphasis on industrial needs, focusing on the individual with industrial safety responsibilities.

TSM 301. Leadership and Ethics Seminar. (Cross-listed with A E, BSE). (1-0) Cr. 1. F.S. *Prereq: 201.* 8 week course. Leadership and ethics experiences through case studies and seminar presentations by practitioners. Relationship of workplace competencies to leadership and ethics; portfolios.

TSM 310. Total Quality Improvement. (3-0) Cr. 3. S. *Prereq: Stat 101 or 104, junior classification.* Introduction to the fundamental concepts of TQM - Deming style of management, statistical studies to understand the behavior of products, processes, or services, and how to define and document processes and customer focus. Introduction to continuous improvement tools and methods - DMAIC, SPC, and Design of experiments; emphasis on team work and problem solving skills.

TSM 322. Preservation of Grain Quality. (2-3) Cr. 3. S. *Prereq: Math 140 or higher.* Principles and management for grain quality preservation. Grain drying and storage. Fans and airflow through grain. Grain handling methods and system planning. Grain quality measurement and end-use value analysis.

TSM 324. Soil and Water Conservation Management. (2-3) Cr. 3. S. *Prereq: Math 140 or 160.* Introduction to engineering and conservation principles applied to the planning of erosion control systems, water control structures, water quality management, and drainage and irrigation systems.

TSM 325. Biorenewable Systems. (Cross-listed with A E, Agron, An S, BusAd, Econ). (3-0) Cr. 3. F. *Prereq: Econ 101, Chem 155 or higher, Math 140 or higher.* Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, transportation/logistics, and marketing.

TSM 327. Animal Production Systems. (3-0) Cr. 3. F. *Prereq: 210.* Confined animal feeding operations. Environmental controls for animal production. Response of animals to the environment. Heat and moisture balance in animal housing. Ventilation, water, feed handling, air pollution, odor and waste management systems.

TSM 330. Agricultural Machinery and Power Management. (2-3) Cr. 3. F.S. *Prereq: 210, Math 142 or 160.* Selection, sizing, and operational principles of tractors and machinery systems. Cost analysis and computer techniques applied to planning and management of agricultural machine systems. Principles, operation, and application of agricultural machinery.

TSM 333. Precision Farming Systems. (2-2) Cr. 3. F. *Prereq: Math 140 or 160, junior or senior classification.* Geographic information systems and global positioning systems. Sampling strategies for precision farming. Building prescriptions and recommendations. Systems for precision farming, equipment, software uses, legal and social issues, and economics. Only one of TSM 333 and 433 may count toward graduation.

TSM 335. Tractor Power. (3-3) Cr. 4. F. *Prereq: 210, Math 142.* Theory and construction of tractor engines, mechanical power trains and hydraulic systems. Introduction to traction, chassis mechanics, and hydraulic power.

TSM 337. Fluid Power Systems Technology. (2-2) Cr. 3. S. *Prereq: 210.* Fundamental fluid power principles. Fluid properties. Function and performance of components such as pumps, valves, actuators, hydrostatic transmission and continuously variable transmissions. Basic analysis of fluid power systems. Introduction to electrohydraulics.

TSM 340. Advanced Automated Manufacturing Processes. (2-2) Cr. 3. F. *Prereq: 216, 240.* NC programming operations for CNC mills and lathes. Transfer of parts descriptions into detailed process plans, tool selection, and NC codes. Computer assisted CAD/CAM NC programming for 2D/3D machining.

TSM 363. Electric Power and Electronics for Agriculture and Industry. (3-3) Cr. 4. F. *Prereq: 210, Physics 112.* Basic electricity. Electrical safety, wiring, 3-phase service, controls, and motors for agricultural and industrial applications. Planning building electrical systems. Electronics to sense, monitor, and control mechanical processes: semiconductors, digital logic circuits; speed, pressure, position, temperature, and moisture sensors. Nonmajor graduate credit.

TSM 370. Occupational Safety. (3-0) Cr. 3. S. *Prereq: 270, junior standing.* Identifies safety and health risks in industrial work environments. Focus on how managers and supervisors meet their responsibilities for providing a safe workplace for their employees. Includes the identification and remediation of workplace hazards. Nonmajor graduate credit.

TSM 372. Legal Aspects of Occupational Safety and Health. (2-0) Cr. 2. F. *Prereq: 272.* Legal implications of legislation as it applies to health and safety in the workplace. Includes OSHA regulations, worker's compensation, and workplace liability.

TSM 397. Internship in Technology. Cr. R. F.S.SS. *Prereq: At least 45 credits of coursework, in AST or I Tec major, and approval of internship coordinator.* A supervised work experience in an approved learning setting with application to technology practices and principles. Reporting during work experience and self and employer evaluation required. Minimum GPA requirement.

TSM 399. Work Experience in Technology. Cr. 2. Repeatable. F.S.SS. *Prereq: 397 and approval of instructor.* Written reports and reflection on work experience. A maximum of 4 credits of TSM 399 maybe be used toward the total credits required for graduation.

TSM 401. Professionalism Seminar. (Cross-listed with A E, BSE). (1-0) Cr. 1. F.S. *Prereq: 301.* 8 week course. Examination of professionalism in the context of engineering and technology. Time, project and personnel management. Communications and professional portfolios. Professional licensure. Transition to professional careers.

TSM 408. Interdisciplinary Problem Solving. (Cross-listed with I E, E E). (3-0) Cr. 3. F.S. *Prereq: Junior or senior classification.* Use of the Theory of Constraints as a way of approaching problem solving, win-win negotiation, project planning and effective delegation in the context of engineering/business systems. Team projects aimed at improving design outcomes. Nonmajor graduate credit.

TSM 409. Interdisciplinary Systems Effectiveness. (Cross-listed with I E, E E). (3-0) Cr. 3. F.SS. *Prereq: Junior or senior classification.* Focus on functions that determine the effectiveness of an entire organization. Generic Theory of Constraints solutions to production, distribution, and project management are compared to traditional solutions. Strategy for improvements discovered using simulations. Nonmajor graduate credit.

TSM 415. Technology Capstone I. (1-2) Cr. 2. F.S. *Prereq: senior classification.* Team development, communications, and responsibilities. Identification of current technological problems in agricultural and industrial systems. Development of alternate solutions using creativity, critical analysis, and planning techniques.

TSM 416. Technology Capstone II. (1-2) Cr. 2. F.S. *Prereq: 415.* Selection of promising potential solutions to technology problems identified in 415 for development and analysis by student teams. Presentation of project through oral presentations, written reports, and working prototypes.

TSM 424. Impacts of Agriculture on Water Quality. (3-0) Cr. 3. F. *Prereq: Math 140 or 160, one of the following: 324, Agron 154.* Water use and water quality standards; characteristics of surface and groundwater resources; types of agricultural water pollutants and their impacts on water quality; how agricultural pollutants move and enter water resources; management practices to reduce ag pollutant movement and protect water resources. Nonmajor graduate credit.

TSM 433. Precision Farming Systems Advanced Concepts and Applications. (3-0) Cr. 3. F. *Prereq: Math 140 or equivalent, admission to Master of Agriculture program.* Technologies for precision resource management. Geospatial information technologies for precision agriculture (geographic information systems, global positioning systems, remote sensing systems). Sensing and sampling strategies in precision agriculture. Building input recommendations. Systems for precision agriculture, equipment, software uses, legal and social issues, and production economics. Advanced concepts and the future of precision agriculture. Only one of TSM 333 and 433 may count toward graduation. Nonmajor graduate credit.

TSM 440. Cellular Lean Manufacturing Systems. (2-2) Cr. 3. F.S. *Prereq: 310, 340.* Reviews principles and concepts required for cellular manufacturing system design to meet customer demand in production, quality, on-time delivery, and continuously reducing manufacturing cost. Emphasis on applying lean manufacturing principles, simulation techniques, and Kaizen methodologies with hands-on projects.

TSM 443. Statics and Strength of Materials for Technology. (2-2) Cr. 3. F. *Prereq: AE 271 or 272; Phys 111.* Application of standard analytic and computer based techniques of solving problems related to force and moments. The properties of materials and how to select appropriate materials for a particular design is reviewed.

TSM 444. Facility Planning. (3-0) Cr. 3. F. *Prereq: 216 and 240; Stat 101 or 104.* Principles and practices in designing, evaluating, and organizing existing facilities or creating new facilities. Emphasis on AutoCAD-based new facility design project - product design, production flow analysis, activity relationship analysis, layout deployment, materials handling, office and other service requirement design, and the necessary cost analysis for the new facility.

TSM 445. Polymer and Composite Processing. (2-2) Cr. 3. S. *Prereq: 240 or equivalent.* Design and production of plastic parts including thermoplastics and thermoset/composites. A study of plastic properties and their relationships to processing parameters and control techniques. Applying advanced CAE technology to check process feasibility, determine optimal process conditions, evaluate part and mold designs, and estimate the cost of plastic injection processes.

TSM 465. Automation Systems. (2-2) Cr. 3. S. *Prereq: 363.* Theory and applications of automation systems. Emphasizes features, capabilities, design and programming skills of Programmable Logic Controller (PLC) based industrial control systems. Introduction to industrial robots and sensors.

TSM 470. Industrial Hygiene: Physical, Chemical, and Biological Hazards. (3-0) Cr. 3. S. *Prereq: 272; Math 160 or higher.* A qualitative and quantitative introduction to health effects of chemical, biological, and physical hazards in a workplace. Nonmajor graduate credit.

TSM 471. Safety Laboratory. (0-2) Cr. 1. S. *Prereq: 470 (can be taken concurrently).* Introduction to equipment, methods, and strategies to measure, evaluate, control, and research hazards and risk in the workplaces.

TSM 477. System Safety Analysis. (Dual-listed with 577). (3-0) Cr. 3. F. *Prereq: Math 160, Stat 101 or 104.* System safety focuses on developing a safety oriented pattern of thinking that is appropriate for today's complex systems. The tools that will be gained in this course will be helpful in recognizing, understanding, and analyzing hazards and risks in modern complex systems.

TSM 481. Conversion of Lignocellulosic Materials. (Cross-listed with FOR). (2-3) Cr. 3. F. *Prereq: For 280 or TSM 210 or A E 215 or equivalent.* Conversion of Lignocellulosic Materials. (Cross-listed with TSM.) (2-3) Cr. 3. F. Prereq: 280 or TSM 210 or A E 216 or equivalent. Chemical properties of lignocellulosic materials. Wood chemistry. Various conversion processes. Pulp and paper technology. Biobased products. Other fiber products. Cellulose derivatives. Term paper and/or student project required for graduate level. Nonmajor graduate credit.

TSM 490. Independent Study. Cr. arr. Repeatable. *Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department.* A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.
H. Honors
I. Manufacturing
J. Agriculture and Biosystems Management
M. Machine Systems
O. Occupational Safety

TSM 491. Seed Science Internship Experience. (Cross-listed with Agron, Hort). Cr. arr. Repeatable. F.S.SS. *Prereq: Agron 338, advanced approval and participation of employer and instructor.* A professional work experience and creative project for seed science secondary majors. The project requires prior approval and participation of the employer and instructor. The student must submit a written report.

TSM 493. Workshop in Technology. Cr. arr. Repeatable. Offered as demand warrants.
A. Agriculture and Biosystems Management
B. Machine Systems
C. Manufacturing
D. Occupational Safety

Courses primarily for graduate students, open to qualified undergraduate students

TSM 540. Advanced Design and Manufacturing. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Application of six sigma philosophy to advance product design and process control. Application of value steam mapping to the existing manufacturing system to develop future continuous improvement plans. Application of Taguchi Parameter design methodologies for optimizing the performance of manufacturing processes. Application of Taguchi Tolerance Design methodologies for product design.

TSM 541. Comprehensive Modern Manufacturing Systems. (3-0) Cr. 3. SS. *Prereq: Permission of instructor.* The study, design, and implementation of PULL manufacturing systems and their integration with functions of the production system for the manufacture of superior quality, low cost products. Topics include lean manufacturing system design, cost estimation/justification, JIT manufacturing, integrated quality and process control, automation, and CAD/CAM.

TSM 545. Manufacturability of Plastics. (2-2) Cr. 3. *Prereq: Permission of instructor.* Overview of current business environment and issues related to design for manufacturability of plastic products. Provide understanding of available materials and processes in manufacturing plastic parts. Utilize injection molding for an in-depth study of five elements for making successful plastic products; consumer input, part design, mold design, material selection, and manufacturing process. Computer-aided engineering exercises and laboratory practices included.

TSM 575. Safety and Public Health Issues in Modern Society. (2-0) Cr. 2. Exploration and analysis of current safety and public health issues impacting society. The focus will be on topics that impact individuals in work, public, and home environments.

TSM 577. System Safety Analysis. (Dual-listed with 477). (3-0) Cr. 3. F. *Prereq: Math 160, Stat 101 or 104.* System safety focuses on developing a safety oriented pattern of thinking that is appropriate for today's complex systems. The tools that will be gained in this course will be helpful in recognizing, understanding, and analyzing hazards and risks in modern complex systems.

TSM 590. Special Topics in Technology. Cr. arr. Repeatable. *Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor.*
A. Agriculture and Biosystems Management
B. Machine Systems

C. Manufacturing
D. Occupational Safety

TSM 593. Workshop in Technology. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

TSM 598. Technical Communications for a Master's Degree. (Cross-listed with A E). Cr. 1. F.S.SS. A technical paper draft based on the M.S. thesis or creative component is required of all master's students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on M.S. thesis or creative component is required of all master's students. This presentation must be in a form that satisfies the normal presentation requirements of a professional society. The presentation itself (oral or poster) may be made at a professional society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Satisfactory-fail only.

TSM 599. Creative Component. Cr. arr. Repeatable. A discipline-related problem to be identified and completed under the direction of the program adviser. Three credits required for all nonthesis master's degree students.

Courses for graduate students

TSM 601. Graduate Seminar. (Cross-listed with A E). (1-0) Cr. 1. F. Keys to writing a good MS thesis or PhD dissertation. How to begin formulating research problems. Discussion of research problems, review of literature, research hypothesis, objectives, methods, procedures, and reports. Research grant proposals, patents and intellectual property rights, and international research centers of excellence will be discussed.

TSM 652. Program and Learner Evaluation. (3-0) Cr. 3. *Prereq: Stat 401 or equivalent.* Techniques for evaluating learners, facilities, programs, and staff utilizing theories for developing measurement instruments. Outcomes assessment is emphasized.

TSM 655. Academic Leadership in Technology and Engineering. (3-0) Cr. 3. *Prereq: Permission of instructor.* A definition of the faculty role in technology and engineering disciplines, including strategies for dealing with programs, personnel, and constituencies are presented. Leadership skills involving team formation, team operation, and conflict resolution are addressed.

TSM 657. Curriculum Development in Technology and Engineering. (3-0) Cr. 3. *Prereq: Permission of instructor.* Basic concepts, trends, practices, and factors influencing curriculum development, techniques, organization and procedures. Emphasis will be given to program and course development.

TSM 694. Teaching Practicum. (Cross-listed with A E). Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification and permission of instructor.* Graduate student experience in the agricultural and biosystems engineering departmental teaching program.

TSM 697. Internship in Technology. Cr. R. *Prereq: permission of major professor and approval by department chair, graduate classification.* One semester and one summer maximum per academic year professional work period. Satisfactory-fail only.

TSM 698. Technical Communications for a Doctoral Degree. (Cross-listed with A E). Cr. 1. F.S.SS. A technical paper draft based on the dissertation is required of all Ph.D. students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on the dissertation is required of all Ph.D. students. This presentation must be in a form that satisfies the normal presentation requirements of a professional society. The presentation itself (oral or poster) may be made at a professional society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Satisfactory-fail only.

TSM 699. Research. Cr. arr.

TSM 698. Technical Paper for a Doctoral Degree. (Cross-listed with A E). Cr. 1. F.S.SS. A technical paper draft based on dissertation is required of all Ph.D. students. This paper must be in a form that satisfies the requirements of some specific journal. Satisfactory-fail only.

TSM 699. Research. Cr. arr.

Textiles and Clothing

(Administered by the Department of Apparel, Educational Studies, and Hospitality Management)

Robert Bosselman, Chair of Department

Distinguished Professors (Emeritus): Fanslow, Moyer, Winakor

University Professor (Emeritus): Farrell-Beck

Professors: Bosselman, Damhorst, Fiore, Kadolph

Professors (Emeritus): Anderson, Beavers, Brun, Burnet, Cowan, Crabtree, Gilmore, Smith, Stone, Williams

Associate Professors: Baltzer, Hausafus, Niehm, Parsons

Associate Professors (Emeritus): Amos, Brackelsberg, Brown, Ebert, Huss, Kundel, Kunz, Walsh

Associate Professor (Adjunct): Strohbehn

Assistant Professors: Barker, Hurst, Karpova, Keino, Y. Lee, Marcketti, Rajagopal, Wohlsdorf-Arendt, Zheng

Assistant Professor (Adjunct): Glock

Instructor (Adjunct): Fratzke

Lecturers: Ackerman, Burger, Christensen, Fiihr, Fitzpatrick, Kramer, M. Lee, Sanger, Trost, Wirth, Wise

Undergraduate Study

The program offers study for the degree of bachelor of science with a major in apparel merchandising, design, and production (AMDP). The program offers students a broad understanding of textile and apparel products, merchandising and marketing strategies, technical and creative design, product development, production processes, and business practices leading to a wide range of careers at state, national, and international levels in business and industry. Courses in the program provide scientific, technical, and humanistic knowledge about textiles, apparel, and related products basic to career preparation. Courses also provide knowledge applicable to the development and use of apparel and textile products by individuals, families, and institutions. The program provides a foundation for graduate study. Graduates understand the production, distribution, and use of textiles and apparel, aesthetic expression, and communication. They are prepared to plan, develop, and present textile and apparel products to meet the needs of consumers. They understand the issues involved in textile and apparel production and marketing, both nationally and internationally. Graduates appreciate the interdependence of nations and cultures as producers and consumers of textile products.

The AMDP major provides a broad-based program of study with flexibility in creating an individualized program. To complete the program, a student combines general education, AMDP core classes, and structured clusters of courses to form an option in merchandising, creative design, technical design, product development, or production and sourcing management.

An option in merchandising prepares students for the planning, development, and presentation of market-oriented product lines and events. Career opportunities are in product development, buying, promotion, and management in both manufacturing and retailing sectors with a focus on the textile and apparel industry. An option in creative design is appropriate for those interested in the aesthetic and creative aspects of design, product or line development, or promotion of textiles and apparel. The option in technical design prepares students for careers in technical design, product development, and quality assurance. An option in product development is appropriate for those interested in both designing and merchandising products or lines for consumer groups. Students in design have a review of their design skills after T C 225 and T C 278.

An option in production and sourcing management prepares students for positions related to apparel engineering, plant management, quality assurance, costing, product development, sourcing, and buying piece goods or trim for apparel manufacturing or retailing firms.

In addition, a student in merchandising or production and sourcing management selects a secondary option from business and entrepreneurship, consumer behavior/marketing, communications/publications, history/museum studies, human resource management, international trade, or public relations/event management. The combinations of primary and secondary options allow students to individualize their programs.

For additional courses of interest, see Apparel, Educational Studies, and Hospitality Management.

The program offers a minor in apparel merchandising, design, and production. The minor can be earned by taking T C 131 or 165; 204; 231, 245, or 275; 6 credits at the 300-400 level; for a total of 16 to 17 credits.

Grade point requirement: All students majoring in apparel merchandising, design, and production are required to earn a C– or better in all AESHM and T C courses applied toward the degree, including transfer credits.

Graduate Study

The program offers work for the master of science and doctor of philosophy with a major in textiles and clothing. The program also participates in the Master of Family and Consumer Sciences degree by offering a specialization within that program. For all programs the field of study is highly interdisciplinary; programs of study are tailored to students' background and interests.

Graduates understand how textiles and apparel are essential in meeting individual and societal needs and understand the interdependence of nations and cultures as producers and consumers. Graduates understand diverse philosophies of scholarship and apply multiple methods to creative activity, research, and teaching. Strong writing and oral communication skills help graduates disseminate scholarship and compete successfully for awards and grants.

Graduates accept positions relevant to their academic experience. All doctoral graduates have teaching experience. Masters and doctoral graduates have experience working in team-oriented and interactive environments. Graduates are prepared to adapt to future changes in their professions and to provide leadership in professional and public practice. They bring a strong sense of ethics to research, teaching, and business endeavors.

Program emphases for graduate study include consumer behavior; entrepreneurship; merchandising and marketing aspects of textiles and clothing; acquisition and use of textiles and apparel within cultures; U.S. dress and textiles from the 19th into the 21st centuries; textiles; social/psychological aspects of dress; aesthetics and design; product quality and development; textile conservation; and computer-aided design.

The program participates in the interdepartmental gerontology minor.

Courses primarily for undergraduate students.

T C 131. Overview of the Fashion Industry. (3-0) Cr. 3. F.S. Introduction to fashion industry, industry structure from concept to consumer. Focus on fashion-driven consumer goods.

T C 165. Dress and Diversity in Society. (3-0) Cr. 3. F.S.SS. Examination of diversity among consumers and forecasting future trends in consumer behavior. Social responsibility issues related to appearance.

T C 204. Textile Science I. (3-3) Cr. 4. F.S.SS. *Prereq: 131.* WWW lectures. Textile fibers, yarns, fabrication, coloration, and finishes. Quality and performance application to consumer soft goods and industrial textiles.

T C 210. Computer Applications in Textiles and Clothing. (0-2) Cr. 1. F.S.SS. *Prereq: 111, 131; 245 or concurrent.* Applications of basic skills in Photoshop, Illustrator, PDM, Excel, and databases.

T C 221. Apparel Assembly Processes. (1-4) Cr. 3. F.S.SS. *Prereq: 204 or concurrent.* Principles of garment assembly. Use of mass production equipment and methods to analyze, develop and assemble garments.

T C 225. Patternmaking I. (2-4) Cr. 4. F.S. *Prereq: 131, 204, 221. Permission of instructor.* Basic flat pattern and draping methods for women's, men's and children's wear. Patternmaking by computer.

T C 231. Product Development and Manufacturing. (3-2) Cr. 4. F.S. *Prereq: 204.* Analysis of apparel product development, sourcing, and manufacturing processes. Focus on materials and specifications relative to quality, performance, and cost.

T C 245. Aesthetics and Brand Image. (3-0) Cr. 3. F.S. *Prereq: 131, 165; 204 or concurrent.* Elements and principles of design. Analysis of fashion products and promotional settings affecting the consumer. Analysis of experiential aesthetic aspects of brand.

T C 257. Museum Studies. (3-0) Cr. 3. F. *Prereq: Sophomore standing.* Overview of museums in contemporary American society. Museum history, functions, philosophy. Collection and curatorial practices. Funding and governance issues. Object research and exhibit development.

T C 278. Fashion Illustration. (0-6) Cr. 3. F.S. *Prereq: 131, 245 or concurrent enrollment. Permission of instructor.* Development of drawing skills, including line, shape, perspective and value. Introduction to drawing the fashion figure and apparel using a variety of media. Fashion presentation and introduction to portfolio development.

T C 301. Basic Design Concepts Review. Cr. 1. Repeatable maximum of 2 credits. F.S. *Prereq: Completion or enrollment in 225, 278. Permission of instructor.* Project review and skill assessment related to 2-dimensional and 3-dimensional visualization, apparel assembly, basic product knowledge, design problem solving. Review of fashion illustration, textiles, flat pattern, basic apparel assembly, design problem solving. Satisfactory-fail only.

T C 305. Quality Assurance of Textiles and Apparel. (Dual-listed with 505). (2-2) Cr. 3. F.S. *Prereq: 231, one course in natural science; Stat 101, 226, or 401.* Principles of product and materials evaluation and quality assurance. Developing specifications and using standard practices for evaluating materials, product characteristics, performance, and quality.

T C 321. Computer Integrated Textile and Fashion Design. (0-6) Cr. 3. F.S. *Prereq: 278 or concurrent enrollment. Permission of instructor.* Analysis and advanced use of computer-aided design software for textile and fashion design for various markets. Digital presentation and portfolio development.

T C 325. Patternmaking II. (2-4) Cr. 3. F.S. *Prereq: 301. Permission of instructor.* Principles of advanced patternmaking by flat pattern and draping techniques. Interaction of fabric characteristics with style features. Analysis of fit and design; problem solving. Patternmaking by computer.

T C 326. Creative Design Processes. (Dual-listed with 526). (2-2) Cr. 3. F.S. *Prereq: 325 or concurrent enrollment. Permission of instructor.* Exploration of the creative process and sources of inspiration with emphasis on fashion presentation and design development for a variety of markets. Continued development of fashion illustration techniques. Use of traditional and non-traditional materials to create innovative garments.

T C 328. Design Seminar. (Dual-listed with 528). Cr. arr. Repeatable. F.S.SS. *Prereq: Vary with topic.* Focus on artisanal textile, apparel, or surface design techniques. Topics vary by term.

T C 354. History of European and North American Dress. (3-0) Cr. 3. F. *Prereq: 3 credits from Hist or Art H.* Survey of history of dress from ancient times through present; focus on European and North American dress. Emphasis on connection of dress to the social, cultural, environmental, and technological contexts of the Western world. Nonmajor graduate credit.

T C 356. History of Twentieth Century Fashion. (Dual-listed with 556). (3-0) Cr. 3. S. *Prereq: 3 credits Hist or Art H; T C 204 recommended.* Survey of major design and technological developments in 20th Century fashion. Emphasis on fashion as a system of design and production, culture of consumption, fashion change, and trends in art, society, and culture.

T C 362. Cultural Perspectives in Dress. (3-0) Cr. 3. S. *Prereq: 165 or 3 credits in anthropology, psychology, or sociology.* Analysis of multiple factors related to dress in selected societies, including technology, aesthetics, social organization, ritual, stability and change. Applications to apparel business.

T C 372. Sourcing and Global Issues. (3-0) Cr. 3. F.S. *Prereq: 231, AESHM 275; Econ 101 or 102 recommended.* Evaluation of key issues facing textile and apparel businesses in global markets considering ethical, economic, political, social, and professional implications. Sourcing strategies in a global environment. Corporate and consumer social responsibility.

T C 376. Merchandise Planning and Control. (2-2) Cr. 3. F.S. *Prereq: AESHM 275; Acct 284.* Assortment planning, model stocks, budget development, retail math, buying concepts and strategies.

T C 377. Brand Management and Promotions. (3-0) Cr. 3. F.S. *Prereq: 245; AESHM 340 or Mkt 340.* Principles of brand image development and management; focus on experiential marketing, promotions, store design/layout, visual merchandising components.

T C 380. Field Study. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits in T C, junior classification, minimum 2.0 GPA. Permission by application.* Study of and tours of textile and apparel manufacturers, forecasting firms, design studios, showrooms, markets, retailers, museums, testing laboratories, trade seminars and exhibitions, and other areas of interest within the textile and apparel industry.
A. Pre-trip Orientation. Cr.
R. Orientation to the field study location during semester preceding trip. B. Field trip. Cr. 1-2. Trip to location under supervision of faculty member. Reports required.

T C 381. International Field Study. Cr. arr. Repeatable. Alt. S., offered 2010. SS. *Prereq: 9 credits in T C, junior classification, minimum 2.0 GPA. Permission by application.* Study of and tours of textile and apparel manufacturers, forecasting firms, design studios, showrooms, markets, retailers, museums, testing laboratories, trade seminars and exhibitions, and other areas of interest within the textile and apparel industry. Countries vary.
A. Pre-trip Orientation. Cr.
R. Orientation to the international locations during semester preceding trip. B. Field trip. Cr. 1-3. Trip to international location under supervision of faculty member. Reports required.

T C 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

T C 404. Textile Science II. (Dual-listed with 504). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 204, 245; one natural science course.* Theories and principles of textile science; emphasis on fiber chemistry, performance and smart textiles, dyeing, and detergency.

T C 411. Seminar on Current Issues. Cr. arr. Repeatable. *Prereq: Senior classification, 12 credits in T C.* Trends, issues, and scholarship in textiles and apparel.

T C 415. Technical Design Processes. (2-2) Cr. 3. F. *Prereq: 231, 301. Permission of instructor.* Garment development and analysis of fit, performance, quality, cost. Exploration of alternative materials, construction methods, grading markers; develop specifications.

T C 431. Apparel Production Management. (2-3) Cr. 3. S. *Prereq: 231; T C 221 recommended.* Procedures and experiences related to application and use of process controls: method analysis, work measurement, costing, and production planning. Resource management, technology applications, and quality assurance.

T C 467. Consumer Behavior. (3-0) Cr. 3. F. *Prereq: Stat 101 or 104 or 226; T C 165.* Application of concepts and theories from the social sciences to the study of consumer behavior related to appearance. Experience in conducting market and consumer research.

T C 470. Supervised Experience. Cr. 3. Repeatable. F.S.SS. *Prereq: 311 and minimum 2.0 GPA; permission by application; junior or senior classification.* Supervised work experience with a cooperating firm or organization.
A. Textile Industry. Prereq: 305.
B. History of Dress and Textiles. Prereq: 6 credits from 257, 354, 356 or 362; 3 credits in anthropology or history recommended.
C. Textile and Apparel Design. Prereq: 210, 225, 231, 245; 278 recommended.
E. Entrepreneurship. Prereq: AESHM 275, 474.
I. Merchandising. Prereq: AESHM 275.
M. Museum. Prereq: 257.
N. Apparel Production Management. Prereq: 431
O. Technical Design. Prereq: 231, 225; 305, 415 and 431 recommended.
Q. Quality Assurance. Prereq: 305.
T. Public Relations and Publishing. Prereq: T C 275 and Advrt 230; JI MC 220 or JI MC 305.
U. Product Development. Prereq: 231, 245.
V. Sourcing and Global Issues. Prereq: TC 372

T C 475. Retail Information Analysis. (2-2) Cr. 3. F.S. *Prereq: 376.* Forecasting, customer demand, assortment planning, market research, analysis of customer databases, data mining, database interface, pattern recognition, retail technology applications and supply-chain/logistics management.

T C 490. Independent Study. Cr. arr. Repeatable. F.S. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair.*
A. Textile Science
B. History of Dress and Textiles
C. Textile and Apparel Design
D. Aesthetics
E. Entrepreneurship
F. Sociological and Psychological Aspects of Dress and Textiles
G. Consumer Behavior
H. Honors
I. Merchandising
K. Cultural Analysis of Dress and Textiles
M. Museums
N. Apparel Production Management
O. Technical Design
Q. Quality Assurance
T. Public Relations and Publishing
U. Product Development
V. Sourcing and Global Issues

T C 495. Senior Design Studio. (1-5) Cr. 3. F.S. *Prereq: 321, 325, 326. Permission of instructor.* Creation of a line of apparel from concept through completion. Development of portfolio using manual and computer-aided techniques. Line must be submitted to juried competition.

T C 496. Fashion Forecasting and Product Development. (3-0) Cr. 3. *Prereq: 231, 245, AESHM 275.* Applying consumer, aesthetic, and quantitative trend information to develop value-added apparel/textile products and product lines with merchandising/promotion campaigns for diverse target markets. Multi-function team projects. Presentation to industry representatives.

T C 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

T C 499. Undergraduate Research. Cr. arr. Repeatable. F.S.SS. *Prereq: Senior classification, 15 credits in T C. Permission of instructor, adviser, and department chair.* Research experience in textiles and clothing with application to a selected problem.

Courses primarily for graduate students, open to qualified undergraduate students

T C 504. Textile Science II. (Dual-listed with 404). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 204, 245; one natural science course.* Theories and principles of textile science; emphasis on fiber chemistry, performance and smart textiles, dyeing, and detergency.

T C 505. Quality Assurance of Textiles and Apparel. (Dual-listed with 305). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 231; Stat 226 or 401; one natural science course.* Principles of product and materials evaluation and quality assurance. Developing specifications and using standard practices for evaluating materials, product characteristics, performance, and quality. Proposal and research project.

T C 510. Foundation of Scholarship in Textiles and Clothing. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Overview of scholarship in textiles and clothing with emphasis on current and future directions. Fundamentals of writing literature reviews. Examination of ethical issues in scholarship and academic life. Introduction to creativity and an entrepreneurial perspective.

T C 521. Digital Textile and Apparel Design. (1-4) Cr. 3. Alt. SS., offered 2010. *Prereq: Experience with flat pattern or draping techniques and image manipulation software. Permission of instructor.* Design development, analysis and application of digital textile printing to textile products and garment forms.

T C 526. Creative Design Processes. (Dual-listed with 326). (2-2) Cr. 3. Repeatable. Alt. S., offered 2010. *Prereq: Permission of instructor.* Exploration of the creative process and sources of inspiration with emphasis on fashion presentation and design development for a variety of markets. Continued development of fashion illustration techniques. Use of traditional and non-traditional materials to create innovative garments.

T C 528. Design Seminar. (Dual-listed with 328). Cr. arr. Repeatable. F.S.SS. *Prereq: Vary with topic.* Focus on artisanal textile, apparel, or surface design techniques. Topics vary by term.

T C 556. History of Twentieth Century Fashion. (Dual-listed with 356). (3-0) Cr. 3. S. *Prereq: Graduate standing.* Survey of major design and technological developments in 20th Century fashion. Emphasis on fashion as a system of design and production, culture of consumption, fashion change, and trends in art, society, and culture.

T C 557. Textile Conservation and Collection Management. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: 204.* Condition assessment, repair, and stabilization of textiles and apparel in museum collections. Dry, aqueous, and solvent cleaning. Examination of storage and exhibition techniques, materials, and conditions. Experience with cataloging and management practices.

T C 562. Dress and Culture. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 362 or 6 credits in social science or cultural anthropology.* Analysis of dress as artifact, behavior, and symbol from cultural perspectives. Focus on construction of cultural identity. Examination of ethnographic approaches and field research methods to the study of dress as material culture.

T C 567. Consumer Behavior and Apparel. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 467 or Mkt 447; Stat 401.* Application of concepts and theories from the social sciences to the study of consumer behavior. Experience in conducting research; manuscript writing.

T C 570. Practicum in Textiles and Clothing. Cr. arr. Repeatable. F.S.SS. *Prereq: 510, 6 graduate credits in textiles and clothing. Permission of instructor.* Supervised experience related to career objective. Proposal must be approved semester before placement.
A. Teaching practicum
B. Internship

T C 572. Sourcing and Global Issues. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: a course in merchandising, Econ 101.* Evaluation of key issues facing textile and apparel businesses in global markets considering ethical, economic, political, social, and professional implications. Experience in conducting research using secondary data.

T C 581. International Study. Cr. arr. Repeatable. S.SS. *Prereq: 9 credits in T C. Permission by application.* Study abroad of apparel and textile design, merchandising, forecasting firms, production, distribution, consumption, history, and museums. Countries vary.
A. Pre-trip Orientation. Cr.
R. Orientation to the international locations during semester preceding trip B. Field trip. Cr. 1-3. Trip to international location under supervision of faculty member. Report required.

T C 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s).* Individually designed textile and clothing-related projects that reflect the special interests of the student.
A. Textile Science
B. History of Dress and Textiles
C. Textile and Apparel Design
D. Aesthetics
E. Entrepreneurship
F. Sociological and Psychological Aspects
G. Consumer Behavior
I. Merchandising
K. Cultural Analysis of Dress and Textiles
L. Conservation
M. Museums
N. Apparel Production Management
O. Technical Design
P. Interdisciplinary
Q. Quality Assurance
T. Public Relations and Publishing
U. Product Development
V. Sourcing and Global Issues

Courses for graduate students

T C 610. Philosophical Issues of Textiles and Clothing Scholarship. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 2 courses in research methods, 6 graduate credits in textiles and clothing.* Models, theory, alternative philosophies, and ethics of science as applied in textiles and clothing scholarship. Grant writing and research program development.

T C 611. Seminar. Cr. arr. Repeatable. *Prereq: 6 graduate credits in textiles and clothing. Permission of instructor.* Discussion of scholarship and current issues. Topics vary.

T C 625. Design Theory and Process. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Permission of instructor.* Analysis of design theory and creative processes, including strategies for solving aesthetic, functional, and technology-focused design problems. Design criticism and frameworks for practice-based design research.

T C 650. Historic Research Methods in Dress and Textiles. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Permission of instructor.* Current methods, interpretive strategies, and diverse academic approaches to research in history of dress and textiles, including material culture approach. Emphasis on historical research, writing, and evaluation of sources.

T C 665. Social Science Theories of Appearance. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: 6 credits in sociology or psychology.* Analysis of social science theories and concepts applicable to clothing and appearance research. Emphasis on qualitative research and philosophy of knowledge, including postmodern, symbolic interaction, semiotic, and feminist theories.

T C 675. Research in Merchandising. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: AESHM 275 or equivalent.* Merchandising and related marketing theory, research processes, and methods. Experience in conducting research; prepare manuscripts for academic, industry and lay audiences.

T C 690. Advanced Topics. Cr. arr. Repeatable. *Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E.*

T C 699. Research. Cr. arr. Repeatable.

Theatre and Performing Arts

www.theatre.iastate.edu

(Administered by the Department of Music)

Performing Arts graduates will understand and demonstrate: 1) Knowledge of the cultural heritage and history of the Performing Arts 2) A theoretical and experiential background in the areas of performance, theatrical design, music, and dance 3) Knowledge of creative problem solving and artistic collaboration 4) Skills necessary to perform in or design for a variety of periods, styles, and genres in theatre and dance 5) Awareness of the diversity of expression in the Performing Arts throughout the world's cultures 6) A practical understanding of the rigors of the field.

Assessment measures include the semester exhibit of design work or audition pieces, graduating senior seminar and exit interviews, public performances or designs, course grades, exhibited convention work, and internship evaluations.

Undergraduate Study

Students interested in theatre as a major area of concentration declare a major in Performing Arts and select an emphasis in Theatrical Design or Acting/Directing. Students implement the theories and principles explored in the classroom by participating in production work. During the academic year, Iowa State University Theatre presents up to ten mainstage and second stage productions in Fisher Theater, and works in close collaboration with ISU Music and Dance.

The major in Performing Arts offers the undergraduate student a cross-disciplinary concentration in Music, Dance and Theatre. The core curriculum consists of 24 credits in the three areas. Students elect a 24-credit emphasis in either Dance, Theatrical Design or Acting/Directing. In addition to coursework, Performing Arts majors and minors participate in concert (Orchesis, Footfalls), workshop (Opera Studio, Minority Theatre Workshop) and production (Barchje, Stars Over Veishea, ISU Theatre/Music Theatre/Second Stage and Studio) experiences.

Performing Arts graduates, in addition to a solid theoretical and experiential background in the areas of performance, theatrical design, dance and music, are prepared to meet the challenges of the work force or graduate school with their strengths in collaboration, creative problem solving, meeting deadlines and processing diverse input to yield cohesive output. Two required professional internships prior to graduation are vital to the student's appreciation and practical understanding of the rigors of the field.

The theatre area offers a wide variety of courses. Students may select from courses in acting, design (costume, scenic, lighting/sound), make-up, stage direction, playwriting, stage management, and theatre history. Independent study and special topics courses supplement formal course offerings to provide opportunities to intensify study in a particular aspect of theatre.

Auditions for ISU Theatre productions are open to all students irrespective of academic major. Similarly, participation in areas of production other than acting is open to both majors and nonmajors. Qualified students also present experimental, laboratory, and Minority Theatre Workshop productions. Student actors, directors, designers, and technical crew heads are required to maintain a grade point average of at least 2.0 to participate in productions.

Theatre scholarships are awarded on a yearly basis to students who make significant contributions to Iowa State University Theatre.

Bachelor of Arts - Performing Arts Major (Perf)

The Core for the Performing Arts Major (24 cr)

(For individual Dance and Music course descriptions, see *Index* for individual department listing.)

Music 101, 102

Dance 120-Modern Dance, 130–Ballet I, 220–Modern Dance Composition

Dance 270–Dance Appreciation

Thtre 255, 263, 365

Perf 105–(six semesters), Perf 310 (2), Perf 401

Emphasis in Theatrical Design (24 cr)

Thtre 250 (2 cr), 360, 366, 455, 461, 465, 466, Music 133

Emphasis in Dance (24 cr)

Art 292, Music 133, Ex Sp 355

Dance 222, 224 (2 cr), 232, 360, 370

Select 2 credits from: Dance 140, 150, 160, 170, 211 (instead of 160, 170)

Select 2 credits from: Dance 223, 233, 242, 243, 262

Select 3 credits from: Dance 320, 384, 385, 386

All students enrolled in the Dance Emphasis must register for one dance technique course every semester of residence up to a total of 8 credits and must complete one computer course (Com S 103, 107, 207, C I 201).

Emphasis in Acting/Directing (24 cr)

Thtre 151, 250 (2 cr), 251, 351, 451, 455, 465, 466

Music 133

Minor in Performing Arts (21 cr)

Perf 105 (three semesters)

Music 101, 102

Dance 120 or 130, 270

Thtre 255, 263 or 251

plus six credits 300+ in Dance, Thtre or Perf

Communication Proficiency requirement: Select one course from Engl 302, 303, 304, 305, 306, 307, 309, 314, 315, 316, 366, 370.

Graduate Study

The department offers graduate courses as supporting work in other fields.

Performing Arts

Courses primarily for undergraduate students.

Perf 105. Issues in the Performing Arts. (1-0) Cr. R. F.S. Cross-disciplinary analysis and discussion of topics in the performing arts. Six semesters required of performing arts majors.

Perf 310. Performing Arts Internship. Cr. R. F.S.SS. Required of performing arts majors. A job or internship with a professional or semi-professional performing arts organization. Satisfactory-fail only.

Perf 401. Performing Arts Seminar. (2-0) Cr. 2. S. Intensive collaborative study and practice of topics in music, dance and theatre. Required of performing arts majors. Nonmajor graduate credit.

Theatre

Courses primarily for undergraduate students.

Thtre 106. Introduction to the Performing Arts. (3-0) Cr. 3. F.S.SS. An audience oriented, broad-based, team-taught survey of the performing arts which emphasizes theatre and includes segments on television, radio, film, dance, and music.

Thtre 110. Theatre and Society. (3-0) Cr. 3. F.S. An introduction to Theatre focusing on its relationship with society throughout history.

Thtre 151. The Actor's Voice. (3-0) Cr. 3. S. Study and practice of fundamentals of vocal production: breathing, quality, articulation, projection, and expressiveness for the performing artist.

Thtre 224. Concert and Theatre Dance. (Cross-listed with DANCE). (0-3) Cr. arr. Repeatable. F.S. *Prereq: By audition only.* Choreography, rehearsal, and performance in campus dance concerts and/or musical theatre productions. Satisfactory-fail only.

Thtre 250. Theatre Practicum. Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor.* Practice in various aspects of technical theatre production. Satisfactory-fail only.

Thtre 251. Acting I. (3-0) Cr. 3. F.S. Theory and practice in fundamentals of acting.

Thtre 255. Introduction to Theatrical Production. (3-3) Cr. 4. F.S. Standard structure and procedures, historical overview of performing arts production including the design and creation of scenery, costumes and lighting.

Thtre 263. Script Analysis. (3-0) Cr. 3. F.S. Theory, analysis, and interpretation of play scripts for production.

Thtre 290. Special Projects. Cr. arr. Repeatable. F.S.SS. *Prereq: 3 credits in theatre; permission of instructor; approval of written proposal.*

Thtre 316. Creative Writing -- Playwriting. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Engl 250, not open to freshmen.* Progresses from production of scenes to fully developed one-act plays. Emphasis on action, staging, writing, analytical reading, workshop criticism, and individual conferences. Nonmajor graduate credit.

Thtre 351. Acting II. (3-0) Cr. 3. S. *Prereq: 251, Dance 120 recommended.* Theory and practice of techniques of acting with emphasis on character and scene analysis.

Thtre 352. Stage Combat. (1-2) Cr. 2. Alt. S., offered 2010. *Prereq: 351.* Theory, history, and practice of theatrical combat. Includes tumbling, hand-to-hand, quarterstaff, broadsword, rapier, and dagger.

Thtre 354. Musical Theatre I. (2-2) Cr. 3. *Prereq: 251 or Music 232 or 3 credits in Dance.* Theory, history and practice of musical theatre techniques. Designed to develop the musical theatre performance skills of singers, dancers, and actors.

Thtre 355. Musical Theatre II. (2-2) Cr. 3. *Prereq: 354.* Theory, history and practice of musical theatre techniques. Designed to develop the musical theatre performance skills of singers, dancers, and actors.

Thtre 357. Stage Make-up. (1-2) Cr. 2. F. Theory and practice of make-up and hair-styling techniques for the performing arts: Theatre, Opera, Dance, Television and Film. Lab required.

Thtre 358. Oral Interpretation. (3-0) Cr. 3. F. Principles of oral interpretation: practice in analysis, in reading aloud of literary selections, and in reader's theatre.

Thtre 359. Theatre for Children and Youth. (3-0) Cr. 3. Study and practice of directing, acting, and the production of theatre for children and youth.

Thtre 360. Stagecraft. (3-2) Cr. 4. S. *Prereq: 255.* Tools, materials, and techniques of planning, constructing and painting of performing arts scenography. Basic principles of lighting technology. Technical drawing for performing arts production.

Thtre 365. Theatrical Design I. (2-2) Cr. 3. F. *Prereq: 255.* An exploration of the elements, principles and art of theatrical design.

Thtre 366. Theatrical Design II. (2-2) Cr. 3. S. *Prereq: 365.* Intensive application of the principles introduced in 365. In-depth study and practice of the graphic skills of rendering and drafting.

Thtre 367. Stage Management. (3-0) Cr. 3. F. *Prereq: 255.* The responsibilities and techniques of stage management for the performing arts.

Thtre 393. Workshop. Cr. 3. Repeatable. F.S.SS. *Prereq: 3 credits in theatre.* Offered to explore special topics.
A. Minority Theatre
B. Repertory
C. Children's Theatre
D. Musical Theatre
E. Creative Dramatics
F. International Storytelling

Thtre 451. Acting III. (3-0) Cr. 3. F. *Prereq: 351 and permission of instructor.* Analysis and practice of period scenes.

Thtre 455. Directing I. (3-0) Cr. 3. F. *Prereq: 255; 263; 251 recommended.* Theory, techniques, and practice of directing.

Thtre 456. Directing II. (2-2) Cr. 3. S. *Prereq: 455.* Practical and theoretical experience in directing the stage play.

Thtre 461. Theatrical Design Studio. (3-2) Cr. 4. Repeatable. F.S. *Prereq: Permission of instructor.* Focuses on the art and craft of specific areas of theatrical design. Each semester the student will focus on one or two of the following: scenic, costume, or lighting design.

Thtre 465. History of Theatre I. (3-0) Cr. 3. F. *Prereq: Hist 201 or equivalent.* Theatre history from ancient times to 1800. Nonmajor graduate credit.

Thtre 466. History of Theatre II. (3-0) Cr. 3. S. *Prereq: 465.* Theatre history from 1800 to present. Nonmajor graduate credit.

Thtre 469. Advanced Theatre Practicum. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits in theatre courses; junior classification.* Practicum in production with ISU Theatre, with opportunities for specialization within various areas. Required: Approval of written proposal.

Thtre 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits in theatre, approved written proposal, junior classification.* Only one independent study enrollment within the department is permitted per semester. No more than 9 credits in Thtre 490 may be counted toward graduation.

Thtre 497. Senior Seminar. (3-0) Cr. 3. S. *Prereq: 15 credits in theatre courses; senior classification.* Directed study of a theatre issue or problem identified by each student. Students synthesize relevant theory and research culminating in senior project or paper.

Thtre 499. Theatre Internship. Cr. arr. Repeatable. F.S.SS. *Prereq: 18 credits in theatre, other courses deemed appropriate by faculty adviser; 2nd semester junior or senior standing; cumulative GPA of at least 2.5 overall and 3.0 in theatre courses.* Supervised application of theatre in professional settings.

Courses primarily for graduate students, open to qualified undergraduate students

Thtre 504. Seminar. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits in theatre.* Topics may include the following:
A. Musical Theatre
B. Acting Techniques
C. Acting Styles
D. Design and Technical Theatre
E. Arts Management

Thtre 590. Special Topics. Cr. arr. Repeatable. *Prereq: Approved written proposal.*

Toxicology

www.toxicology. iastate.edu

toxmajor@iastate.edu

(Interdepartmental Graduate Major)

Supervisory Committee: A. Kanthasamy, Chair; J. Coats, A. Kanthasamy, R. Martin, P. Murphy, G. Osweiler

Toxicology is the science of studying the adverse effects of substances on living organisms. Students observe, gather data and predict risks and outcomes in populations. Whole organism research and cellular and molecular approaches are used to determine toxicant exposure and mechanisms. Work is offered for the degrees doctor of philosophy and master of science. Students majoring in toxicology will be affiliated with one of the following cooperating departments: Agricultural and Biosystems Engineering; Animal Science; Biochemistry, Biophysics and Molecular Biology; Biomedical Sciences; Chemistry; Entomology; Food Science and Human Nutrition; Genetics, Development and Cell Biology; Geological and Atmospheric Sciences; Natural Resource Ecology and Management; Physics; Plant Pathology; Veterinary Diagnostic and Production Animal Medicine; Veterinary Microbiology and Preventive Medicine; and Veterinary Pathology.

The prerequisites for entrance into the graduate toxicology major include an undergraduate degree in a relevant area of study; for example, chemical engineering, biology, biochemistry, chemistry, ecology, entomology, food science and technology, microbiology, nutritional science, zoology, or veterinary medicine. Minimum undergraduate coursework should include the following or their equivalent: 1 year of college mathematics, including calculus; 1 year of inorganic chemistry with quantitative analysis; 1 course in physics; 1 year of organic chemistry; 2 years of biological sciences including 1 course in physiology.

Other courses that are considered desirable in undergraduate preparation include: biochemistry, physical chemistry, qualitative analysis, and some specialized courses such as histology or advanced physiology.

Facilities and faculty are available for fundamental research in such areas as environmental fate and effects of chemicals, insect toxicology, aquatic toxicology, food safety, nutritional toxicology, mycotoxins, neurotoxicology, cellular and molecular toxicology and veterinary toxicology.

Students majoring in toxicology will be affiliated with a cooperating department. All Ph.D. students take a core curriculum consisting of Tox 501 and 502, Tox 504 (Toxicology Seminar, taken twice); 7 additional credits in toxicology; 8 credits in biochemistry from BBMB 404, 405, 420, 451, 542; 3 graduate credits in physiology, histology, pathology, neuroscience, immunobiology or cellular and molecular biology; and Stat 401 and 402. M.S. students take a core of Tox 501, 502, 504; 3 additional credits in toxicology; BBMB 404, 405; and Stat 401. Additional coursework is selected to meet departmental requirements and to satisfy individual student research interests.

A graduate minor in toxicology is available for students enrolled in other majors. A minor for an M.S. degree includes Tox 504 and 501 and 3 credits in other toxicology courses. A minor at the Ph.D. level includes Tox 504, 501, and 6 credits in other toxicology course work. One member of the student's program of study committee will be a member of the toxicology faculty.

Most students awarded doctoral degrees continue their training as postdoctoral associates at major research institutions in the U.S. or abroad in preparation for research and/or teaching positions in academia, industry, the military, veterinary research, or government environmental and public health institutions. A few go directly to permanent research positions in industry. Many students awarded master's degrees continue their training as doctoral students; however, some choose research support positions (i.e., technician, chemist, research associate) in academia, industry, or government. A more thorough list of outcomes is available at our Web site.

Graduates of the Toxicology major will be able to carefully design, execute and analyze experiments that extend the knowledge of toxicology and closely related sciences. They will be able to clearly communicate research findings, and thoroughly evaluate the literature of toxicology, contributing significantly to the advancement of the field.

Courses primarily for undergraduate students.

Tox 419. Foodborne Hazards. (Cross-listed with FS HN, Micro). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Micro 201 or 302, a course in biochemistry.* Pathogenesis of human microbiological foodborne infections and intoxications, principles of toxicology, major classes of toxicants in the food supply, governmental regulation of foodborne hazards. Only one of Tox 419 and 519 may count towards graduation. Nonmajor graduate credit.

Tox 420. Food Microbiology. (Cross-listed with FS HN, Micro). (3-0) Cr. 3. F. *Prereq: Micro 201 or 302.* Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduate students

Tox 501. Principles of Toxicology. (3-0) Cr. 3. F. *Prereq: BBMB 404 or equivalent.* Principles of toxicology governing entry, fate, and effects of toxicants on living systems. Includes toxicokinetics and foreign compound metabolism relative to toxification or detoxification. Fundamentals of foreign compound effects on metabolism, physiology, and morphology of different cell types, tissues, and organ systems.

Tox 502. Toxicology Methods. (0-6) Cr. 3. Alt. S., offered 2010. *Prereq: Tox 501.* Provides demonstrations or laboratory experience in the application of methods used in toxicology, including safety procedures, calculation and data analysis, teratologic and morphologic evaluation, electrophysiologic measures, in vitro enzyme induction/biotransformation, neural and behavioral toxicology testing.

Tox 504. Toxicology Seminar. (1-0) Cr. 1. Repeatable. F.S.SS. *Prereq: Permission of instructor required.* Presentation of a seminar about a current topic in toxicology as part of a weekly series of seminars by graduate students, faculty, and guest lecturers from off campus.

Tox 515. Regulatory Toxicology. (Cross-listed with FS HN). (1-0) Cr. 1. Alt. F., offered 2010. *Prereq: BBMB 404 or FSHN 403.* Regulatory toxicology in the real world. Approaches used by toxicologists in regulatory agencies for generating, enforcing and complying with laws and regulations in an unambiguous, defensible manner. Different obligations of scientists in research and regulatory settings. Perform simple risk assessments and suggest ways of dealing with data gaps. Examine strengths and weaknesses of common approaches used by regulatory agencies.

Tox 519. Food Toxicology. (Cross-listed with FS HN, NutrS). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: A course in biochemistry.* Basic principles of toxicology. Toxicants in the food supply: modes of action, toxicant defense systems, toxicant and nutrient interactions, risk assessment. Only one of Tox 419 and 519 may count toward graduation.

Tox 526. Veterinary Toxicology. (Cross-listed with VDPAM). (3-0) Cr. 3. S. *Prereq: Permission of instructor.* A study of disease processes in animals caused by toxicants and the use of differential diagnostic and therapeutic procedures. Emphasis is on use of clinical cases to define mechanism of poisoning, diagnostic and management procedures and public health and food safety issues.

Tox 546. Clinical and Diagnostic Toxicology. (Cross-listed with VDPAM). (0-3) Cr. arr. Repeatable. F.S.SS. *Prereq: D.V.M. degree or 526.* Advanced study of current problems and issues in toxicology. Emphasis on problem solving utilizing clinical, epidemiological, and laboratory resources.

Tox 550. Pesticides in the Environment. (Cross-listed with Ent). (2-0) Cr. 2. S. *Prereq: 9 credits of biological sciences.* Coats. Fate and significance of pesticides in soil, water, plants, animals, and the atmosphere.

Tox 554. General Pharmacology. (Cross-listed with B M S). (3-0) Cr. 3. S. *Prereq: BMS 549 and 552; BBMB 404, 405.* General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems.

Tox 565. Methods of Biostatistics. (Cross-listed with STAT). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 500 or 401; Stat 543 or 447.* Statistical methods useful for biostatistical problems. Topics include analysis of cohort studies, case-control studies and randomized clinical trials, techniques in the analysis of survival data and longitudinal studies, approaches to handling missing data, and meta-analysis. Examples will come from recent studies in cancer, AIDS, heart disease, psychiatry and other human and animal health studies. Use of statistical software: SAS, S-Plus or R.

Tox 570. Risk Assessment for Food, Agriculture and Veterinary Medicine. (Cross-listed with Agron, VDPAM). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 104 or consent of instructor: Wolt, Hurd.* Risk assessment principles as applied to biological systems. Exposure and effects characterization in human and animal health and ecological risk assessment. Risk analysis frameworks and regulatory decision-making. Introduction to quantitative methods for risk assessment using epidemiological and distributional analyses. Uncertainty analysis.

Tox 575. Cell Biology. (Cross-listed with B M S). (3-0) Cr. 3. F. *Prereq: 10 credits in biological science and permission of instructor.* A multi-instructor course covering major topics in cell structure and function, including: universal features of prokaryotic and eukaryotic cells, types of utilization and conversion of energy, genetic control of cell shape and functionality, internal organization of cells, communication between cells and their environment, development of multicellular systems. Students have to write a term paper.

Tox 590. Special Topics. Cr. arr. Repeatable. Contact individual faculty for special projects or topics. Graded.

Courses for graduate students

Tox 626. Advanced Food Microbiology. (Cross-listed with FS HN, Micro). (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: FS HN 420 or 421 or 504.* Topics of current interest in food microbiology, including new foodborne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials.

Tox 627. Rapid Methods in Food Microbiology. (Cross-listed with FS HN, Micro). (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: FS HN 420 or 421 or 504.* Provides an overview of rapid microbial detection methods for use in foods. Topics include historical aspects of rapid microbial detection, basic categories of rapid tests (phenotypic, genotypic, whole cell, etc.), existing commercial test formats and kits, automation in testing, sample preparation and "next generation" testing formats now in development.

Tox 656. Cellular and Molecular Pathology II. (Cross-listed with V PTH). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate course in biochemistry, genetics, or cell biology.* Cellular and molecular mechanisms of carcinogenesis.

Tox 675. Insecticide Toxicology. (Cross-listed with ENT). (2-3) Cr. 3. Alt. F., offered 2009. *Prereq: 501 or Ent 555.* Coats. Principles of insecticide toxicology; classification, mode of action, metabolism, and environmental effects of insecticides.

Tox 697. Graduate Research Rotation. (0-12) Cr. arr. Repeatable. F.S.SS. *Prereq: Admission to Toxicology graduate program.* Graduate research projects performed under the supervision of selected faculty members in the graduate Toxicology major.

Tox 699. Research. Cr. arr. Repeatable.

Transportation

www.ctre.iastate.edu/mstrans/

(Interdepartmental Graduate Major)

Supervisory Committee: K. Gkritza, Chair; D. Johnston, M. Crum

Work is offered for the degree master of science with a major in transportation under a cooperative arrangement with various departments including Civil, Construction and Environmental Engineering (CCEE), Community and Regional Planning (CRP), and Logistics, Operations and Management Information Systems (LOMIS). Opportunities are afforded for research in such areas as modeling and performance of transportation systems, highway safety and information systems, remote sensing, environmental analysis, techniques for urban and regional transportation system planning, environmental and social policy analysis of transportation systems, transportation policy analysis, analysis of transportation technologies, commodity distribution, public administration of the transportation planning process, regional development and transportation system interrelationships, transportation economics and finance, and planning for logistics management.

Students majoring in transportation will develop a program of study under the guidance of a program of study committee selected by the student in consultation with and approved by the chair of the faculty supervisory committee. For administrative purposes, the student's home department will be the department originally admitting the student. A major professor may be selected from any of the three participating departments. A student must designate at least one member of the POS committee from his or her home department, and at least one member from outside the home department.

A student must complete at least 36 credits of acceptable work including preparation of a 6 credit thesis or a 2-3 credit creative component. A structured minor requires 12 credits of approved transportation courses and a thesis or creative component on a transportation related topic.

A required core includes C E 551, Trans 691, Stat 401 and at least one course from all three cooperating departments (CRP, CCEE and LOMIS). Detailed requirements are available from the chair of the supervisory committee.

Graduate students pursuing a major in any of the cooperating departments who have an interest in transportation are encouraged to consider a formal declared minor in transportation. Students considering a declared minor should consult with the chair of the supervisory committee about the requirements for it.

Students typically focus their program of study to support a career in one of five areas: transportation consulting, regional and statewide transportation planning, transportation service operations and management, transportation policy and economic analysis, and transportation planning and operation for local and state governments. Graduates will have specific knowledge in one or more of these focus areas and the skills to conduct research and analysis of transportation issues. These skills allow graduates to be productive immediately in positions related to a focus area or to continue in more advanced transportation graduate work.

Courses primarily for graduate students

Trans 555. Economic Analysis of Transportation Investments. (3-0) Cr. 3. F. *Prereq: C E 350 or 355.* Application of economic analysis methodologies to evaluate transportation projects. Multi-modal approaches to evaluate impacts of transportation investments and maximize economic efficiency while considering equity and other social issues related to investment options.

Trans 599. Creative Component. Cr. arr. *Prereq: Pre-enrollment contract required.* Advanced topic for creative component report in lieu of thesis.

Trans 691. Seminar in Transportation Planning. Cr. arr. Repeatable. S. Provides an overview of current transportation issues; lecturers provide seminars on a variety of timely transportation topics.

Trans 699. Research. Cr. arr. Repeatable.

University Studies

Associate Provost for Academic Programs

Certain interdisciplinary courses are offered through university studies, at the discretion of the associate provost for academic programs and upon the advice of the Faculty Senate Curriculum Committee. No major is available in university studies, but credit obtained through university studies offerings may be applied toward a degree in any of the colleges, consistent with the stipulations of the student's curriculum.

Requests to make use of U St 290, 490, 590 should be directed to the associate provost for academic programs and should be accompanied by a positive recommendation from the department heads and deans of the instructors making the request. The associate provost for academic programs will refer requests to the Faculty Senate Curriculum Committee which will make recommendations to the associate provost for academic programs regarding their disposition after consultation with appropriate college and university committees.

Courses primarily for undergraduate students.

U St 105. Carver Academy Seminar: Freshmen. (1-0) Cr. 1. F. *Prereq: Acceptance in Carver Academy Program, George Washington Carver scholarship recipient.* Orientation to the university for Carver Academy students focusing primarily on transition and acclimation to the university environment. Individual and group identity development. Life and legacy of George Washington Carver. Satisfactory-fail only.

U St 106. Carver Academy Seminar: Freshmen. (1-0) Cr. 1. S. *Prereq: Acceptance in Carver Academy Program, George Washington Carver scholarship recipient.* Introduction for Carver Academy students to resources at ISU to supplement classroom learning. Exploration of multicultural communities and leadership opportunities at ISU. Satisfactory-fail only.

U St 111. Hixson Scholars Seminar. (1-0) Cr. 1. F. *Prereq: Recipient of the Hixson Opportunity Award.* Orientation to Iowa State University and the Hixson Opportunity Awards Program. Satisfactory-fail only.

U St 115. MVP Seminar. (1-0) Cr. 1. F. *Prereq: Recipient of the MVP Award.* Orientation to Iowa State University and the MVP Program. Satisfactory-fail only.

U St 116. MVP Seminar. (1-0) Cr. 1. S. *Prereq: Recipient of the MVP Award, 115 or consent of instructor.*. A continuation of the introduction to life and resources at Iowa State University and to the functions of the Multicultural Vision Program focusing individually in areas of personal development, ethnic and racial identity, and leadership. Satisfactory-fail only.

U St 120. Student Support Services Program Seminar. (1-0) Cr. 1. S. *Prereq: Acceptance in Student Support Services Learning Community.* Designed to assist students in developing successful academic strategies to meet demands of college and achieve desired goals. Satisfactory-fail only.

U St 160. Gender Justice. (2-0) Cr. 1. F.S. Half semester course. Examines the socialization process in the United States and how our perspectives are formed. An introduction to patriarchy, sexism, and ally development are explored. Skills to enhance communication and understanding among women and men will be developed. Satisfactory-fail only.

U St 170. Leadership ISU. (0-2) Cr. 1. F. *Prereq: Freshman or sophomore classification.* An introductory leadership course for first-year and second-year students. Students will gain a basic understanding of leadership skill development and resources available to student leaders at Iowa State University. Course content will be delivered through a variety of methods such as guest speakers, team building exercises, and small group discussions. Students will be expected to

complete several out of class assignments to apply the leadership skills they have learned. Satisfactory-fail only.

U St 205. Carver Academy Seminar: Peer Mentors. (1-0) Cr. 1. F. *Prereq: 106, intended primarily for sophomores.* Leadership and peer mentor training for Carver Academy students who will be serving as peer mentors in Carver Academy. Definitions and analysis of diversity in academia. Academic portfolio preparation and career exploration. Satisfactory-fail only.

U St 206. Carver Academy Seminar: Peer Mentors. (1-0) Cr. 1. S. *Prereq: 106, Intended primarily for sophomores.* Development of leadership and mentoring skills. Survey of leadership in diverse communities in the U.S. Satisfactory-fail only.

U St 290. Independent Study. Cr. arr. *Prereq: Permission of the associate provost for academic programs.* Independent study on topics of an interdisciplinary nature. Intended primarily for freshmen and sophomores.

N. Ncore. The Ncore Course: Forum on Race and Ethnicity in the United States. Cr. 3. Prereq: Selection as an Ncore student scholar. Attendance at Ncore. Exploration of issues of race and ethnicity in the United States.

U St 301. McNair Scholars Seminar: Orientation to the McNair Program and to Academic Research. (0-2) Cr. 1. F. *Prereq: New fall admit to the Ronald E. McNair Postbaccalaureate Achievement Program.* Covers program guidelines and requirements, the basics of preparing for the graduate admissions process, and the formulation of a research topic to begin the required research project. Satisfactory-fail only.

U St 302. McNairs Scholars Seminar: The Review of Literature and the Methodology. (0-2) Cr. 1. S. *Prereq: 301.* Covers the review of literature and the methodology components of the required research project. Satisfactory-fail only.

U St 305. Carver Academy Seminar: Community Leaders. (1-0) Cr. 1. F. *Prereq: Intended primarily for juniors.* Leadership development for Carver Academy students; frameworks for multicultural leadership. Students will research and assess needs for community enhancement projects under faculty supervision. Satisfactory-fail only.

U St 306. Carver Academy Seminar: Community Leaders. (1-0) Cr. 1. S. *Prereq: Intended primarily for juniors.* Leadership development for Carver Academy students; self-directed development of leadership abilities. Implement student-directed community enhancement projects under faculty supervision. Begin preparation for graduate and professional schools and career placement. Satisfactory-fail only.

U St 311. Leadership Seminar I. (1-0) Cr. 1. Repeatable. *Prereq: 111, 115.* For students serving as peer mentor first-year seminar leaders under faculty supervision. Development of course facilitation and peer leadership skills. Satisfactory-fail only.
A. Leaders in Hixson Seminar
B. Leaders in MVP Seminar

U St 312. Leadership Seminar II. (1-0) Cr. 1. Repeatable. *Prereq: 311.* For students serving as leaders in Hixson Seminar or MVP Seminar under faculty supervision. Development of course facilitation and peer leadership skills. Satisfactory-fail only.
A. Leaders in Hixson Seminar
B. Leaders in MVP Seminar

U St 336. International Perspectives in Career Development. (3-0) Cr. 3. Students will examine the career development process in the context of pursuing an international career. Topics will include career exploration, the job search, and cultural differences from international points of view. Faculty members will guest lecture on culture, history, economics, environment, and art of the selected country. Following the spring seminar students will participate in a study tour of the selected country where they will visit international employers and historical and cultural sites. Satisfactory-fail only.

U St 401. McNair Scholars Seminar: Data Collection and Data Analysis. (0-2) Cr. 1. F. *Prereq: 302.* Covers the data collection and data analysis sections of the required research project. Satisfactory-fail only.

U St 402. McNair Scholars Seminar: Findings, Conclusions, and the Writing of the Final Report. (0-2) Cr. 1. S. *Prereq: 401.* Final course for second year scholars. Covers data analysis, data clean up, and the writing of the final project. Satisfactory-fail only.

U St 405. Carver Academy Seminar: Fellows. (1-0) Cr. 1. F. *Prereq: Intended primarily for seniors.* Continued preparation for graduate school, professional school and/or chosen profession. Research project experience with faculty mentor is required. Satisfactory-fail only.

U St 406. Carver Academy Seminar: Fellows. (1-0) Cr. 1. S. *Prereq: Intended primarily for seniors.* Oral and written presentation of research under faculty supervision. Satisfactory-fail only.

U St 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of the associate provost for academic programs.* Independent study on topics of an interdisciplinary nature. Intended primarily for juniors and seniors.

Courses primarily for graduate students, open to qualified undergraduate students

U St 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of graduate college.* Independent study on topics of an interdisciplinary nature. Intended primarily for graduate students.

Veterinary Clinical Sciences

Claire Andreasen, Interim Chair of Department

Professors: Andreasen, Betts, Evans, Hoefle, Hopkins, Jergens, Kraus, Merkley, Noxon, D. Riedesel, Toombs, Ware, Whitley

Professors (Emeritus): Carithers, Clark, Eness, Grier, Jackson, McGee

Professor (Collaborator): Carpenter

Associate Professors: Baldwin, Booth, Fox, McClure, Miles, O'Brien, Reinertson, E. Riedesel, Wagner

Assistant Professors: Christensen, Deitz, Ellinwood, Grozdanic, Kersh, May, Brett Sponseller, Wong

Instructors (Adjunct): Alcott, Claude, Clemans, Dujowich, Gerber, Ginman, Gross, Koshino, Krebs, L'Heureux, Madron, E. Miller, Morgan, Olsen, Parker, Sakai, Schoeffler, Schutte, Severin, Waller, Willmore, Wynne

Senior Clinician: King

Lecturer: Howard-Martin

Clinicians: Berryessa, Buttrick, Caston, Cerfogli, Galow-Kersh, Howard, Kauffman, Kraus, D. Miller, Morrison, Prickett, Beatrice Sponseller, Thompson, Zacharias

Professional Program of Study

For the professional curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see *Veterinary Medicine, Curriculum.*

The curriculum of veterinary clinical sciences explores the preventive health care, and diagnosis and treatment of diseases of companion and competitive athletic animals. Veterinary specialists lead didactic and laboratory based learning in the clinical sciences. Experiential based courses conducted through the Veterinary Medical Center during the fourth year provide the student an opportunity to participate in the application of clinical skills and knowledge.

Graduate Study

The department offers work for the degree master of science with major in veterinary clinical science, and minor work for students majoring in other departments. Within the veterinary clinical sciences major, the student may specialize in veterinary medicine, surgery, or theriogenology. The D.V.M. degree or equivalent is prerequisite to a major graduate work.

Both thesis and nonthesis options are available and require the completion of a minimum of 30 graduate credits and a final examination.

World languages and cultures requirements may be established by the student's program of study committee.

Courses primarily for professional curriculum students

V C S 305. Shelter Medicine. Cr. 1. S. *Prereq: First year classification in Veterinary Medicine or with permission of instructor.* An elective course designed to educate the veterinary student about issues of relevance to companion animal population and shelter medicine and welfare. Students may concurrently be enrolled in VCS 306X.

V C S 311. Veterinarian in Society I. Cr. R. F. *Prereq: First-year classification in veterinary medicine.* Introduction to the veterinary profession and the various career opportunities available.

V C S 312. Veterinarian in Society II. (Cross-listed with VDPAM). (1-0) Cr. 1. S. *Prereq: First-year classification in veterinary medicine.* A continuation of the Veterinarian in Society series. This course is designed to provide an introduction to the topics of animal behavior, animal welfare, and the human animal bond.

V C S 313. Veterinarian in Society III. (1-1) Cr. 1. F. *Prereq: Second-year classification in veterinary medicine.* A continuation of the Veterinarian in Society series. The course covers selected topics on moral and ethical issues affecting the practice of veterinary medicine.

V C S 314. Veterinarian in Society IV. (1-0) Cr. 1. F. *Prereq: Third-year classification in veterinary medicine.* A continuation of the Veterinarian in Society series. This course will focus on helping students develop their communication, leadership, team building and conflict resolution skills.

V C S 315. Veterinarian in Society V. (1-0) Cr. 1. S. *Prereq: Third-year classification in veterinary medicine.* A continuation of the Veterinarian in Society series. This course will emphasize veterinary law.

V C S 339. Clinical Foundations I. (Cross-listed with B M S). (0-2) Cr. 1. F. *Prereq: First-year classification in veterinary medicine.* Canine physical examination; basic behavior, animal handling and restraint; medical record keeping.

V C S 385. Seminar. Cr. R. Repeatable. F.S. *Prereq: Classification in veterinary medicine.* Seminars and case discussions on selected clinical subjects by staff and fourth-year students of the College of Veterinary Medicine. Attendance is required for a passing grade Satisfactory-fail only.

V C S 391. Clinical Imaging. (1-0) Cr. 1. F. *Prereq: First-year classification in veterinary medicine.* Evaluation of morphologic anatomy of the dog and cat utilizing clinical imaging methods - radiography, ultrasonography, computed tomography, magnetic resonance imaging and nuclear imaging. Emphasis will be placed on normal radiographic anatomy.

V C S 393. Principles of Surgery. (3-0) Cr. 3. F. *Prereq: Second year classification in veterinary medicine.* General principles of surgery of companion animals

V C S 394. Principles of Surgery Laboratory. (0-3) Cr. 1. S. *Prereq: Second year classification in veterinary medicine.* General principles of surgery of companion animals.

V C S 395. Small Animal Surgery. (2-0) Cr. 2. S. *Prereq: V C S 394.* Small animal surgery.

V C S 396. Equine Surgery. (2-0) Cr. 2. S. *Prereq: 394.* Elective course in equine surgery.

V C S 398. Anesthesiology. (1-0) Cr. 1. S. *Prereq: Second-year classification in veterinary medicine.* Anesthetic equipment, agents, and procedures for domestic animals.

V C S 399. Ophthalmology. (1-0) Cr. 1. S. *Prereq: Third year classification in veterinary medicine.* Principles and techniques of medical and surgical ophthalmology.

V C S 401. Advanced Small Animal Orthopedics. (1-0) Cr. 1. S. *Prereq: Third or Fourth-year classification in veterinary medicine.* Lecture course covering advanced diagnosis and treatment of small animal orthopedic conditions. Medical and surgical options are covered.

V C S 402. Clinical Cardiology. (1-0) Cr. 1. F. *Prereq: Third or fourth-year classification in veterinary medicine; 444 or concurrent enrollment in 444.* Elective course in diagnosis and management of cardiac diseases. Emphasis on interpretation of electrocardiography.

V C S 405. Pet Bird and Exotic Species Medicine. (1-3) Cr. 2. Alt. S., offered 2010. *Prereq: Second-, third- or fourth-year classification in veterinary medicine.* Elective course in management and diseases of pet birds and exotic species.

V C S 407. Feline Internal Medicine. (1-0) Cr. 1. F. *Prereq: Third-year classification in veterinary medicine.* Elective course in feline internal medicine.

V C S 414. Companion Animal Nutrition. (1-0) Cr. 1. S. *Prereq: Third or fourth -year classification in veterinary medicine.* Elective course in small animal and equine nutrition.

V C S 415. Advanced Small Animal Dermatology. (1-2) Cr. 2. F. *Prereq: Third or Fourth-year classification in veterinary medicine.* Elective course in dermatology.

V C S 419. Preceptorship in Companion Animal/ Equine Veterinary Medical Practice. (0-40) Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine, permission of department chair.* Elective course in veterinary practice under the guidance of veterinarians in approved practice settings.

V C S 421. Husbandry and Diseases of Non-traditional Species. (2-0) Cr. 1. Alt. F., offered 2010. *Prereq: Second-, third-, or fourth-year classification in veterinary medicine.* Husbandry, management, and common diseases of rabbits, guinea pigs, hamsters, gerbils, rats, and mice.

V C S 436. Small Animal Internal Medicine. (3-0) Cr. 3. F. *Prereq: Third year classification in veterinary medicine.* Clinical diagnosis and treatment of diseases of small animals.

V C S 440. Introduction to Clinics. (Cross-listed with VDPAM). Cr. R. F. *Prereq: Third-year classification in veterinary medicine.* Rotating assignments through multiple sections within the Veterinary Teaching Hospital.

V C S 443. Equine Lameness. (1-2) Cr. 2. S. *Prereq: Second or third-year classification in veterinary medicine.* Orthopedic diseases of the equine.

V C S 444. Small Animal Medicine. (4-0) Cr. 4. F.S. *Prereq: Third-year classification in veterinary medicine.* Clinical diagnosis and treatment of diseases of small animals.

V C S 445. Equine Medicine. (2-0) Cr. 2. F. *Prereq: Third-year classification in veterinary medicine.* Clinical diagnosis and treatment of diseases of equine.

V C S 446. Clinical Neurology. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical rotation in neurology with an emphasis on neurolocalization, disease processes, use of diagnostics in medical and surgical neurology and treatment options. Exposure to neurosurgical techniques.

V C S 448. Diagnostic Imaging and Radiobiology. (2-2) Cr. 3. F.S. *Prereq: Third-year classification in veterinary medicine.* Essentials of diagnostic image interpretation. Essentials of radiobiology, radiation therapy and protection from radiation.

V C S 449. Junior Surgery Laboratory. (1-6) Cr. 3. F. *Prereq: Third-year classification in veterinary medicine.* Pre-laboratory presentations and laboratories introduce the student to surgical technique principles that can be applied to all animal species.
A. Alternative Curriculum - consists of only neutering humane society animals throughout the laboratory experience.
B. Traditional Curriculum - provides a broader range of surgical experiences throughout the laboratory experience, including humane society neutering.

V C S 450. Disturbances of Reproduction. (Cross-listed with VDPAM). (4-0) Cr. 4. F. *Prereq: Third-year classification in veterinary medicine.* General principles of diseases causing disturbances in reproduction.

V C S 451. Advanced Junior Surgery Laboratory. (1-6) Cr. 2. S. *Prereq: 449. 8 weeks.* Continuation of surgical laboratory experience. Techniques and advanced principles learned are applicable to all animal species.
A. Alternative Curriculum - consists of only neutering humane society animals throughout the laboratory experience.
B. Traditional Curriculum - exposure to more advanced surgical techniques with most surgical principles useful in all animal species. Also includes some humane society neutering.
C. Traditional Curriculum - a second repeat for students with a special interest in small animal surgery. Limited space is available.

V C S 452. Clinical Dermatology. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine, small animal option.* Study of clinical dermatological problems via computer-aided instruction, case simulations, and/or lectures. Clinical management of cases presented to Veterinary Teaching Hospital.

V C S 453. Small Animal Medicine I. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in small animal medicine.

V C S 454. Small Animal Medicine II. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in small animal medicine.

V C S 455. Small Animal Soft Tissue Surgery. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in soft tissue surgery.

V C S 456. Small Animal Orthopedic Surgery. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in orthopedic surgery.

V C S 457. Equine Medicine. Cr. 4. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in equine medicine.

V C S 458. Equine Surgery. Cr. 4. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in equine surgery.

V C S 459. Small Animal Overpopulation Medicine and Surgery. Cr. 2. *Prereq: Fourth year classification in Veterinary Medicine.* A 2-week surgical emphasis, elective rotation at a humane society that addresses the issues facing veterinarians and non-veterinary humane society personnel who deal with small animal overpopulation issues. Each section can be taken for credit once.
A. Nebraska Humane Society, Omaha NE
B. Animal Rescue League of Iowa, Des Moines IA.
C. WaySide Waifs, Kansas City MO

V C S 460. Radiology. Cr. 3. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in veterinary radiology.

V C S 463. Community Practice. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical experience in hospital based general practice.

V C S 464. Equine Field Services. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in equine ambulatory practice.

V C S 465. Farrier. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine; 457 and 458.* Elective clinical assignment on the principles and practices of normal and therapeutic horseshoeing and equine foot care.

V C S 466. Anesthesiology. Cr. 3. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in small animal and large animal anesthesiology.

V C S 468. Intensive Care. Cr. 4. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment to provide supervision of hospital cases requiring intensive care and including emergency cases.

V C S 469. Ophthalmology. Cr. 2. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment in ophthalmology.

V C S 470. Radiology. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine. Completion of VCS 460 recommended.* Elective clinical assignment in veterinary radiology.

V C S 471. Animal Reproduction. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in animal reproduction. Equine and small animal reproduction only.
E. Equine Reproduction
S. Small Animal Reproduction

V C S 472. Small Animal Medicine. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in small animal medicine.

V C S 473. Small Animal Surgery. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in small animal surgery split between soft tissue surgery (one week) and orthopedic surgery (one week).

V C S 474. Equine Medicine and Surgery. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in equine medicine or surgery.
M. Medicine
S. Surgery

V C S 476. Anesthesiology. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in small animal and large animal anesthesiology.

V C S 478. Intensive Care. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Elective clinical assignment in intensive care.

V C S 479. Ophthalmology. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine and V C S 469.* Elective clinical assignment in ophthalmology.

V C S 480. Veterinary Dentistry. Cr. 1. F. *Prereq: Third or Fourth-year classification in veterinary medicine.* All aspects of veterinary dentistry, prophylaxis, endodontics, and orthodontics.

V C S 483. Advanced Small Animal Surgery. Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine and V C S 473.* Elective clinical assignment in small animal surgery. One or both sections offered can be taken more than once.
O. Orthopedic surgery
S. Soft tissue surgery

V C S 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor.*

V C S 492. Orientation for International Experience. (2-0) Cr. 1. Repeatable. S. *Prereq: Classification in veterinary medicine.* 8 weeks. Predeparture orientation for group study abroad. Cultural considerations for the study abroad experience and a conversational language introduction. Out of class work may be assigned.

V C S 495. Seminar. Cr. R. S. *Prereq: Fourth-year classification in veterinary medicine.* Seminars and case discussions on selected subjects by staff of the College of Veterinary Medicine and others, including student presentations. Completion of the seminar is required for graduation. Satisfactory-fail only.

V C S 496. International Preceptorship. (0-40) Cr. arr. Repeatable. *Prereq: Second-year classification in veterinary medicine.* International Preceptorships and Study Abroad Group programs. Provides opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduate students

V C S 590. Special Topics. Cr. arr. Repeatable.
A. Medicine
B. Surgery
C. Theriogenology
D. Radiology
E. Anesthesiology

V C S 596. International Preceptorship. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: Admission to graduate college.* International Preceptorships and Study Abroad Group programs. Provides opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

V C S 599. Creative Component. Cr. arr. *Prereq: Enrollment in nonthesis master's degree program.*

Courses for graduate students

V C S 604. Seminar. Cr. 1. Repeatable. F.S.

V C S 640. Advanced Radiology. (2-0) Cr. 2. *Prereq: 448.* Detailed principles of clinical radiology with particular reference to radiographic interpretation.

V C S 671. Advanced General Surgery. (1-3) Cr. 2. *Prereq: Permission of instructor.* Course designed to discuss and perform advanced surgical procedures in soft tissue, orthopedic and neurological surgery. Minimally invasive surgical procedures and organ transplantation will be included.

V C S 672. Advanced Special Surgery. (1-3) Cr. 2. *Prereq: Permission of instructor.* Innovative techniques in microvascular, thoracic, gastrointestinal, neurological and reconstructive surgery will be investigated.

V C S 676. Advanced Medicine. (2-0) Cr. 2. *Prereq: 445.* Principles of general medicine. A study in depth of factors that contribute to the development of clinical signs as related to the pathogenesis of disease.

V C S 677. Advanced Medicine. (2-0) Cr. 2. *Prereq: 445.* An advanced study of metabolic diseases.

V C S 699. Research. Cr. arr. Repeatable.
A. Medicine
B. Surgery
C. Theriogenology
E. Anesthesiology

Veterinary Diagnostic and Production Animal Medicine

Patrick Halbur, Chair of Department

University Professor: McKean

Professors: Evans, Halbur, Harris, Hoffman, Hopkins, Hyde, Janke, Osweiler, Shearer, Thomson, Trampel, Uhlenhopp, Yoon, Zimmerman

Professors (Emeritus): Carson, Hartwig, Hopper, Kunesh, Wass

Professor (Collaborator): Thacker

Associate Professors: Engelken, Frana, Hurd, Kersting, Main, Millman, O'Connor, Thompson, Timms, Youngs

Associate Professors (Collaborators): Apley, Polson

Assistant Professors: G. Dewell, Holtkamp, Karriker, Opriessnig, Ramirez, Wang

Assistant Professors (Adjunct): Harmon, Imerman, Kinyon

Assistant Professors (Collaborators): Erdman

Instructors (Adjunct): Clothier, Irwin, Madson, Patterson, Vander Ley

Senior Clinicians: Baker, Cooper, Gorden

Lecturers: Bickett-Weddle, C. Plummer, Sweiger

Clinicians: R. Dewell, Ensley, Gauger, Johnson, Kim, Leuschen, P. Plummer, Ramamoorthy, Rathje, Schwartz, Strait, West

Professional Program of Study

For the professional curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see V*eterinary Medicine, Curriculum.*

Courses in veterinary diagnostic and production animal medicine provide students with basic and advanced skills in diagnostics, reproduction, medicine, surgery, production, and health management of the major livestock species. Students in the fourth year of the curriculum in veterinary medicine may elect to take advanced courses in beef, dairy, swine, poultry or sheep production medicine. Elective courses may include preceptorships in private practices, at other veterinary schools, in research and disease control laboratories, or in related agribusinesses.

Production animal medicine emphasizes the integration of veterinary medicine with nutrition, genetics, economics, food safety, and other disciplines, enabling graduates to acquire and use a broad knowledge base to support the health and improve the production and efficiency of the food supply chain.

Graduate Study in Veterinary Preventive Medicine

Veterinary Preventive Medicine is a multidisciplinary program focused on the study of health and disease in populations. The various disciplines represented in the program are unified by a common approach based on the application of statistical methods to problem solving in populations. Through their research and course work, students will learn to understand and apply a variety of disciplines, principles, and techniques to population health issues involving environmental, ecological, nutritional, genetic, infectious, or non-infectious diseases.

Graduate study in Veterinary Preventive Medicine will provide valuable skills and experience to persons interested in public health, food safety, emerging infectious diseases, zoo or wildlife health management, and livestock health. A degree in Veterinary Preventive Medicine may be valuable for individuals considering a future in the biological or pharmaceutical industries, government regulatory agencies, public veterinary practice, or international service agencies responsible for population health.

Veterinary Preventive Medicine is an interdepartmental major administered by the Department of Veterinary Diagnostic and Production Animal Medicine (VDPAM) with participating faculty from colleges and departments across the University and collaborators from the National Animal Disease Center (USDA:ARS) and the National Veterinary Services Laboratories (USDA:APHIS) located in Ames, Iowa.

Both thesis and nonthesis options are available and require the completion of a minimum of 30 graduate credits for thesis and 36 graduate credits for nonthesis and a final examination.

Graduate Study in Veterinary Diagnostic and Production Animal Medicine

Veterinary Diagnostic and Production Animal Medicine masters degree is a program focused on the assessment of health and disease in populations of animals and the development of methods to study populations of animals. The various disciplines represented in the program are unified by a common approach based on the application of epidemiological and statistical methods to enable quantitative evaluation and critical appraisal of clinical and research data to continuously establish best production practices for health assurance; further to provide the principles and tools for design and execution of hypothesis-based research in production animal units or in research trials supporting animal health issues. Through their research and course work, students will learn to understand and apply a variety of disciplines, principles, and techniques to population health issues involving environmental, ecological, nutritional, genetic, infectious, or non-infectious diseases. This includes gaining knowledge of current principles of diagnostic evaluation and critical to best support decisions about animal health programs and practices.

Graduate students will be provided experiences in production animal medicine by involvement in the animal health and food supply decision making processes of modern production systems.

Graduate study in Veterinary Diagnostic and Production Animal Medicine will provide valuable skills and experience to persons interested in public health, food safety, food policy, emerging infectious diseases, wildlife health management, and livestock health assurance. A degree in Veterinary Diagnostic and Production Animal Medicine may be valuable for individuals considering leadership positions in food supply veterinary medicine.

Veterinary Diagnostic and Production Animal Medicine is administered by the Department of Veterinary Diagnostic and Production Animal Medicine (VDPAM) with participating faculty from colleges and departments across the University and collaborators from the National Animal Disease Center (USDA:ARS) and the National Veterinary Services Laboratories (USDA:APHIS) located in Ames, Iowa.

Both thesis and nonthesis options are available and require the completion of a minimum of 30 graduate credits for thesis and 36 graduate credits for nonthesis and a final examination.

Courses primarily for professional curriculum students

VDPAM 309. Intro to Production Animal Informatics. (1-0) Cr. 1. S. The fundamentals of how clinical, diagnostic, production and financial information is obtained and used by production animal operations. Students will acquire skills to create and use spreadsheets for manipulating and summarizing data. They will also acquire knowledge of where to find inexpensive and readily available resources with information on how to use spreadsheets and other software. Students will also have the opportunity to work with different record keeping programs used by swine, beef and dairy operations.

VDPAM 310. Intro to Production Medicine. Cr. 2. S. *Prereq: Currently enrolled in Vet Med III.* The role of the veterinarian in the management of animal health and production in dairy and beef cattle herds, beef feedlots and swine herds. Provides veterinary students with a starting point to understand the principles and techniques that are the basis of food-animal health management programs.

VDPAM 311. Introduction to Food Animal Clinics. (1-1) Cr. 1. Repeatable. S. *Prereq: Vaccinated for rabies, enrollment in Veterinary Medicine.* A one hour per week discussion of current cases in the food animal hospital and topics of interest. Student will learn physical examination of the food animal as well as animal handling techniques and record keeping procedures. Students will be able to participate in activities related to cases in the food animal hospital and the VDPAM Department. Satisfactory-fail only.

VDPAM 312. Veterinarian in Society II. (Cross-listed with V C S). (1-0) Cr. 1. S. *Prereq: First-year classification in veterinary medicine.* A continuation of the Veterinarian in Society series. An introduction to the topics of animal behavior, animal welfare, and the human animal bond.

VDPAM 340. Clinical Foundations I. (0-40) Cr. 1. F.S.SS. *Prereq: Classification in veterinary medicine.* One week course at Great Plains Veterinary Educational Center in Clay Center, Nebraska. An introduction to Food Supply Veterinary Medicine covering industry (beef, dairy, pork, sheep) overviews, production systems, behavior, welfare, handling and restraint and examination techniques, biosecurity, epidemiology and food safety.

VDPAM 350. Basic Livestock Nutrition and Feeding. (1-0) Cr. 1. S. *Prereq: Classification in Veterinary Medicine.* Introductory course on livestock (beef, dairy, swine, sheep, and equine) nutrition and feeding principles. Students will apply scientific facts and principles to problem-solving procedures in determining nutritious and economical livestock feeding programs.

VDPAM 402. Advanced Dairy Production Informatics. (1-1) Cr. 2. Repeatable. S. *Prereq: 309 or permission of instructor.* Advanced coverage of concepts related to collection, manipulation, analysis and reporting of information used by dairy farms and their consultants. Hands on experience with Dairy Comp 305 and PCDart as well as other dairy management and information software. Integrates this data with dairy operations' financial situations.

VDPAM 402L. Advanced Dairy Production Informatics Lab. Cr. arr. Repeatable. S. *Prereq: Permission of instructor.* Continued practice in computer dairy records. Experience in tracking sample herd performance and providing written report with graphs/tables as the final assignment

VDPAM 407. Evidence Based Clinical Decision Making. (Dual-listed with 507). (1-0) Cr. 1. S. *Prereq: Permission of instructor.* Discussion, lectures and laboratories to assess the quality and significance of medical evidence in making informed decisions about the treatment of individual animals and animal populations.

VDPAM 408. Poultry Diseases. (Dual-listed with 508). Cr. 2. Alt. S., offered 2010. *Prereq: Enrollment in College of Veterinary Medicine.* Bacterial, viral, parasitic, and nutritional diseases of domestic poultry and gamebirds; biosecurity, immunization, and management procedures to prevent poultry diseases.

VDPAM 414. Veterinary Practice Entrepreneurship. (Dual-listed with 514). Cr. 2. S. *Prereq: Graduate Veterinarian.* To provide a formal exposure to the entrepreneurial and business skills necessary to own and operate a successful veterinary practice.

VDPAM 416. Bovine Reproduction Evaluation Laboratory. (0-4) Cr. 1. F.S. *Prereq: Third year classification in veterinary medicine. 10 students per section.* Bovine rectal palpation techniques will be repetitively taught in 7 four-hour sessions. Students will also learn techniques of epidural anesthesia, artificial insemination, and ultrasonic imaging. University-owned cattle will be used.

VDPAM 419. Advanced Swine Production Informatics. (1-0) Cr. 1. F. *Prereq: 309.* Advanced coverage of concepts related to collection, manipulation, analysis and reporting of information used by swine production companies. Production, financial, diagnostic and clinical data will be covered in the course. Hands-on experience with computer software and information systems used in swine production will be provided. Students will learn to objectively evaluate the validity of information that is presented to them and also be able to make practical and useful recommendations regarding the types of information tools that can/should be used. The students will learn what software and information systems are available and be able to critically evaluate them.

VDPAM 420. Preceptorship in Veterinary Medical Practice. Cr. arr. Repeatable. F.S.SS. *Prereq: Fourth-year classification in veterinary medicine.*. Elective course in veterinary practice under the guidance of veterinarians in approved practice settings.

VDPAM 426. Veterinary Toxicology. (Dual-listed with 526). (3-0) Cr. 3. S. *Prereq: Third-year classification in veterinary medicine.* Study of toxicological diseases of domestic animals emphasizing clinical recognition, circumstances of poisoning, differential diagnosis with clinical and laboratory data, therapeutic procedures, preventive management and public health implications. Supplemented with case-based materials.

VDPAM 436. Beef Records Analysis. (0-30) Cr. arr. F.S. *Prereq: Classification in Veterinary Medicine, VM1-VM3 or special permission of instructor.* The class will have both a lecture and lab component and students can enroll in one or both. Lectures will emphasize current production and evaluation techniques for beef cow/calf operations and students will learn to conduct and critically assess production and financial data using a standardized approach. Lab activities will allow students an opportunity to work with individual beef cattle producers to identify areas for improving profitability, health, and sustainability. Enrolling in the class for multiple semesters will be encouraged.

VDPAM 437. Basic Clinical Skills for Production Medicine (MS 623-701): Dairy Herd Problem Identification. (7-33) Cr. 2. F.S.SS. *Prereq: Fourth-year classification in veterinary medicine.* Seven hours recitation/discussion and 33 hours clinical experience per week. Course taken for two weeks at University of Wisconsin, Madison, on a space-available basis. Learn to interpret DHI records and use them to identify and monitor herd problems of production, mastitis, reproduction, and replacement heifer management. Evaluate rates and treatment protocols of common dairy herd diseases. Assess dairy housing including ventilation and freestalls. Estimate costs of herd problems and develop partial-budgets.

VDPAM 438. Mastitis Problem Investigations (MS 623-703): Mastitis/Milk Quality. (9-31) Cr. 2. F.S.SS. *Prereq: Fourth-year classification in veterinary medicine.* Nine hours recitation/discussion and 31 hours clinical experience per week. Course taken for two weeks at University of Wisconsin, Madison, on a space-available basis. Learn to evaluate rates of clinical mastitis using manual and computerized (DC305) record systems. Interpret somatic cell count records to target mastitis problems. Collect samples and interpret milk microbiology reports. Evaluate mastitis risks in housing systems (stalls, bedded packs, etc). Analyze milking systems and milker practices. Develop mastitis treatment protocols.

VDPAM 439. Clinical Investigations of Fresh Cow and Calf Problems (MS 623-705): Applied Dairy Nutrition. (3-37) Cr. 2. F.S.SS. *Prereq: Fourth-year classification in veterinary medicine.* Three hours lecture, 37 hours clinical experience per week. Course taken for two weeks at University of Wisconsin, Madison, on a space-available basis. Learn to evaluate calf and peri-parturient cow management practices. Develop an investigation stragegy for ambiguous herd problems. Collect samples and interpret herd-based diagnostic tests for infectious and metabolic diseases. Assess environmental risk factors for metabolic and infectious disease including hygiene and housing. Assess nutritional status of herds via nutritional management, actual feed intake, particle length determination, etc.

VDPAM 440. Introduction to Clinics. (Cross-listed with V C S). Cr. R. F. *Prereq: Third-year classification in veterinary medicine.* Rotating assignments through multiple sections within the Veterinary Teaching Hospital.

VDPAM 445. Clinical Medicine. (3-0) Cr. 3. S. *Prereq: Third year classification in veterinary medicine.* Clinical diagnosis and treatment of diseases of swine, beef, dairy, and sheep.

VDPAM 450. Disturbances of Reproduction. (Cross-listed with V C S). (4-0) Cr. 4. F. *Prereq: Third-year classification in veterinary medicine.* General principles of diseases causing disturbances in reproduction.

VDPAM 451. Clinical Embryo Transfer. (0-40) Cr. 2. F.S.SS. *Prereq: Fourth year classification in veterinary medicine.* Elective clinical assignment in techniques of embryo transfer. Primary species studied will be bovine but equine and small ruminant embryo transfer will be covered during appropriate seasons. Enrollment is limited to four students per two week session.

VDPAM 455. Diagnostic Laboratory Practicum. Cr. 2. Repeatable. F.S. *Prereq: Fourth-year classification in veterinary medicine.* Practical experience in diagnosis of infectious and toxic diseases of livestock through exposure to cases in the ISU Veterinary Diagnostic Laboratory.

VDPAM 456. Veterinary Diagnostic Lab Methods & Applications. (16-0) Cr. 1. F. *Prereq: VM 2, VM 3 or VM 4.* Cases materials are used to develop diagnostic questions and to better understand the value of diagnostic tests. Testing methods and interpretation of diagnostic tests are coupled with sampling strategy and objective assessment of available evidence to provide accurate diagnosis.

VDPAM 476. Food Animal Field Service. (40-0) Cr. 2. F.S. *Prereq: Fourth year classification in Veterinary Medicine or Permission of Instructor.* Elective course in food animal field services. Students will assist the University veterinarian in delivering health care production management services to the ISU livestock farms and other selected farms in the region. Focus will be on delivery of individual animal care and establishment of best practices for herd management of dairy production systems at the university and in the region.

VDPAM 477. Food Animal Medicine and Surgery. Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Clinical assignment focused on the management of food animal medicine and surgery cases. Specific instruction in clinical evaluation of cases coupled with appropriate diagnostic testing and therapeutic intervention will be emphasized. Additional instruction will be provided in disease prevention, intensive care and management of food animal species. Particular emphasis will be placed on appropriate on-label and extra-label drug usage in food animal species.

VDPAM 479. Applied Swine Production Medicine. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: 310.* Advanced course in swine production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week. Assignments will include preceptorships with a practicing veterinarian and/or a production unit.

VDPAM 480. Swine Production Medicine. (15-25) Cr. 2. Repeatable. F.S.SS. *Prereq: 310 or permission of instructor.* Two week clinical rotation in swine production medicine. Students will be assigned to take the lead in investigating field based client cases with supervision of the instructors. Develop critical thinking skills that will allow students to apply concepts of herd management, production analysis, economic analysis, and disease prevention in addressing client cases. Variable amounts of travel to farm sites will be required with the potential for rare overnight stays.

VDPAM 482. Applied Beef Production Medicine. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: 310.* Advanced course in beef production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week.
A. Assignment with practicing veterinarian and/or production unit
B. Bull Breeding Soundness at Great Plains Veterinary Educational Center (GPVEC)
C. Calving at GPVEC
D. Feedlot Management at GPVEC
E. Weaning Management at GPVEC
F. Pregnancy Examination at GPVEC
G. Bovine Reproduction at GPVEC
I. Stocker/Feedlot Management

VDPAM 483. Beef Production Medicine. (15-20) Cr. 2. F.S. *Prereq: 310.* Two week advanced clinical rotation in beef production medicine. Fifteen hours recitation/discussion and 20 hours clinical experience per week. This course is designed to expose students to cow-calf and feedlot production concepts. The activities scheduled for the rotation depend greatly on the time of year. When ever possible, the class incorporates field trips. Students should anticipate that travel is required and overnight stays may be required. These field trips can vary in length from several hours to several days and may include weekends. As of 2006, one week of the rotation is spent at the Great Plains Veterinary Education Center, Clay Center, NE. Students should, therefore, plan accordingly and contact the instructor, immediately, if they anticipate a conflict. Students should not schedule Grand Rounds during this rotation.

VDPAM 484. Dairy Production Medicine. (15-20) Cr. 2. F.SS. *Prereq: Fourth-year classification in veterinary medicine; 310.* Two week course in dairy production medicine combining class time with multiple on-farm visits to learn various management aspects (DHIA, DC305 & PC Dart record analysis, calf rearing through lactating cows, reproduction programs, udder health and milk quality, biosecurity, welfare, nutrition and cow comfort) for a wide variety of dairy operations. Students will learn the latest in dairy management by reviewing current topic articles and gain experience in farm evaluation through a group project. Fifteen hours recitation/discussion and 20 hours clinical experience per week.

VDPAM 485. Applied Dairy Production Medicine. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: VDPAM 484.* Advanced course in dairy production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week. Assignments will include preceptorships with a practicing veterinarian and/or a production unit.

VDPAM 486. Introduction to Small Ruminant Production Medicine. (13-6) Cr. 1. S. *Prereq: Classification in Veterinary Medicine.* Herd health, disease monitoring and prevention, and typical management systems will be emphasized in lecture. Students will be required to learn and demonstrate proficiency at typical veterinary procedures such as blood collection, breeding soundness exams and parasite evaluations. Students will also be expected to develop herd health programs for individual producers. Field trip required.

VDPAM 487. Livestock Disease Prevention. (3-0) Cr. 3. F. A survey of diseases of large domestic animals, including discussion of causes, transmission, and control. Designed for students majoring in agricultural sciences.

VDPAM 488. Laboratory in Clinical Microbiology. Cr. 1. Repeatable. F.S.SS. *Prereq: Fourth-year classification in veterinary medicine.* Application of microbiological procedures to the diagnosis of infectious diseases.

VDPAM 489. Issues in Food Safety. (Cross-listed with An S, FS HN, HRI). (1-0) Cr. 1. S. *Prereq: Credit or enrollment in FS HN 101 or 272 or HRI 233; FS HN 419 or 420; FS HN 403.* Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

VDPAM 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of department chair.*

VDPAM 491. Advanced Ruminant Nutrition. (30-10) Cr. 3. F. *Prereq: 350 recommended.* Beef and dairy nutrition from the calf to the adult, lactating cow. Balanced rations for beef cow-calf, feedlot & dairy operations. Introduces different feedstuffs and forage varieties to determine those that are best suited for bovine diets.

VDPAM 492. Orientation for International Experience. (2-0) Cr. 1. S. *Prereq: Classification in veterinary medicine.* Predeparture orientation for group study abroad. Cultural considerations for the study abroad experience and a conversational language introduction. Out of class work will be assigned.

VDPAM 494. Advanced Dairy Production Medicine II. (20-20) Cr. 2. S. *Prereq: 484 or permission of instructor.* Advanced coverage in investigating dairy herd problems relating to milk quality or nutrition. Milk quality and nutrition troubleshooting will be taught through the combination of lecture and on-farm investigations. Students will combine lecture knowledge, data acquired from on-farm investigations and record analysis to generate management plans.

VDPAM 496. International Preceptorship. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: Second-year classification in veterinary medicine.* International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduate students

VDPAM 507. Evidence Based Clinical Decision Making. (Dual-listed with 407). (1-0) Cr. 1. S. *Prereq: Permission of instructor.* Discussion, lectures and laboratories to assess the quality and significance of medical evidence in making informed decisions about the treatment of individual animals and animal populations.

VDPAM 508. Poultry Diseases. (Dual-listed with 408). Cr. 2. Alt. S., offered 2010. *Prereq: Permission of instructor.* Bacterial, viral, parasitic, and nutritional diseases of domestic poultry and gamebirds; biosecurity, immunization, and management procedures to prevent poultry diseases.

VDPAM 514. Veterinary Practice Entrepreneurship. (Dual-listed with 414). Cr. 2. S. To provide a formal exposure to the entrepreneurial and business skills necessary to own and operate a successful veterinary practice.

VDPAM 522. Principles of Epidemiology and Population Health. (Cross-listed with V MPM). (3-0) Cr. 3. S. *Prereq: Micro 310 or equivalent.* Epidemiology and ecology of disease in populations. Disease causality and epidemiologic investigations. Issues in disease prevention, control, and eradication.

VDPAM 526. Veterinary Toxicology. (Dual-listed with 426). (Cross-listed with Tox). (3-0) Cr. 3. S. *Prereq: Permission of instructor.* A study of the disease processes in animals caused by toxicants and the use of differential diagnostic and therapeutic procedures. Emphasis is on use of clinical cases to define mechanism of poisoning, diagnostic and management procedures and public health and food safety issues.

VDPAM 527. Applied Statistical Methods in Population Studies. (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 401.* Measures of agreement, assessment of diagnostic tests, correlated data analysis, bioinformatics, linear models, comparison of multiple groups.

VDPAM 529. Epidemiological Methods in Population Research. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: Stat 401.* Designing, conducting, and analyzing data from field-based studies, including cross-sectional, case-control, cohort, and ecological studies. Clinical trials. Modeling disease in populations.

VDPAM 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, B BMB, BCB, B M S, FS HN, Hort, NutrS, EEOB, NREM,V MPM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.
A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

VDPAM 546. Clinical and Diagnostic Toxicology. (Cross-listed with Tox). (0-3) Cr. arr. Repeatable. F.S.SS. *Prereq: D.V.M. degree or 526.* Advanced study of current problems and issues in toxicology. Emphasis on problem solving utilizing clinical, epidemiological, and laboratory resources.

VDPAM 551. Advanced Veterinary Diagnostic Medicine. (0-3) Cr. arr. Repeatable. F.S.SS. *Prereq: 455.* Necropsy techniques of animals with emphasis on gross and microscopic lesion description and microbiological diagnosis of disease in food animals.

VDPAM 570. Risk Assessment for Food, Agriculture and Veterinary Medicine. (Cross-listed with Agron, Tox). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: Stat 104 or consent of instructor: Wolt, Hurd.* Risk assessment principles as applied to biological systems. Exposure and effects characterization in human and animal health and ecological risk assessment. Risk analysis frameworks and regulatory decision-making. Introduction to quantitative methods for risk assessment using epidemiological and distributional analyses. Uncertainty analysis.

VDPAM 590. Special Topics. Cr. arr. Repeatable. *Prereq: Permission of instructor.* Topics in medicine, surgery, theriogenology; beef, swine, dairy, or sheep production medicine.

VDPAM 596. International Preceptorship. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: Admission to graduate college.* International Preceptorships and Study Abroad Group programs. Provides opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

VDPAM 599. Creative Component. Cr. arr. Repeatable. *Prereq: Enrollment in nonthesis master's degree program.*

Courses for graduate students

VDPAM 650. Swine Diagnostic Medicine. Cr. arr. SS. *Prereq: Permission of instructor.* A detailed study of swine diseases emphasizing the pathogenesis and diagnosis of swine respiratory, enteric, reproduction, metabolic, and septicemic diseases.

VDPAM 655. Advanced Swine Production Medicine. Cr. arr. S. *Prereq: Permission of instructor.* Detailed overview of applied techniques used in swine production medicine; production modeling and record analysis, production economics and financial analysis, therapeutic and vaccination strategies, quality control procedures and food safety.

VDPAM 699. Research. Cr. arr. Repeatable.

Veterinary Microbiology and Preventive Medicine

Michael Wannemuehler, Interim Chair of Department

Distinguished Professors: Roth

Distinguished Professors (Emeritus): Beran, Cheville, Kaeberle, Ross, Switzer

Professors: Minion, Nolan, Phillips, Platt, Reynolds, Rosenbusch, Thoen, Uhlenhopp, Wannemuehler, Yoon, Zhang, Zimmerman

Professors (Emeritus): Hogle, Kramer, Moon

Professors (Collaborators): Carpenter, Kehrli, Nystrom-Dean, Schultz, Tabatabai, Thacker

Associate Professors: Cornick, Davis, Griffith

Associate Professors (Collaborators): Frey, Harp, Panigrahy, Richt, Sacco, Sharma, Zuerner

Assistant Professors: Bellaire, Blitvich, Miller, Sponseller

Assistant Professors (Collaborators): Anderson, Bannantine, Brockmeier, Faaberg, Halling, Lager, Register, Roof, Scupham, Stabel, Stanton, Vaughn, Vincent, Waters, Wesley

Instructor (Collaborator): Schlater

Lecturer: Brown

Clinician: Plummer

The Department of Veterinary Microbiology and Preventive Medicine offers instruction in the areas of bacteriology, mycology, virology, immunology, epidemiology and public health at the graduate level.

Microbiologic, immunologic, regulatory, and preventive medical aspects of infectious diseases of animals are emphasized in courses for students in the veterinary curriculum.

Professional Program of Study

For the professional curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see *Veterinary Medicine, Curriculum*.

The Department of Veterinary Microbiology and Preventive Medicine provides instruction on pathogenic bacteria, fungi, and viruses and their interaction with host animal species. Principles and applications of infectious diseases, immunity to disease, diagnostic methods for infectious diseases, and vaccinology are covered. Principles and applications of epidemiology, public health, preventive veterinary medicine, regulatory veterinary medicine and food safety are also emphasized.

Graduate Study

The department offers opportunities for the degree doctor of philosophy with a major in veterinary microbiology. A specialization in preventive medicine is an option for this degree. Graduates in the Veterinary Microbiology and Preventive Medicine programs have a broad understanding of the fundamental processes involved in infectious diseases, pathogenesis and immunology. They are able to effectively establish research programs, which involve complex biological systems and disease syndromes. They are also prepared to address microbial-based social, ethical and environmental problems. Graduates acquire effective written and oral communication skills which lead to successful research and teaching careers in the medical and veterinary sciences. The department also offers work towards the master of science with majors in veterinary microbiology or veterinary preventive medicine. A non-thesis master's option is available for majors in preventive medicine. Courses are open for students majoring in other graduate programs.

Prerequisite to graduate study is completion of coursework in general microbiology, biology, biochemistry, mathematical sciences, and physics. Candidates for the majors in veterinary microbiology should possess an undergraduate degree in biomedical science with emphasis in medical microbiology or the D.V.M. degree. Candidates for the major in preventive medicine should possess the D.V.M. degree.

The department also participates in the interdepartmental majors and programs in genetics, immunobiology, and MCDB (molecular, cellular, and developmental biology; see Index).

Each graduate student must demonstrate proficiency in English composition within two semesters in residence.

Courses primarily for professional curriculum students

V MPM 378. Case Study IV. (2-0) Cr. 2. S. *Prereq: Second-year classification in veterinary medicine.* Case-based applied learning that relates to the basic science courses. Emphasis on early integration of basic and clinical science concepts.

V MPM 380. Veterinary Immunology. (2-0) Cr. 2. S. *Prereq: First-year classification in veterinary medicine.* Structure and function of the immune system in animals.

V MPM 386. Veterinary Microbiology. (3-5) Cr. 5. F. *Prereq: Second-year classification in veterinary medicine.* Bacteria and fungi of veterinary importance with emphasis on mechanisms of disease production and laboratory diagnostic procedures.

V MPM 387. Veterinary Virology. (3-0) Cr. 3. S. *Prereq: Second-year classification in veterinary medicine.* Basic principles of animal virology. Pathogenesis of viral infections. The nature and ecology of viruses of veterinary and zoonotic importance.

V MPM 388. Public Health and the Role of the Veterinary Profession. (3-0) Cr. 3. S. *Prereq: Second-year classification in veterinary medicine.* Fundamental epidemiology, zoonotic diseases, occupational health, food safety, other public health topics.

V MPM 390. Topics in Veterinary History. (2-0) Cr. 1. S. 8 weeks. Significant persons, noteworthy events, and pivotal scientific discoveries in the course of the development and advancement of veterinary medicine from ancient times to the present.

V MPM 409. Infectious Diseases of Captive Wild Animals. (1-0) Cr. 1. F. *Prereq: Second year classification in veterinary medicine.* Infectious diseases (bacterial, viral, and mycotic) of non-human primates, birds, ruminants, cold-blooded animals, marine mammals, and carnivores.

V MPM 437. Infectious Diseases and Preventive Medicine. (3-0) Cr. 3. S. *Prereq: Third-year classification in veterinary medicine.* Etiology, epidemiology, laboratory diagnosis, regulatory control and preventive medicine aspects of the infectious diseases of swine, sheep, goats, cattle and horses.

V MPM 486. Laboratory in Public Health. Cr. 1. Repeatable. F.S. *Prereq: Fourth-year classification in veterinary medicine.* Discussions, lectures, exercises and field trips related to veterinary public health.

V MPM 490. Independent Study. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor and department chair.*

V MPM 491. CDC Epidemiology Elective Preceptorship. Cr. 6. F.S.SS. Introduction to preventive medicine, public health and the principles of applied epidemiology within the working atmosphere of the Centers for Disease Control.

V MPM 494. Zoo Preceptorship. Cr. arr. Repeatable. F.S.SS. *Prereq: Fourth year classification in veterinary medicine.* Elective course in zoo veterinary practice under guidance of approved veterinarians.

V MPM 496. International Preceptorship. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: Second-year classification in veterinary medicine.* International Preceptorships and Study Abroad group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduate students

V MPM 520. Medical Immunology I. (4-0) Cr. 4. F. *Prereq: Micro 310 or V MPM 386, 3 credits in biochemistry.* Nature of the immune system and its role in health and disease. Credit for either V MPM 520 or 575, but not both may be applied toward graduation.

V MPM 522. Principles of Epidemiology and Population Health. (Cross-listed with VDPAM). (3-0) Cr. 3. S. *Prereq: Micro 310 or equivalent.* Epidemiology and ecology of disease in populations. Disease causality and epidemiologic investigations. Issues in disease prevention, control, and eradication.

V MPM 536. Zoonoses and Environmental Health. (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: 386, 387 and 388 or equivalent or permission of instructor.* Pathogensis and control of zoonotic diseases. Factors influencing transmission and survival of pathogenic microorganisms in the environment.

V MPM 540. Livestock Immunogenetics. (Cross-listed with An S, Micro). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: An S 561 or Micro 575 or V MPM 520.* Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

V MPM 542. Introduction to Molecular Biology Techniques. (Cross-listed with GDCB, BBMB, BCB, B M S, EEOB, FS HN, Hort, NREM, NutrS, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Satisfactory-fail only.

A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping. (F.S.SS.)
B. Protein Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonol antibody production. (S.SS.)
C. Cell Techniques. Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.)
D. Plant Transformation. Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.)
E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)

V MPM 565. Professional Practice in the Life Sciences. (Cross-listed with Pl P, Agron, An S, BCB, Hort, Micro). Cr. arr. Repeatable. S. *Prereq: Graduate classification.* Professional discourse on the ethical and legal issues facing life science researchers. Offered in modular format; each module is four weeks.
A. Professional Practices in Research. (Cr. 1.0) Good scientific practices and professional ethics in the life sciences.
B. Intellectual Property and Industry Interactions. (Cr. 0.5) Ethical and legal issues facing life scientists involved in research interactions with industry.

V MPM 575. Immunology. (Cross-listed with MICRO). (3-0) Cr. 3. S. *Prereq: 310.* Humoral and cellular immune functions. Interactions between cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either V MPM 575 or V MPM 520, but not both, may be applied toward graduation.

V MPM 586. Medical Bacteriology. (Cross-listed with MICRO). (4-0) Cr. 4. F. *Prereq: Permission of instructor.* Bacteria associated with diseases of vertebrates, including virulence factors and interaction of host responses.

V MPM 586L. Medical Bacteriology Laboratory. (0-6) Cr. 2. F. *Prereq: credit or enrollment in 586 or 625.* Procedures used in isolation and identification of pathogenic bacteria, including molecular and genetic techniques used in research.

V MPM 587. Animal Virology. (4-0) Cr. 4. *Prereq: Permission of instructor.* The biology of animal viruses and pathgenic mechanisms in viral diseases.

V MPM 587L. Laboratory in Animal Virology. (0-3) Cr. 1. *Prereq: Permission of the instructor.* Basic laboratory techniques in virology.

V MPM 590. Special Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*

V MPM 596. International Preceptorship. (0-40) Cr. arr. Repeatable. F.S.SS. *Prereq: Admission to graduate college.* International Preceptorships and Study Abroad Group programs. This course will provide opportunties for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunties.

V MPM 599. Creative Component. Cr. arr. *Prereq: Nonthesis M.S. Option only.* A written report based on laboratory research, library reading, or topics related to the student's area of specialization and approved by the student's advisory committee.

Courses for graduate students

V MPM 604. Seminar. (1-0) Cr. 1. Repeatable. F. Satisfactory-fail only.

V MPM 608. Molecular Virology. (Cross-listed with Micro, Pl P). (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: BBMB 405 or GDCB 511.* C. Miller, B. Blitvich, A. Miller. Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

V MPM 615. Molecular Immunology. (Cross-listed with BBMB, Micro). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: BBMB 405 or 502.* Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signalling pathways leading to expression of genes that control and activate immune function.

V MPM 625. Mechanisms of Bacterial Pathogenesis. (Cross-listed with Micro). (4-0) Cr. 4. Alt. S., offered 2011. *Prereq: Credit in Biochemistry and Microbiology.* Review of current concepts in specific areas of microbial pathogenesis including the genetic basis for bacterial disease, genetic regulation and control of virulence factors and their mechanisms of action, and host-pathogen interactions at the cellular and molecular levels. The application of microbial genetics to understanding pathogenesis will be included.

V MPM 629. Advanced Topics in Cellular Immunology. (2-0) Cr. 2. Alt. S., offered 2010. *Prereq: 520 or 575.* Current topics and literature in cellular immunology. Topics include thymocyte development and selection, T cell interactions with antigen presenting cells, and lymphocyte effector functions.

V MPM 660. Pathogenesis of Persistent Infections. (Cross-listed with V Pth). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Permission of instructor.* Study of current knowledge related to host pathogen interactions during persistent and chronic infections by bacteria, viruses and parasites.

V MPM 690. Current Topics. Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.* Colloquia or advanced study of specific topics in a specialized field.
A. Immunology
B. Infectious Diseases

V MPM 698. Seminar in Molecular, Cellular, and Developmental Biology. (Cross-listed with MCDB, BBMB, GDCB, MIcro). (2-0) Cr. arr. Repeatable. F.S. Student and faculty presentations.

V MPM 699. Research. Cr. arr. Repeatable.

Veterinary Pathology

www.vetmed.iastate.edu/departments/vetpath/

Claire Andreasen, Chair of Department

Distinguished Professor (Emeritus): Cheville

University Professor (Emeritus): Kluge

Professors: Ackermann, Andreasen, Bender, Halbur, Haynes, Hyde, Janke, Myers, Osweiler

Professors (Emeritus): Carson, Greve, Hagemoser, Holter, Hopper, Jeska, Ledet, Miller, Moon, Niyo, Seaton, Stahr

Professors (Collaborators): Arp, Brogden, Meador, Sasseville

Associate Professors: Beetham, Jarvinen, Jones, Yaeger

Associate Professors (Collaborators): Olsen, Perry

Assistant Professors: Danielson, Fales, Garcia-Tapia, Hostetter, Petersen

Assistant Professors (Adjunct): van Geelen

Assistant Professors (Collaborators): Greenlee, Harris, Meyerholz, Palmer, Thacker, Thomsen

Instructors (Adjunct): Burrough, Johnson, Olivier, Ostojic, Pillatzki, Plattner

Lecturer: Flaherty

Professional Program of Study

For the professional curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see *Veterinary Medicine, Curriculum*.

The Department of Veterinary Pathology offers a systematic study of basic disease mechanisms with emphasis on the changes in gene expression, cells, tissues, organs, and body fluids associated with disease. The theory and practice of veterinary pathology, veterinary clinical pathology, veterinary parasitology, veterinary toxicology, and related disciplines provide the basis for accurate diagnosis and a rational approach to the treatment and prevention of animal diseases.

Graduate Study

The department offers work for the degree master of science and doctor of philosophy with a major in veterinary pathology. As an option, students may choose an area of specialization in pathology, veterinary anatomic pathology, veterinary clinical pathology, veterinary toxicology, or veterinary parasitology (www.vetmed.iastate.edu/departments/vetpath/default.aspx?id=2562&ekmensel=c57dfa7b_166_170_2562_1). The master of science degree is available on a thesis or nonthesis basis in the veterinary pathology major with or without an area of specialization.

For the ACVP training track (residency) of the anatomic or clinical pathology graduate program designed to train veterinary pathologists, the student must have a funded position within the Department of Veterinary Pathology. If the student does not have a funded position or is not enrolled in the departmental degree program, enrollment in courses pertaining to the residency program and activities that support the residency program must have the approval of the Department Chair of Veterinary Pathology and the head of the departmental residency training program.

Graduates have a broad understanding of the mechanistic basis of disease pathogenesis. They are able to communicate with clinicians, other scientists, and other colleagues on scientific matters, and with the general public on related science policy matters. Graduates are able to address complex problems facing the agricultural and biomedical sciences, and comparative medicine, and are able to make appropriate diagnoses and investigations of animal diseases. They consider ethical, social, legal and environmental issues, and are skilled at carrying out research, communicating research results, and writing concise and competitive grant proposals.

Collaborative work is recommended in other departments in the College of Veterinary Medicine or departments or programs in other colleges. The department participates in the interdepartmental program in immunobiology (www.immunobiology.iastate.edu/) and the interdepartmental major in toxicology (www.toxicology.iastate.edu). (See Index.)

A veterinary degree (doctor of veterinary medicine or equivalent) is required for training in Veterinary Anatomic Pathology and Veterinary Clinical Pathology. Other specializations do not require the veterinary degree. A minimum score of 550 paper-based (213 computer-based; 79 internet based) is required on the TOEFL examination for students whose native language is not English. Scores on the standardized Graduate Record Examination (GRE) General Test are required of students not having a veterinary degree from the United States or Canada. The GRE General Test is strongly recommended for all other applicants. A foreign language requirement will be determined by the

student's program of study committee with the approval of the departmental chair. The Graduate English Examination is a graduate college requirement for native English speakers.

The M.S. thesis degree in veterinary pathology, with or without an area of specialization, requires a minimum of 30 graduate credits. Following completion of all other requirements, a comprehensive final examination is administered covering all graduate work including the thesis. The examination is typically oral, but a written component may be specified by the program of study committee. The degree candidate must submit a thesis, including at least one manuscript suitable for publication, to the committee members and departmental chair at least two weeks prior to the final examination. The departmental requirement for graduate courses includes 3 credits of basic biological sciences (biochemistry, genetics, cell biology), 4 credits of statistics (Stat 401), 4 credits of systemic pathology (from V Pth 570 or 571), 1 credit of postmortem pathology (V Pth 551), 1 credit of seminar (V Pth 605), and a significant number of research credits (V Pth 699).

The M.S. nonthesis degree in veterinary pathology, with or without an area of specialization, requires a minimum of 40 graduate credits including at least 10 graduate credits earned outside the department. Every nonthesis master's degree program requires evidence of individual accomplishment demonstrated by completion of a creative component, special report, or scientific study. A minimum of 3 credits of such independent work (V Pth 599) and a practical diagnostic examination (V Pth 606) corresponding to the area of specialization are required on every program of study. The final examination is comprehensive and consists of written and oral questions. The departmental requirement for graduate courses includes those for the M.S. thesis degree plus additional courses corresponding to the area of degree emphasis of specialization. Contact the department for a more complete list of requirements and information on areas of specialization.

The Ph.D. degree in veterinary pathology, with or without an area of specialization, requires a minimum of 72 graduate credits including at least 12 graduate credits earned outside the department. The preliminary examination, consisting of written and oral components, is comprehensive and not restricted to the content of graduate courses. The degree candidate must submit a dissertation, including at least two manuscripts suitable for publication, to the committee members and departmental chair at least two weeks prior to the final examination. The final examination is primarily a defense of the dissertation, but it may include questions on other areas of specialized knowledge. The department also offers a combined DVM/Ph.D. program designed for completion of courses for the Ph.D. degree in Veterinary Pathology simultaneously with study in the professional curriculum in the College of Veterinary Medicine. Contact the department for a more complete list of requirements for the Ph.D. degree and information on areas of specialization.

Courses primarily for professional curriculum students

V Pth 342. Anatomic Pathology I. (Dual-listed with 542). (2-2) Cr. 3. S. *Prereq: First-year classification in veterinary medicine.* Basic pathology with emphasis on disease in animals and introduction to diseases by system.

V Pth 372. Anatomic Pathology II. (3-3) Cr. 4. F. *Prereq: 342.* Response to injury by each body system.

V Pth 376. Veterinary Parasitology. (Dual-listed with 576). (3-3) Cr. 4. F. *Prereq: Second-year classification in veterinary medicine.* Parasitic diseases of domestic animals and their control.

V Pth 377. Case Study III. (0-4) Cr. 2. F. *Prereq: Second-year classification in veterinary medicine.* Clinical applications of the basic sciences taught concurrently in the fall semester of the second year curriculum in veterinary medicine.

V Pth 401. Basics of Medical Terminology. (1-0) Cr. 1. F. 8 weeks, offered first half semester only. Discussion of prefixes, suffixes, and roots (mostly from Latin and Greek) that comprise medical terms.

V Pth 409. Introduction to Veterinary Cytology and Laboratory Techniques. (0-2) Cr. 1. S. *Prereq: Third-year classification in veterinary medicine.* Description, interpretation, and techniques for cellular preparations from tissues and body fluids.

V Pth 410. Llama Medicine. (1-0) Cr. 1. S. *Prereq: Second or third year classification in veterinary medicine.* Offered first half semester only. Introduction to basic camelid medicine, including anatomy, behavior, restraint, handling, husbandry, herd health, common diseases, surgical conditions, and anesthesia protocols.

V Pth 425. Clinical Pathology. (2-4) Cr. 4. S. *Prereq: 372.* Principles of clinical hematology, clinical chemistry, and urinalysis in domestic animals.

V Pth 456. Necropsy Laboratory Practicum. Cr. 1. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Practicum in postmortem examination and diagnosis.

V Pth 457. Clinical Pathology Laboratory Practicum. Cr. 1. Repeatable. *Prereq: Fourth-year classification in veterinary medicine.* Methodology in clinical chemistry, hematology and cytology; practice in interpretation of laboratory data.

V Pth 478. Global Protozoology - Molecular Biology of Protozoa. (Dual-listed with 578). (Cross-listed with Ent). (2-1) Cr. 3. F. *Prereq: Permission of instructor.* Analysis of cellular systems, molecules, and organelles of pathogenic protozoan parasites. Emphasis is placed on processes and systems that are unique to protozoa, are important to understanding vector-parasite-host biology/ecology, or are targets of disease prevention/treatment programs for international disease control. Nonmajor graduate credit.

V Pth 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of instructor and department chair.*

V Pth 492. Orientation for International Experience. (2-0) Cr. 1. Repeatable. S. *Prereq: Classification in veterinary medicine.* 8 weeks. Predeparture orientation for group study abroad. Cultural considerations for the study abroad experience and a conversational language introduction. Out of class work will be assigned.

V Pth 496. International Preceptorship. (0-40) Cr. 1-12. Repeatable. F.S.SS. *Prereq: Second-year classification in veterinary medicine.* International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experience in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduate students

V Pth 530. Teaching and Learning in Veterinary Medical Education. (3-0) Cr. 3. F. Study of principles of teaching and learning as they relate to veterinary medical education. These include: theories of learning, analyzing content/learners/context, identifying goals, identifying appropriate instructional strategies (specific to medical education), matching assessment processes to goals and strategies, common curricular approaches and decision-making processes in medical education, and the scholarship of teaching and learning for veterinary medical educators.

V Pth 542. Anatomic Pathology I. (Dual-listed with 342). (2-2) Cr. 3. S. *Prereq: Graduate classification and Biol 352 or equivalent for graduate credit, permission of instructor.* Basic pathology with emphasis on disease in animals and introduction to diseases by system.

V Pth 548. Diagnostic Parasitology Laboratory. Cr. 1-3. F.S.SS. *Prereq: 376 or 576.* Contact hours are (0-3 to 0-9). A laboratory experience in the technical and applied aspects of veterinary parasitology.

V Pth 549. Clinical Pathology Laboratory. (0-3) Cr. 1. Repeatable. F.S.SS. *Prereq: 457; permission of instructor.* Laboratory procedures and clinical interpretations with emphasis on hematology, cytology, and clinical chemistry. Satisfactory-fail only.

V Pth 550. Surgical Pathology Laboratory. Cr. 1-3. Repeatable. F.S.SS. *Prereq: 570 or 571; permission of instructor.* Contact hours are (0-3 to 0-9). Diagnosis of lesions in biopsy specimens; classification of neoplasms. Course includes rotation through departmental biopsy service and review of selected cases from departmental archives. Satisfactory-fail only.

V Pth 551. Postmortem Pathology Laboratory. Cr. 1-3. Repeatable. F.S.SS. *Prereq: 542; permission of instructor.* Contact hours are (0-3 to 0-9). Necropsy techniques of animals with emphasis on gross and microscopic lesions and diagnosis. Satisfactory-fail only.

V Pth 554. Ethics in Scientific Research and Writing. (1-0) Cr. 1. Alt. SS., offered 2010. *Prereq: Graduate classification.* Ethical conduct in biomedical research, criticism, writing, and adherence to regulations. Satisfactory-fail only.

V Pth 570. Systemic Pathology I. (2-4) Cr. 4. Alt. F., offered 2010. *Prereq: 342 or 542; permission of instructor.* Pathology of the respiratory, reproductive, endocrine, musculoskeletal, and cardiovascular systems. Emphasis on pathogenesis and anatomic pathology correlated with interpretive clinical pathology where appropriate.

V Pth 571. Systemic Pathology II. (2-4) Cr. 4. Alt. F., offered 2009. *Prereq: 342 or 542; permission of instructor.* Pathology of the integumentary, urinary, digestive, lymphoid, and nervous systems and special senses. Emphasis on pathogenesis and anatomic pathology correlated with interpretive clinical pathology where appropriate.

V Pth 576. Veterinary Parasitology. (Dual-listed with 376). (3-3) Cr. 4. F. *Prereq: Graduate classification and 542.* Parasitic diseases of domestic animals and their control.

V Pth 578. Global Protozoology - Molecular Biology of Protozoa. (Dual-listed with 478). (Cross-listed with Ent). (2-1) Cr. 3. F. *Prereq: Permission of instructor.* Analysis of cellular systems, molecules, and organelles of pathogenic protozoan parasites. Emphasis is placed on processes and systems that are unique to protozoa, are important to understanding vector-parasite-host biology/ecology, or are targets of disease prevention/treatment programs for international disease control.

V Pth 590. Special Topics. Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor.*
A. Veterinary Pathology
B. Veterinary Parasitology
C. Veterinary Toxicology

D. Veterinary Clinical Pathology
E. Other

V Pth 596. International Preceptorship. (0-40) Cr. 1-12. Repeatable. F.S.SS. *Prereq: Admission to graduate college.* International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

V Pth 599. Creative Component Research. Cr. arr. Repeatable. Course for departmental graduate research.
A. Veterinary Pathology
B. Veterinary Parasitology
C. Veterinary Toxicology
D. Veterinary Clinical Pathology

Courses for graduate students

V Pth 604. Pathology Case Seminar. Cr. 1-2. Repeatable. F.S. *Prereq: permission of instructor.* Description and interpretation of microscopic lesions and clinical pathology data collected from cases of natural and experimental disease. Satisfactory-fail only.

V Pth 605. Current Topics Seminar. Cr. 1. Repeatable. F.S.SS. A seminar of graduate research at the time of thesis or dissertation defense.

V Pth 606. Diagnostic Interpretation. Cr. R. F.S.SS. *Prereq: permission of instructor.* A comprehensive examination in the diagnostic description and interpretation of case materials relevant to veterinary pathology and areas of specialization for the graduate degree preliminary examination.
A. Veterinary Pathology
B. Veterinary Parasitology
C. Veterinary Toxicology
D. Veterinary Clinical Pathology

V Pth 652. Pathologic Hematology. (2-2) Cr. 3. Alt. S., offered 2010. *Prereq: 425; permission of instructor.* Pathologic changes in blood constituents of domestic animals.

V Pth 655. Cellular and Molecular Pathology I. (3-0) Cr. 3. Alt. S., offered 2011. *Prereq: Graduate course in biochemistry, genetics, or cell biology.* Cellular and molecular mechanisms of cell injury, cellular responses to injury, and inflammation.

V Pth 656. Cellular and Molecular Pathology II. (Cross-listed with Tox). (3-0) Cr. 3. Alt. S., offered 2010. *Prereq: Graduate course in biochemistry, genetics, or cell biology.* Cellular and molecular mechanisms of carcinogenesis.

V Pth 660. Pathogenesis of Persistent Infections. (Cross-listed with V MPM). (2-0) Cr. 2. Alt. S., offered 2011. *Prereq: Permission of instructor.* Study of current knowledge related to host pathogen interactions during persistent and chronic infections by bacteria, viruses and parasites.

V Pth 663. Clinical Chemistry. (2-2) Cr. 3. Alt. S., offered 2011. *Prereq: 425; permission of instructor.* The pathophysiology, methodology, and clinical application of laboratory medicine.

V Pth 679. Histopathology of Laboratory Animals. (0-4) Cr. 2. Alt. SS., offered 2010. *Prereq: 570 or 571; permission of instructor.* Study of microscopic lesions in laboratory animals with emphasis on description, etiology, pathogenesis, and diagnosis.

V Pth 699. Research. Cr. arr. Repeatable. Course restricted to graduate program within the department.
A. Veterinary Pathology
B. Veterinary Parasitology
C. Veterinary Toxicology
D. Veterinary Clinical Pathology

Women's Studies

www.public.iastate.edu/~wsprogram/homepage.html

(Interdepartmental Program)

Diane Price Herndl, Program Director
Julie Snyder-Yuly, Assistant Director

Core Faculty: Leslie Bloom (Curriculum & Instruction), Chrisy Moutsatsos (Anthropology), Anastasia Prokos (Sociology).

Undergraduate Study

Women's Studies in the College of Liberal Arts and Sciences is a cross-disciplinary program in which students may elect a minor or a major. Women's Studies provides an opportunity for students to examine women's roles, contributions, and status in social and cultural context and to investigate a variety of disciplines from feminist perspectives. Women's Studies creates an understanding that interrelated factors —e.g., race, ethnicity, class, age, disability, religion, national origin, and sexual orientation — inform knowledge of women's history, culture, and social roles. Women's Studies seeks to improve critical thinking and to provide students with the intellectual means to question prevailing assumptions. It encourages students to explore the contexts and ideological origins of knowledge and to examine the relationship between knowledge and power in society. It promotes social responsibility by examining the connections between personal experience and political activity, and validates student contributions and voices. Women's Studies graduates are skilled in critical thinking, research methods, and effective communication. Because they have developed a thorough understanding of gender, race, and class, they can understand and work effectively with employers, colleagues, and clients to analyze and address complex social problems. Women's Studies graduates acquire strong backgrounds for careers in such areas as counseling, education, human resources, public policy, politics, business, or law. The program includes core courses in Women's Studies and cross-listed courses in anthropology, art history, classical studies, economics, English, history, health and human performance, political science, psychology, religion, sociology, speech communication, and world languages and cultures. An undergraduate major requires 33 credits of core, cross-listed, and independent study courses. Women's Studies majors must satisfy the following requirements:

1. 21 credits selected from women's studies core courses (W S).
   A. Required core courses: W S 201, 301, 401 and 402. Students must also choose between a thesis, W S 499 (3 cr.) or an internship, W S 491 (3 cr.)
   B. The remaining 6 credits should be chosen from the Women's Studies core courses: W S 203, 205, 302, 320, 350, 425, 435, 450 (may be taken more than once), and 490.
   C. No more than 6 credits of W S 490 may be counted toward the W S major.
2. 12 credits selected from W S cross-listed courses or W S core courses.

Women's Studies majors must also declare either a minor or a second major in a different program or department. Communication Proficiency requirement: The Women's Studies major requires an average grade of C- or better in English 150 and 250 (or 250H) and W S 301.

Undergraduate students may minor in Women's Studies by taking 15 semester hours of Women's Studies classes, including W S 201, 301 and one 400 level core Women's Studies course, plus 6 additional credits of core or cross-listed courses.

Any student interested in a minor or major in Women's Studies should contact the Assistant Director of the program.

Graduate Study

The graduate minor in Women's Studies is designed to provide students with knowledge of theories and methods within a variety of approaches in feminist scholarship. The program seeks to integrate and synthesize knowledge from many disciplines and to offer students opportunties for systematic study of gender and women's experiences and perspectives in all knowledge fields. Students will be prepared to take leadership roles in supporting gender equity and diversity in their careers in education, social service work, business, law, public policy, governmental and non-governmental organizations, and research.

The graduate minor requires 12 credits for students enrolled in a master's or a doctoral degree program. Students are required to take either W S 510 or W S 620; taking both is strongly recommended. Students will also take two or three electives selected from the list of core and cross-listed Women's Studies courses approved for graduate study. At least one member of the Women's Studies faculty will serve on the program of study for doctoral students. A list of eligible faculty members may be obtained from the Director of the Women's Studies program. Women's Studies has 70 affiliated faculty members from departments and programs throughout the University.

Courses primarily for undergraduate students

W S 201. Introduction to Women's Studies. (3-0) Cr. 3. Introduction to the interdisciplinary field of Women's Studies. Contemporary status of women in the U.S. and worldwide from social, economic, historical, political, philosophical and literary perspectives. Analysis of intersection of gender, race, class, and sexuality. Subject matter includes work, health, sexuality, and violence. Foundation for the other courses in the program.

W S 203. Introduction to Lesbian Studies. (3-0) Cr. 3. S. Study of contemporary and historic lesbian cultures and communities from a US and international perspective. Addresses issues of race, class, gender and sexuality as they intersect with the formation of lesbian identities. Explores who identifies as lesbian and how that dis/enables political resistance and formation of community.

W S 205. Introduction to Queer Studies. (3-0) Cr. 3. F. *Prereq: Engl 150.* Interdisciplinary study of issues relating to lesbian, gay, bisexual, transgender, and queer identities in the U.S. Attention will be given to race and socioeconomic class.

W S 222. Leadership Styles and Strategies in a Diverse Society. (Cross-listed with LAS). (3-0) Cr. 3. *Prereq: Sophomore classification.* Develop and practice leadership skills through understanding personal leadership styles, leadership theory and communication theory, including how they relate to gender issues and cultural diversity; exploring personality types, communication styles, and leadership styles, networking and developing mentoring relationships; setting goals and participating in leadership opportunities and service.

W S 258. Human Reproduction. (Cross-listed with Biol). (3-0) Cr. 3. F. *Prereq: Biol 101, or 155, or 211.* Anatomy and physiology of human reproductive systems, including fertility, pregnancy, and delivery.

W S 301. International Perspectives on Women and Gender. (3-0) Cr. 3. Repeatable. F. *Prereq: 201 or 3 credits in Women's Studies at the 300 level or above.* Study of women in a range of cultures, depending on faculty specialization. Special emphasis on women in development seen in postcolonial context. Nonmajor graduate credit.

W S 302. Issues in Women's Health and Reproduction. (3-0) Cr. 3. *Prereq: Women's Studies 201 or 3 credits in Women's Studies at 300 level or above.* Current feminist scholarship in the social sciences and humanities on women's health, health care, and reproduction. Intersections among race, gender, class, ability, and sexuality are emphasized. Nonmajor graduate credit.

W S 304. Creative Writing - Fiction. (Cross-listed with Engl). (3-0) Cr. 3. F.S. *Prereq: Engl 250, not open to freshmen.* Progresses from practice in basic techniques of fiction writing to fully developed short stories. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

W S 307. Women in Science and Engineering. (Cross-listed with Biol). (3-0) Cr. 3. F. *Prereq: A 200 level course in science, engineering or women's studies; Engl 250.* The interrelationships of women and science and engineering examined from historical, sociological, philosophical, and biological perspectives. Factors contributing to underrepresentation; feminist critiques of science; examination of successful strategies.

W S 320. Ecofeminism. (Cross-listed with Env S). (3-0) Cr. 3. Alt. F., offered 2009. *Prereq: W S 201 or 3 credits in Women's Studies at the 300 level or above.* Women's relationships with the earth, non-human nature, and other humans. The course explores the connections between the mastery of women and the mastery of nature; origins of ecofeminism and its relation to the science of ecology and to other branches of feminist philosophies. Critique of modern science, technology, political systems as well as solutions will be included.

W S 321. Economics of Discrimination. (Cross-listed with Econ). (3-0) Cr. 3. F. *Prereq: Econ 101.* Economic theories of discrimination. Analysis of the economic problems of women and minorities in such areas as earnings, occupations, and unemployment. Public policy concerning discrimination. Poverty measurement and antipoverty programs in the U.S. Nonmajor graduate credit.

W S 323. Gender and Communication. (Cross-listed with Sp Cm, ComSt). (3-0) Cr. 3. *Prereq: Sp Cm 212.* The rhetorical strategies women and men use to succeed in oral communication; the theory, principles, and practice of effective gender communication in a variety of settings. Nonmajor graduate credit.

W S 327. Sex and Gender in Society. (Cross-listed with Soc). (3-0) Cr. 3. F.S.SS. *Prereq: Soc 130 or 134.* How the biological fact of sex is transformed into a system of gender stratification. The demographics and social positions of women and men in the family, education, media, politics, and the economy. Theories of the social-psychological and sociological bases for behavior and attitudes of women and men. The relationship between gender, class, and race.

W S 328. Sociology of Masculinities and Manhood. (Cross-listed with Soc). (3-0) Cr. 3. S. *Prereq: Soc 130, 134, or W S 201.* Examination of socially constructed and idealized images of manhood, the nature of social hierarchies and relations constructed on the basis of imagery, ideologies, and norms of masculinity. Theories on gender (sociological, psychological, and biological). Particular attention given to theory and research on gender variations among men by race, class, ethnicity, sexual orientation, physical ability and age.

W S 333. Women and Leadership. (Cross-listed with LAS). (3-0) Cr. 3. *Prereq: Sophomore classification.* This course will examine historical and contemporary barriers to and opportunities for women's leadership in a variety of contexts, including professions and public service. It will examine theories of women's leadership, gender differences in leadership styles, and the perceptions and expectations about women's leadership. Multiple perspectives of women's leadership will be highlighted through lectures, readings, videos, guest speakers and group work.

W S 336. Women and Religion. (Cross-listed with Relig). (3-0) Cr. 3. F. *Prereq: Relig 105, 210 or W S 201 recommended.* Examines the status of women in various religions, feminist critiques of religious structures and belief systems, and contemporary women's spirituality movements. Nonmajor graduate credit.

W S 338. Feminist Philosophy. (Cross-listed with Phil). (3-0) Cr. 3. F. *Prereq: 3 credits in philosophy or women's studies recommended.* A critical, theoretical examination of the oppression of women, especially as it relates to issues of race, class, and sexual orientation. How concepts such as sex and gender, self and other, nature and nurture, complicate our understanding of what it means to be a woman. Historical and contemporary feminist philosophers addressing topics such as violence, sexuality, pornography, political power, family structure and women's paid and unpaid labor. Nonmajor graduate credit.

W S 339. Goddess Religions. (Cross-listed with Relig). (3-0) Cr. 3. *Prereq: Relig 205 recommended.* Exploration of the foundational myths of Goddess spirituality, including historical and cross-cultural female images of the divine and their modern usage by American women. Nonmajor graduate credit.

W S 340. Women's Literature. (Cross-listed with Engl). (3-0) Cr. 3. F. *Prereq: Engl 250.* Historical and thematic survey of literature by and about women. May include autobiographies, journals, letters, poetry, fiction, and drama. Nonmajor graduate credit.

W S 342. American Indian Women Writers. (Cross-listed with Am In). (3-0) Cr. 3. *Prereq: Engl 250.* Literature of American Indian women writers which examines their social, political, and cultural roles in the United States. Exploration of American Indian women's literary, philosophical, and artistic works aimed at recovering elements of identity, redescribing stereotypes, resisting colonization, and constructing femininity. Nonmajor graduate credit.

W S 345. Women and Literature: Selected Topics. (Cross-listed with Engl). (3-0) Cr. 3. S. *Prereq: Engl 250.* Literature by women and/or dealing with the images of women, e.g., study of individual authors or related schools of authors; exploration of specific themes or genres in women's literature; analysis of recurrent images of women in literature. Nonmajor graduate credit.

W S 346. Psychology of Women. (Cross-listed with PSYCH). (3-0) Cr. 3. S. *Prereq: 2 courses in psychology including 101.* Survey of psychological literature relating to biological, developmental, interpersonal, and societal determinants of the behavior of women.

W S 350. African American Women. (Cross-listed with Af Am). (3-0) Cr. 3. S. *Prereq: 3 credits in Women's Studies or African American Studies.* Economic, social, political and cultural roles of African American women in the U.S. Includes literary, philosophical, and artistic expressions. Myths and realities explored. Nonmajor graduate credit.

W S 352. Gay and Lesbian Literature. (Cross-listed with Engl). (3-0) Cr. 3. *Prereq: Engl 250.* Literary portrayals of gay and lesbian lives and relationships from many different genres. Attention to changing definitions and representations of sexual orientation and gender identity over time.

W S 370. Studies in English Translation. (3-0) Cr. 3. Readings, discussions, and papers in English.
F. French topics on women or feminism (cross listed to Frnch 370F)
G. German topics on women or feminism (cross listed to Ger 370G)
R. Russian topics on women or feminism (cross listed to Rus 370R)
S. Hispanic topics on women or feminism (cross listed to Span 370S)

W S 374. Women in the Ancient Mediterranean World. (Cross-listed with Cl St, Hist). (3-0) Cr. 3. Repeatable. S. *Prereq: Any one course in Cl St, W S, Latin, or Greek.* Chronological and topical survey of the status of women in the Ancient Mediterranean world; study of constructs of the female and the feminine. Readings from ancient and modern sources. Emphasis on either the Greek world and Hellenistic Egypt, or Hellenistic Egypt and Rome.
A. Hellenic World and Hellenistic Egypt
B. Roman World including Roman Egypt

W S 380. History of Women in Science, Technology, and Medicine. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of women's relationship to the fields of science, technology, and medicine, as students and professionals, consumers, subjects and patients, family members, workers and citizens. Concentrates especially on 19th and 20th century United States, concluding with an examination of current issues of special interest to women in science, technology, and medicine.

W S 385. Women in Politics. (Cross-listed with Pol S). (3-0) Cr. 3. S. Examination of the entry and participation of women in politics in the United States and other countries including a focus on contemporary issues and strategies for change through the political process.

W S 386. History of Women in America. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* A survey of social, economic, and political aspects of women's role from colonial era to present; emphasis on employment, education, concepts of sexuality, and changing nature of the home.

W S 401. Feminist Theories. (3-0) Cr. 3. *Prereq: 201 or 3 credits in Women's Studies at the 300 level or above.* Current theories of feminism, the feminine and sexual difference. Topics in race, class, sexuality, and ethnicity as they are addressed in diverse feminisms. May include readings in lesbian, Black, postcolonial, psychoanalytic and postmodern thought. Nonmajor graduate credit.

W S 402. Feminist Research in Action. (3-0) Cr. 3. S. *Prereq: 201 and 301.* Feminist research methods and scholarship. Class collaborates on a community research and action project to improve women's lives. Nonmajor graduate credit.

W S 422. Women, Men, and the English Language. (Cross-listed with Engl, Ling). (3-0) Cr. 3. S. *Prereq: Engl 219.* The ways men and women differ in using language in varied settings and the ways in which language both creates and reflects gender divisions. Nonmajor graduate credit.

W S 425. Intersections of Race, Class and Gender. (Dual-listed with 525). (3-0) Cr. 3. *Prereq: W S 201 and one additional W S course.* Race, ethnicity, class and gender distinctions and intersections lead to inequitable distributions of power, social well-being, and resources. Explores how inequities are institutionalized and how multiple identities are experienced by women in daily life.

W S 435. Women and Development. (Dual-listed with 535). (3-0) Cr. 3. *Prereq: 201 or 3 credits in Women's Studies at the 300 level or above.* Cross-cultural study of development utilizing both case studies and theoretical works. Explores the nature of women's roles in developing countries and the ways women and their needs have been excluded/included in development approaches, policies, and projects. Includes discussion of actual development projects as well as women's organizing.

W S 444. Sex and Gender in Cross-cultural Perspective. (Dual-listed with 544). (Cross-listed with Anthr). (3-0) Cr. 3. S. *Prereq: Anthr 201; Anthr 306*

recommended. Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

W S 450. Topics in Women's Studies. (Dual-listed with 550). (3-0) Cr. 3. Repeatable. S. *Prereq: 201 or 3 credits in Women's Studies at the 300 level or above.* Special and/or experimental topics in a specific discipline, e.g., women and education, women and religion, women and the law, women and science.

W S 460. Seminar in Gender and Ethnicity. (Cross-listed with Engl). (3-0) Cr. 3. Repeatable. F. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in 339; junior classification.* Selected readings of various authors, movements, eras, or genres. Readings in criticism; required research paper. Nonmajor graduate credit.

W S 486. History of Medicine, Gender, and the Body. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Sophomore classification.* History of medicine, history of science, and women's history combine for an intensive examination of topics related to health, the body, and medical care over the centuries. Topics include gender and sexuality, reproduction, historical interpretations of gender differences, and the politics of women's health. Nonmajor graduate credit.

W S 488. Interdisciplinary Research on Women and Leadership. (Cross-listed with LAS). (3-0) Cr. 3. Research on women and leadership in selected content areas (e.g., Athletics, Business, Education, Politics and Public Service, and Science and Engineering). Following overview of quantitative and qualitative methods and critical analyses of journal articles on women and leadership. Students will work with a faculty mentor in selected content areas to research, write and present paper.

W S 490. Independent Study. Cr. arr. Repeatable. *Prereq: Any two courses in Women's Studies, permission of instructor, consultation with the Women's Studies Program Director.* Independent study on a topic in Women's Studies.

W S 491. Senior Internship. (3-0) Cr. 3. Repeatable. F.S.SS. *Prereq: Senior classification. Permission of department.* Internship designed to provide an application of Women's Studies principles and methods in a workplace. To be arranged with an internal or external employer and conducted under the supervision of a member of the Women's Studies faculty.

W S 499. Senior Thesis. (3-0) Cr. 3. F.S.SS. *Prereq: Senior classification.* Senior thesis to be independently researched and written under the supervision of a member of the Women's Studies faculty.

Courses primarily for graduate students, open to qualified undergraduate students

W S 510. Contemporary Feminist Theories. (3-0) Cr. 3. F. Advanced study of current theoretical developments in Women's Studies in the U.S. and around the world. Examination of the epistemological bases of feminist scholarship.

W S 525. Intersections of Race, Class and Gender. (Dual-listed with 425). (3-0) Cr. 3. *Prereq: W S 201 and one additional W S course.* Race, ethnicity, class and gender distinctions and intersections lead to inequitable distributions of power, social well-being, and resources. Explores how inequities are institutionalized and how multiple identities are experienced by women in daily life.

W S 535. Women and Development. (Dual-listed with 435). (3-0) Cr. 3. Cross-cultural study of development utilizing both case studies and theoretical works. Explores the nature of women's roles in developing countries and the ways women and their needs have been excluded/included in development approaches, policies, and projects. Includes discussion of actual development projects as well as women's organizing.

W S 544. Sex and Gender in Cross-cultural Perspective. (Dual-listed with 444). (Cross-listed with Anthr). (3-0) Cr. 3. *Prereq: Anthr 201; Anthr 306 recommended.* Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

W S 545. Women's Literature. (Cross-listed with Engl). (3-0) Cr. 3. Repeatable. Alt. F., offered 2010. *Prereq: 6 credits in literature.* Primary texts by women writers; historical, thematic, formal, or theoretical approaches; secondary readings; e.g., Nineteenth-Century Women Writers; American Women's Personal Narratives; Southern Women Writers of the U.S.

W S 550. Topics in Women's Studies. (Dual-listed with 450). (3-0) Cr. 3. Repeatable. *Prereq: 201 or 3 credits in Women's Studies at the 300 level or above.* Special and/or experimental topics in a specific discipline, e.g., women and education, women and religion, women and the law, women and science.

W S 586. Proseminar in Women's History and Feminist Theory. (Cross-listed with Hist). (3-0) Cr. 3. *Prereq: Permission of instructor.* Feminist theory from the 1960s to the present as it relates to the writing of women's history. Analysis of interpretations of U.S. women's history from patriarchal to postmodernist perspectives.

W S 587. Diversity Issues in Marriage and Family Therapy. (Cross-listed with HD FS). (3-0) Cr. 3. Alt. F., offered 2009. Review treatment implications associated with topics such as gender and power, race/ethnicity, family structure, and socioeconomic status. Discuss treatment implications of social oppression and discrimination on families.

W S 590. Special Topics. Cr. arr. *Prereq: Permission of Women's Studies Program Director.* Independent study on a topic in Women's Studies.

W S 594. Women/Gender in Art. (Dual-listed with 394). (Cross-listed with ART H, Dsn S). (3-0) Cr. 3. *Prereq: Graduate classification, permission of instructor.* Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture.

Courses for graduate students

W S 620. Advanced Seminar in Feminist Research Methods. (3-0) Cr. 3. S. Focus on feminist interdisciplinary research methods. Analysis of contemporary issues facing feminist scholars. Students conduct original research in their disciplinary areas.

World Languages and Cultures

Mark Rectanus, Chair of Department

University Professor (Emeritus): Joanna Courteau

Professors: Bratsch-Prince, Henry, Leonard, Matibag, M. Rectanus

Professors (Emeritus): Bernard, Dow, Frink, J. N. Lacasa

Associate Professors: Allen, Amidon, Gasta, Mariner, Mook, Mu

Associate Professors (Emeritus): Dial, Nabrotzky, Thogmartin

Associate Professor (Adjunct): Rosenbusch

Assistant Professors: Dominguez-Castellano, Haywood-Ferreira, L'Hote, Mesropova, Pardo-Ballester, Rizo-Arbuckle, Vander Lugt, Weber-Feve

Assistant Professors (Emeritus): Chatfield, Johnson

Assistant Professor (Adjunct): Rodriguez

Instructor (Adjunct): Kottman

Senior Lecturers: Martin, Taoutel, Waldemer

Lecturers: Amling, Baszczynski, Cai, Galarraga-Oropeza, Goodman, Guthrie, Looney, Meyers, E. Rectanus, Rosenstock, Shi, Wilhelm, Zwanziger

Undergraduate Study

Curriculum: World language study should be an integral part of an academic program for most students. The theoretical understanding of and practical experience in language underlie many intellectual disciplines that try to meet the complex problems of contemporary society. Courses offered by the Department of World Languages and Cultures are designed to develop students' understanding of a second culture through the language spoken by that culture.

Upon the completion of their program of studies in the Department of World Languages and Cultures, majors with a concentration in French, German, Russian Studies, or Spanish will demonstrate proficiency in five goal areas: Communication, Cultures, Connections, Comparisons, and Communities. Students will be able to: (a) use their concentration language to present and interpret information and to communicate both orally and in writing; (b) demonstrate an understanding of the relationships among the products, practices, and perspectives of the culture(s) in which their concentration language is spoken; (c) demonstrate their ability to acquire information and further their knowledge through their concentration language; (d) demonstrate an understanding of the nature of language and the concept of culture by making comparisons with their own language and culture(s); and (e) demonstrate a desire to become a life-long learner of their concentration language.

Graduates will achieve both linguistic proficiency and cultural literacy through the study of the language and culture of their program. Linguistic proficiency entails the ability to function effectively in the target language and the ability to communicate competently with native speakers of the target language. Students of Latin and Ancient Greek demonstrate proficiency by becoming able to read the languages and to translate from these languages into clear and idiomatic English. Cultural literacy includes a general knowledge of the culture's history, familiarity with its literature, and basic knowledge of its social and political institutions.

The Department offers a major in World Languages and Cultures with two options, leading to the Bachelor of Arts degree: 1) Languages and Cultures with a Concentration in French, German, Russian Studies, or Spanish; 2) Languages and Cultures for Professions (as a second major only) with a Concentration in French, German, Russian Studies, or Spanish. The Department offers minors in Chinese Studies, French, German, Latin, Russian Studies, and Spanish; and instruction in Arabic, Classical Greek, and Portuguese. The Department also houses the College of Liberal Arts and Sciences' Program in Classical Studies.

A full statement of requirements for majors and minors may be obtained from the Department. For a complete statement of all the college degree requirements, *see Liberal Arts and Sciences, Curriculum.* Current and detailed information about the Department, including placement information, is available on-line at www.language.iastate.edu.

Policies

Students who have had formal training in world languages offered at Iowa State may obtain credit by passing appropriate examinations. Students with native fluency in languages taught at Iowa State may not enroll in or take the Exam for Credit

in elementary or intermediate courses (100 and 200 level) in their native language. Students are considered to have native fluency if their ethnic first language as indicated on the matriculation form is the language in which they wish to enroll. Students are also considered to have native fluency if they have had substantial attendance at a secondary school or university where the language of instruction is the language in which they wish to enroll at ISU. Students with native fluency may be eligible to enroll in literature and civilization courses in their native language at the 300 level or above; such students must also consult the department office to determine eligibility for advanced composition and conversation courses (300 level and above). Students who have completed *three or more years* of high-school world language study may not enroll in or receive credit for 101-102 in those languages; credit may be obtained by passing the appropriate Exam for Credit or by completing an advanced sequence (200-level or higher) in that language. 101-102 may not be taken on a remedial basis.

Students who have completed two years but less than three years of a single high-school world language may not enroll in a 101 course in that language. These students may enroll in either a 102 course in that language, or in the case of Spanish, Span 97. Before enrolling in either Span 97 or a 102 language course, students are recommended to take the on-line placement test available at www.language.iastate.edu. Span 97 is designed for students who need additional remedial work in the language at the first-year level (101-102) and are not planning to continue their language study at the second-year 201-202 level. Students who complete Span 97 with a passing grade will have fulfilled the LAS world language requirement. Students who have completed Span 97 and wish to pursue further study in Spanish at the 201-202 level may enroll in 102.

Students with disabilities who need to satisfy the world language requirement may direct questions to their academic adviser and the Disability Resource Office.

Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is not normally available.

The Department of World Languages and Cultures participates in the Iowa Regents' world language summer study abroad programs in France, Peru and Spain. The Department also offers summer programs in Greece, Russia, Spain and Mexico; and semester study abroad programs in Mexico and Spain. Information concerning these programs can be obtained directly from the Department.

Language and literature courses numbered 300 and above are principally taught in the target language; courses numbered in the 270s, 370s, and 470s are taught in English. For courses taught in English about Ancient Greek and Rome, see *Classical Studies*. Students may not take intermediate (200 level) courses for credit after successfully completing any advanced (300/400 level) course, except those in the 370 series or courses taught in English translation. Students who have successfully completed any course in the intermediate (200 level) sequence may not take a lower-numbered course in that sequence for a grade.

Students at all levels of foreign language study will have access to the Language Studies Resource Center, located in 3142 Pearson. The Resource Center contains an extensive collection of world language materials, including audio-visual materials, electronic resources, music, books, language specific software and hardware, and other course-related materials.

Materials fees: Each student enrolled in a 100- through 400- level world language course is assessed a materials and professional support fee of $25.00 per course. No student will be charged more than $50.00 per semester, regardless of the number of world language courses in which she or he is enrolled for the semester. If a student drops a course subject to the fee by the 15th day of the semester the fee for that course will not be assessed.

Communication Proficiency requirement: The Department requires a grade of C- or better in each of Engl 150 and 250 (250H), and a grade of C or better in any course numbered between 370 and 379 (with the exception of Rus 375) taught by the Department of World Languages and Cultures or the interdepartmental program in Classical Studies.

Languages and Cultures for Professions (LCP)

Students with primary majors in the College of Business or the College of Engineering are encouraged to complete an LCP second major option in World Languages and Cultures with a concentration in French, German, Russian Studies, Spanish, or Chinese Studies (minor only). The primary objective of the LCP option is to provide learning environments within which students can achieve global literacy, linguistic proficiency, and inter-cultural competence. In the LCP curriculum, students will learn how professions are shaped by social and cultural forces and, alternatively, how professions shape society. In courses on contemporary culture and society, students will identify and analyze issues dealing with the complex interrelationships of languages and cultures and consider how they may affect their chosen profession. Students will experience living and working in diverse cultural settings through study abroad and internship opportunities offered through the LCP program and/or in collaboration with the Colleges of Business and Engineering. Students enrolled in the LCP second major option may receive non-graded academic credit for the successful completion of internships (WLC courses numbered 499 in each language area).

For the LCP second major option, students will complete 30 credits within their language concentration beyond the fourth-semester level, selected from the list of approved LCP core courses and electives designated for their respective college curricula in either Business or Engineering. Students may only enroll in the LCP option as a second major and may not graduate with the LCP option in the WLC major alone.

Students in the College of Business may combine course work in the International Business (IB) Secondary Major with course work in LCP by selecting from a list of approved options. Students should consult their academic adviser in the College of Business and the WLC advisor for coursework and international experience that fulfill requirements in both the IB and LCP major options. (IB) Major

Graduate Study

The Department of World Languages and Cultures offers course work leading to a graduate minor in French, German, Latin, Russian Studies or Spanish. The graduate minor in each of these languages is designed to provide an opportunity for graduate students to further their knowledge of that language to complement work in their major disciplines. The graduate minor provides formal recognition of student achievement and expertise in one of the languages above. Graduate minor credits are also offered in Greek.

Graduate Minor

Program Requirements:

a. Prerequisites: Graduate students who wish to minor in one of the languages above must have 400-level proficiency in that language. When this is not the case, the student may be required to take a language course below the 400-level, which would not count towards the graduate minor requirements.

b. Course Requirements: For the M.A. or M.S.: Three courses in the language of the minor. No more than three credits may be in courses numbered 401, 402, and 403. For the Ph.D.: Four courses in the language of the minor which must include at least one three credit course at the 500 level. No more than three credits may be in courses numbered 401, 402, or 403. At least two courses for the M.A. and the Ph.D. minors must be taken in residence at Iowa State University. Papers written for these courses are expected to have a content and depth commensurate with the graduate status of the student.

Arabic (Arabc)

Arabc 101. Elementary Arabic I. (4-0) Cr. 4. F. Introduction to modern standard Arabic. Development of reading, writing, listening comprehension, and speaking skills. Attention to use of the Arabic alphabet. Presentation of culture and social customs in Arabic-speaking countries.

Arabc 102. Elementary Arabic II. (4-0) Cr. 4. S. Introduction to modern standard Arabic. Development of reading, writing, listening comprehension, and speaking skills. Attention to use of the Arabic alphabet. Presentation of culture and social customs in Arabic-speaking countries.

Chinese Studies (Chin)

Chinese Studies Minor Option 1: Chinese Studies

Minors in Chinese Studies are required to take Chin 202-202 (Intermediate Chinese), and 9 credits at the 300 level; of these at least 3 additional credits are in Chinese (courses taught in Chinese or English) and 3 credits in one of the following:

Chin 375 (China Today, 3 cr.)
Hist 337 (History of Modern China II, 3 cr.)

The remaining 3 credits are chosen from:
Anthr 326 (Peoples and Cultures of East and Southeast Asia, 3 cr.)
Arch 427 (History, Theory, and Criticism of Chinese Architecture, 3 cr.)
Chin 301 (Advanced Chinese Readings I, 3 cr.)
Chin 302 Advanced Chinese Readings II, 3 cr.)
Chin 370 (Contemporary Chinese Film & Fiction, 3 cr.)
Chin 375 (China Today, 3 cr.)
Chin 490 (Independent Study, 1-6 cr.)
Hist 336 (History of Modern China I, 3 cr.)
Hist 337 (History of Modern China II, 3 cr.)

Chinese Studies Minor Option 2: Languages and Cultures for Professions

A. International Business Secondary Major and Languages and Cultures for Professions Minor Emphasis in Chinese Studies (18 credits)
Required Core Courses: (12 cr.)
Chin 202 (Intermediate Chinese, 5 cr.)
Chin 304 (Chinese for Business and Professions, 4 cr.)
Chin 499 (Internship, 3 cr.)
Electives: (6 cr. – choose from only one of the following categories)

Category 1
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 370 (Contemporary Chinese Film & Fiction, 3 cr.)
Chin 375 (China Today, 3 cr.)
Category 2
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 337 (Modern China II, 3 cr.)
Hist 336 (History of Modern China I, 3 cr.)
Hist 337 (History of Modern China II, 3 cr.)
Hist 479 (China and the Cold War, 3 cr.)
Pol S. 341 (Politics of Asia, 3 cr.)

B. Languages and Cultures for Professions (Business without International Business Secondary Major) (30 credits)
Required Core Courses: (12 cr.)
Chin 202 (Intermediate Chinese, 5cr.)
Chin 304 (Chinese for Business and Professions, 4 cr.)
Chin 499 (Internship, 3 cr.)

Electives (6 cr. –choose from onlyone of the following categories)

Category 1
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 370 (Contemporary Chinese Film & Fiction, 3 cr.)
Chin 375 (China Today, 3 cr.)

Category 2
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 337 (Modern China, 3 cr.)
Hist 336 (History of Modern China I , 3 cr.)
Hist 337 (History of Modern China II, 3 cr.)
Hist 479 (China and the Cold War, 3 cr.)
Pol S. 341 (Politics of Asia, 3 cr.)

C. Engineering Major and Languages and Cultures for Professions Minor Emphasis in Chinese Studies (18 credits)
Required Core Courses: (12 cr.)
Chin 202 (Intermediate Chinese, 5cr.)
Chin 304 (Chinese for Business and Professions, 4 cr.)
Chin 499 (Internship, 3 cr.)

Electives (6 cr. –choose from onlyone of the following categories)

Category 1
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 370 (Contemporary Chinese Film & Fiction, 3 cr.)
Chin 375 (China Today, 3 cr.)

Category 2
Chin 272 (Chinese Cultural Tradition, 3 cr.)
Chin 337 (Modern China, 3 cr.)
Hist 336 (History of Modern China I, 3 cr.)
Hist 337 (History of Modern China II, 3 cr.)
Hist 479 (China and the Cold War, 3 cr.)
Pol S. 341 (Politics of Asia, 3 cr.)

Courses primarily for undergraduate students

Chin 101. Elementary Mandarin Chinese I. (5-0) Cr. 5. F. Introduction to spoken and written colloquial Mandarin through pinyin and simplified characters. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Chin 102. Elementary Mandarin Chinese II. (5-0) Cr. 5. S. *Prereq: 101.* Introduction to spoken and written colloquial Mandarin through pinyin and simplified characters. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Chin 201. Intermediate Mandarin Chinese I. (5-0) Cr. 5. F. *Prereq: 102.* Development of speaking, writing, reading, and listening skills. Review and expansion of grammar skills, introduction to traditional characters and dictionaries; intensification of character acquisition. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Chin 202. Intermediate Mandarin Chinese II. (5-0) Cr. 5. S. *Prereq: 201.* Development of speaking, writing, reading, and listening skills. Review and expansion of grammar skills, introduction to traditional characters and dictionaries; intensification of character acquisition. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is not normally available.

Chin 272. Introduction to Chinese Culture. (3-0) Cr. 3. F. Interdisciplinary introduction to Chinese society and culture from earliest times to the present. Part one: ancient literature, philosophy, religion, art, architecture, customs. Part two: transition to a modern society, social changes, urban life, popular culture, and contemporary values and ideas. Cultural traditions of Hong Kong, Taiwan, and Tibet are also included.

Chin 301. Advanced Chinese Readings I. (3-0) Cr. 3. F. *Prereq: 202 or equivalent.* Continuing study of Chinese beyond intermediate level with a focus on reading and writing skills. Cultural literacy through a variety of texts from the humanities, social sciences, mass media and business.

Chin 302. Advanced Chinese Readings II. (3-0) Cr. 3. S. *Prereq: 301 or equivalent.* Continuing study of Chinese beyond intermediate level with a focus on reading and writing skills. Cultural literacy through a variety of texts from the humanities, social sciences, mass media and business.

Chin 304. Chinese for Business and Professions. (4-0) Cr. 4. S. *Prereq: Chin 202 or equivalent.* Introduction to professional language and culture in China and Chinese-speaking regions in Asia. Development of all four language skills, focusing on practical applications in the professional contexts. Development of global awareness and cross-cultural understanding. Preparation for internships.

Chin 370. Chinese Literature in English Translation. (3-0) Cr. 3. F. *Prereq: Engl 150 or equivalent.* Topics may include traditional prose, poetry, and drama; the Chinese novel; twentieth-century fiction and film; gender and cosmology in Chinese literature. All readings and class discussions in English.

Chin 375. China Today. (3-2) Cr. arr. S. *Prereq: Engl 250 or equivalent*. Topics may vary from year to year. Readings, discussions, and papers in English on contemporary society, culture, literature and the arts.

Chin 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Chinese and permission of department chair.* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. Nonmajor graduate credit.

Czech (Czech)

Courses primarily for undergraduate students

Czech 101. Elementary Czech I. (3-2) Cr. 4. F. Introduction to the Czech language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Czech culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Czech 102. Elementary Czech II. (3-2) Cr. 4. S. *Prereq: Czech 101.* Continued introduction to the Czech language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Czech culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Czech 201. Intermediate Czech I. (3-2) Cr. 4. F. *Prereq: Czech 102 or permision of instructor.* Review of first year principles and expanded study of grammar. Development of reading, writing, listening comprehension, and speaking in Czech within the context of Czech culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Czech 202. Intermediate Czech II. (3-2) Cr. 4. S. *Prereq: Czech 201 or permission of the instructor.* Review of first year principles and expanded study of grammar. Development of reading, writing, listening comprehension, and speaking in Czech within the context of Czech culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

French (Frnch)

World Languages and Cultures majors with a concentration in French have two options:

WLC Option I: French Studies
Under WLC Option I, students with a concentration in French Studies must complete at least 30 credits beyond the intermediate (201-202) level.

A. French Studies Required Core Courses (24 credits)

Frnch 301 (Reading and Writing French I, 3 cr.)
Frnch 302 (Reading and Writing French II, 3 cr.)
Frnch 310 (French Pronunciation and Phonetics, 1 cr.)
Frnch 326 (Studies in French and Francophone Art or Film, 3 cr.) or Frnch 333 (Topics in Contemporary French and Francophone Literature, 3 cr.)
Frnch 334 (Topics in Early Modern and Modern French Literature, 3 cr.)
Frnch 440 (Seminar in French or Francophone Studies, 3 cr.)
Frnch 471 (Foundations of French Civilization, 4 cr.)
Frnch 472 (Modern France and French Civilization, 4 cr.)

B. Electives (6 credits) Six additional credits at the 300 or 400 level in courses instructed in French.

Curricular Notes: Frnch 440 and either Frnch 471 or Frnch 472 must be completed on campus and may not be fulfilled through transfer or study abroad.

Minor in French
The French Minor requires a total of 16 credits in French beyond the 102 level, 10 credits of which must be at the 300-level.

Option 1: 16 credits in French, at least 10 of which at the 300-level, including 301, 302, 310 and one of the following courses: 304, 333, 334.

Option 2: 16 credits in French, at least 10 of which at the 300-level, including 395.

Curricular Notes: Frnch 395 (8 credits) counts towards the minor and may be allocated as follows: generic 300-level credits (1-8 cr.), Frnch 310 (1 cr.), Frnch 320 (3 cr.). French courses instructed in English, including Frnch 370, 375, 378, 471, 472, do not count toward the minor.

WLC Option II: Languages and Cultures for Professions
Under WLC Option II, students with a concentration in French must complete at least 30 credits beyond the intermediate (Frnch 201-202) level.

A. Languages and Cultures for Professions (Business)
Students with a primary major in the College of Business may select from one of the following options:

Business Option 1
International Business Secondary Major and French LCP Minor Emphasis (27 credits total)

I. International Business Secondary Major
(12 credits from approved list)

II. LCP Minor Emphasis Courses (15 credits)
Frnch 301 (Reading and Writing French I, 3 cr.)
Frnch 302 (Reading and Writing French II, 3 cr.)
Frnch 304 (French for Business and Professions, 3 cr.)
Frnch 320 (France Today, 3 cr.)
Frnch 499 (Internship, 3 cr.) or Frnch 395 (Study Abroad, 3 cr.) or other study abroad program (3 cr.)

Curricular Notes: Frnch 395 or 499 fulfills the IB 3-month international experience requirement. Frnch 304, 395 and 499 may be double counted under Business Option 1.

Business Option 2
International Business Secondary Major and LCP Major Option (42 credits total)

I. International Business Secondary Major
(12 credits from approved list)

II. LCP Second Major (30 credits)
A. Required Core Courses (24 cr.)
Frnch 301 (Reading and Writing French I, 3 cr.)
Frnch 302 (Reading and Writing French II, 3 cr.)
Frnch 304 (French for Business and Professions, 3 cr.)
Frnch 320 (France Today, 3 cr.)
Frnch 333 (Topics in Contemporary French and Francophone Literature, 3 cr.) or Frnch 334 (Topics in Early Modern and Modern Frnch Literature, 3 cr.)
Frnch 440 (Seminar in French or Francophone Studies, 3 cr.) (May be repeated once for 6 credits maximum.)
Frnch 471 (Foundations of French Civilization, 3 or 4 cr.) or Frnch 472 (Modern French Civilization, 3 or 4 cr.)
Frnch 499 (Internship, 3 cr.) or Frnch 395 (Study Abroad, 3 cr.) or other study abroad program (3 cr.)

B. Electives (6 credits)
Six additional credits at the 300 or 400 level including 471, 472 or courses instructed in French.

*Additional credit from an approved study abroad program may be applied to the major.

Curricular Notes: Students may enroll in the Languages and Cultures for Professions (LCP) Option in French as a Second Major only. They may not graduate with the Second Major alone.

Business Option 3
III. Languages and Cultures for Professions (without International Business Secondary Major) (30 credits)
A. Required Core Courses (24 cr.)
Frnch 301 (Reading and Writing French I, 3cr.)
Frnch 302 (Reading and Writing French II, 3cr.)
Frnch 304 (French for Business and Professions, 3 cr.)
Frnch 320 (France Today, 3 cr.)
Frnch 333 (Topics in Contemporary French and Francophone Literature, 3 cr.) or Frnch 334 (Topics in Early Modern and Modern Frnch Literature, 3 cr.)
Frnch 440 (Seminar in French or Francophone Studies, 3 cr.) (May be repeated once for 6 credits maximum.)
Frnch 471 (Foundations of French Civilization, 3 or 4 cr.) or Frnch 472 (Modern French Civilization, 3 or 4 cr.)
Frnch 499 (Internship, 3 cr.) or Frnch 395 (Study Abroad, 3 cr.) or other study abroad program (3 cr.)
B. Electives (6 credits)
Six additional credits at the 300 or 400 level including 471, 472 or courses instructed in French.

*Additional credit from an approved study abroad program may be applied to the major.
Curricular Notes: Students may enroll in the Languages and Cultures for Professions (LCP) Option in French as a Second Major only. They may not graduate with the Second Major alone.

IV. Languages and Cultures for Professions (Engineering)
Engineering students pursuing the second major option in French are required to take at least 30 credits beyond the intermediate (French 201-202) level.
A. LCP Required Core Courses (24 credits)
Frnch 301 (Reading and Writing French I, 3cr.)
Frnch 302 (Reading and Writing French II, 3cr.)
Frnch 304 (French for Business and Professions, 3 cr.)
Frnch 320 (France Today, 3 cr.)
Frnch 333 (Topics in Contemporary French and Francophone Literature, 3 cr.) or Frnch 334 (Topics in Early Modern and Modern Frnch Literature, 3 cr.)
Frnch 440 (Seminar in French or Francophone Studies, 3 cr.) (May be repeated once for 6 credits maximum.)
Frnch 471 (Foundations of French Civilization, 3 or 4 cr.) or Frnch 472 (Modern French Civilization, 3 or 4 cr.)
Frnch 499 (Internship, 3 cr.) or Frnch 395 (Study Abroad, 3 cr.) or other study abroad program (3 cr.)

B. Electives (6 credits)
Six additional credits at the 300 or 400 level including 471, 472 or courses instructed in French.

*Additional credit from an approved study abroad program may be applied to the major.
Curricular Notes: Students may enroll in the Languages and Cultures for Professions (LCP) Option in French as a Second Major only. They may not graduate with the Second Major alone.

Courses primarily for undergraduate students

Frnch 101. Elementary French I. (4-0) Cr. 4. F.SS. Beginning level development of reading, writing, listening comprehension, and speaking in French, within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Frnch 102. Elementary French II. (4-0) Cr. 4. S.SS. *Prereq: 101.* Beginning level development of reading, writing, listening comprehension, and speaking in French, within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Frnch 201. Intermediate French I. (4-0) Cr. 4. F. *Prereq: 102.* Intermediate level development of reading, writing, listening comprehension, and speaking in French within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Frnch 202. Intermediate French II. (4-0) Cr. 4. S. *Prereq: 201.* Intermediate level development of reading, writing, listening comprehension, and speaking in French within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Frnch 301. Reading and Writing French I. (3-0) Cr. 3. F. *Prereq: 202.* Emphasis on developing functional language skills in reading and writing. Selective review of grammar within the context of cultural and literary prose. Concurrent enrollment in Frnch 310 is encouraged.

Frnch 302. Reading and Writing French II. (3-0) Cr. 3. S. *Prereq: 301.* Readings in French prose, theater and poetry. Introduction to close reading and analysis. Development of reading and writing skills for upper-level courses. Concurrent enrollment in 310 is encouraged.

Frnch 304. French for Business and Professions. (3-0) Cr. 3. S. *Prereq: Credit or concurrent enrollment in 302.* Communication in business and professional contexts in French-speaking countries. Development of effective communication strategies and project management in the workplace. Cultural contexts of business and professional practice. Emphasis on working across French-American cultures. Preparation for internships. Nonmajor graduate credit.

Frnch 310. French Pronunciation and Phonetics. (1-0) Cr. 1. F.S. *Prereq: Credit or concurrent enrollment in 301.* Practice and theory of correct pronunciation of sounds in French. Techniques of teaching French pronunciation. Correlation between sound and spelling in French. Relationship between pronunciation and grammar.

Frnch 320. France Today. (3-0) Cr. 3. F. *Prereq: Credit or concurrent enrollment in 301.* Intensive conversational and listening practice. Communicative study of contemporary French culture. Introduction to materials, resources, and forms of communication available on the Internet, and in other electronic and print media.

Frnch 326. Studies in French or Francophone Art and Film. (3-0) Cr. 3. Repeatable. F. *Prereq: 302.* Offered F 2009 and F 2011. In-depth study of a selected artist, filmmaker, genre, medium, or movement. Emphasis on analytical interpretation and relationship between art or film and French or Francophone culture, history, and society.

Frnch 333. Topics in Contemporary French or Francophone Literatures. (3-0) Cr. 3. Alt. F., offered 2010. *Prereq: 302.* Repeatable. In-depth study of a selected topic, genre, movement, or writer in 19th-, 20th, and/or 21st century literature, civilization or culture. Emphasis on close reading and discussion.

Frnch 334. Topics in Early Modern and Modern French Literature. (3-0) Cr. 3. S. *Prereq: 302.* Repeatable. In-depth study of a selected topic, genre, movement, or writer in French literature, civilization or culture from the late 15th to the early 19th century. Emphasis on close reading and discussion.

Frnch 370. French Studies in English. (3-0) Cr. 3. Repeatable. Topics vary according to faculty interest. Author, genre or period study in French or Francophone literature, women writers, or contemporary theory. Readings, discussions, and papers in English. F. French topics on women or feminism (cross listed with W S 370F)

Frnch 375. Contemporary France and the Francophone World in English. (3-0) Cr. 3. Readings, discussions, and papers in English on contemporary French or Francophone thought, politics, history, anthropology, arts, etc.

Frnch 378. French Film Studies in English. (3-0) Cr. 3. Repeatable. Analysis and interpretation of film in twentieth-century French society. Topics vary according to faculty interest. Film directors, genres, movements (e.g. The New Wave), historical survey, aesthetics, and cinematography. Readings, discussions and papers in English.

Frnch 395. Study Abroad. Cr. arr. *Prereq: 2 years university-level French.* Supervised instruction in language and culture of France; formal class instruction at level appropriate to student's training, augmented by practical living experience.

Frnch 440. Seminar in French or Francophone Studies. (3-0) Cr. 3. Repeatable. F. *Prereq: 333 or 334.* Seminar in French or Francophone literature, civilization, or cultural studies. Nonmajor graduate credit.

Frnch 471. Foundations of French Civilization. (3-1) Cr. 3-4. F. *Prereq: for fourth credit, six credits in 300-level courses instructed in French.* Study of French history and culture (e.g. art, architecture, music) from Charlemagne to the French Revolution. Readings, discussions and papers in English. Fourth credit: taught in French; supplementary readings and compositions. Nonmajor graduate credit.

Frnch 472. Modern France and French Civilization. (3-1) Cr. 3-4. S. *Prereq: for fourth credit, six credits in 300-level courses instructed in French.* Study of French history and culture (e.g. art, architecture, music) from the Napoleonic era to the present. Readings, discussions and papers in English. Fourth credit: taught in French; supplementary readings and compositions. Nonmajor graduate credit.

Frnch 490. Independent Study. Cr. arr. Repeatable. *Prereq: Permission of French staff and department chair.* Designed to meet the needs of students who wish to focus on areas other than those in which courses are offered. No more than 9 credits in Frnch 490 may be counted toward graduation.

Frnch 499. Internship in French. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits of French at the 300 level; permission of advisor and WLC Internship Coordinator. Work experience using French language skills in the public or private sector, combined with academic work under faculty supervision.* Credits may be applied only to LCP major. No more than 3 credits of Frnch 499 may be applied to the major. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Frnch 590. Special Topics in French. Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level French.*
A. Literature or Literary Criticism
B. Linguistics
C. Language Pedagogy
D. Civilization

German (Ger)

WLC Option I: German Studies
Under WLC Option I, students with a concentration in German must complete at least 30 credits beyond the intermediate (Ger 201-202) level. Students electing the German Studies option may count only one of the following courses towards the major: Ger 370, Ger 371, Ger 375, Ger 378.

A. German Studies Required Core Courses: (24 credits)
Ger 301 (Reading: Problems of the Early Twentieth Century, 3 cr.)
or Ger 304 (German for Business and Professions, 3 cr.)
Ger 302 (Composition, 3 cr.)
Ger 305 (Conversation: The City in Contemporary Europe, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
or Ger 330 (Introduction to German Literature, 3 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)
Ger 475 (Foundations of German Civilization, 4 cr.)
Ger 476 (Topics in German Cultural Studies, 4 cr.)

B. Electives:

The remaining 6 credits may be chosen from the following courses:

Ger 301 (Reading: Problems of the Early Twentieth Century, 3 cr.)
Ger 304 (German for Business and Professions, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
Ger 330 (Introduction to German Literature, 3 cr.)
Ger 370 (German Studies in English, 4 cr.)
Ger 371 (The Holocaust in Text, Image, and Memory, 4 cr.)
Ger 375 (Grimms' Tales, 4 cr.)
Ger 378 (German Film and Media Studies, 4 cr.)
Ger 395 (Study Abroad, 1-10 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)

C. Study Abroad: The department strongly recommends that all students of German participate in an approved study abroad program based in a German-speaking country.

Curricular Notes: Ger 475 (4 cr.) and Ger 476 (4cr.) are required for the WLC major option in German Studies. Majors must enroll in each of these courses for 4 credits. Majors choosing the German Studies option may select one additional course for 4 cr. from the following: Ger 370, 371, 375, or 378.

Minor in German
The minor in German requires at least 15 credits, nine of which must be at the 300 level or higher, of these, three credits must be in literature or culture taught in German (320, 330 or 440). Eligible courses for the minor are: Ger 301, 302, 304, 305, 320, 330, and 440.

WLC Option II: Languages and Cultures for Professions
Under WLC Option II students with a concentration in German must complete a minimum of 30 credits beyond the intermediate (Ger 201-202) level. Students electing the LCP option may not count the following courses toward the major:
Ger 370, Ger 371, Ger 375, Ger 378.

I. Languages and Cultures for Professions (Business)
Students with a primary major in the College of Business may select from one of the following options:

Business Option 1
International Business Secondary Major and German LCP Minor Emphasis (27 credits total)

A. International Business Secondary Major
(12 credits from approved list)

B. LCP Minor Emphasis Courses (15 credits):
Ger 304 (German for Business & Professions, 3 cr.)
Ger 305 (Conversation: The City in Contemporary Europe, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)
Ger 475 (Foundations of German Civilization, 4 cr.)
or Ger 476 Topics in German Cultural Studies, 4 cr.
Ger 499 (Internship, 3 cr.)

Business Option 2
International Business Secondary Major and LCP Major Option (42 credits total)

A. International Business Secondary Major
(12 credits from approved list)

B. LCP Second Major (30 cr.)
I. LCP Required Core Courses (20 credits)
Ger 304 (German for Business & Professions, 3 cr.)
Ger 305 (Conversation: The City in Contemporary Europe, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)
Ger 475 (Foundations of German Civilization, 4 cr.)
or Ger 476 (Topics in German Cultural Studies, 4 cr.)
Ger 499 (Internship, 3 cr.)

II. Electives (10 credits)
Ger 301 (Reading: Problems of the Early Twentieth Century, 3 cr.)
Ger 302 (Composition, 3 cr.)
Ger 330 (Introduction to German Literature, 3 cr.)

Ger 395 (Study Abroad, 2-6 cr.)*

* Additional credit from an approved study abroad program may be applied to the major.

Curricular Notes: students may only enroll in the Languages and Cultures for Professions (LCP) Option as a Second Major. They may not graduate with the Second Major in LCP alone.

Business Option 3
Languages and Cultures for Professions (without International Business Major) (30 credits total)

I. LCP Required Core Courses (20 credits)
Ger 304 (German for Business & Professions, 3 cr.)
Ger 305 (Conversation: The City in Contemporary Europe, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)
Ger 475 (Foundations of German Civilization, 4 cr.)
or Ger 476 (Topics in German Cultural Studies, 4 cr.)
Ger 499 (Internship, 3 cr.)

II. Electives (10 credits)
Ger 301 (Reading: Problems of the Early Twentieth Century, 3 cr.)
Ger 302 (Composition, 3 cr.)
Ger 330 (Introduction to German Literature, 3 cr.)
Ger 395 (Study Abroad, 2-6 cr.)*

* Additional credit from an approved study abroad program may be applied to the major.

II. Languages and Cultures for Professions (Engineering)
Engineering students pursuing the second major option in German are required to take at least 30 credits beyond the intermediate (Ger 201-202) level.

Engineering LCP: Second Major Option in German (30 credits total)
A. Required Core Courses (20 credits)
Ger 304 (German for Business & Professions, 3 cr.)
Ger 305 (Conversation: The City in Contemporary Europe, 3 cr.)
Ger 320 (Germany Today, 3 cr.)
Ger 440 (Colloquium in German Studies, 4 cr.)
Ger 475 (Foundations of German Civilization, 4 cr.)
or Ger 476 (Topics in German Cultural Studies, 4 cr.)
Ger 499 (Internship, 3 cr.)

B. Electives (10 credits)
Ger 301 (Reading: Problems of the Early Twentieth Century, 3 cr.)
Ger 302 (Composition, 3 cr.)
Ger 330 (Introduction to German Literature, 3 cr.)
Ger 395 (Study Abroad, 2-6 cr.)*

* Additional credit from an approved study abroad program may be applied to the major.

Curricular Notes: students may only enroll in the Languages and Cultures for Professions (LCP) Option as a Second Major. They may not graduate with the Second Major in LCP alone.

Courses primarily for undergraduate students

Ger 101. Elementary German I. (4-0) Cr. 4. F.SS. Introduction to German language within the context of German culture; practice in the basic skills. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Ger 102. Elementary German II. (4-0) Cr. 4. S.SS. *Prereq: 101.* Continuation of German 101. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Ger 201. Intermediate German I. (4-0) Cr. 4. F. *Prereq: 102.* Review of grammar, selected readings, further practice in oral and written communication. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Ger 202. Intermediate German II. (4-0) Cr. 4. S. *Prereq: 201.* Continuation of German 201. One section will emphasize the use of German in professional contexts. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Ger 301. Reading: Problems of the Early Twentieth Century. (3-0) Cr. 3. F. *Prereq: 202.* Emphasis on the development of reading skills through a variety of text types with a focus on German Culture from circa 1900 to 1933.

Ger 302. Composition. (3-0) Cr. 3. S. *Prereq: 202.* Emphasis on writing skills, with further development of grammar and reading skills using a variety of current and historical materials.

Ger 304. German for Business and Professions. (3-0) Cr. 3. F. *Prereq: 202.* Communication in business and professional contexts in German-speaking countries. Development of effective communication strategies and project management in the workplace. Cultural contexts of business and professional practice. Preparation for internships. Nonmajor graduate credit.

Ger 305. Conversation: The City in Contemporary Europe. (3-0) Cr. 3. S. *Prereq: 202 minimum, 301 recommended.* Intensive conversational and listening practice in German with an emphasis on a major German-speaking city.

Ger 320. Germany Today. (3-0) Cr. 3. S. *Prereq: 301 or 304.* Selected topics dealing with contemporary German society and culture. Introduction to materials, resources, and forms of communication available on the Internet, and in other electronic and print media.

Ger 330. Introduction to German Literature. (3-0) Cr. 3. F. *Prereq: 301 or permission of instructor.* Selected readings in German literature from Classicism to present. Emphasis on techniques of reading and analysis of literary texts.

Ger 370. German Studies in English. (3-0) Cr. arr. Repeatable. *Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level.* Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Three credits: English, open to all students. Four credits: Required for German concentration credit, supplementary readings and compositions in German.
G. German topics on women or feminism (cross listed to W S 370G)

Ger 371. The Holocaust in Text, Image, and Memory. (3-0) Cr. arr. *Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level.* Examination of such topics as the origins and expressions of Anti-Semitism in central Europe, the political events and structures of the Holocaust, the reality of ghettos and concentration camps, the impact of technological modernization on the Final Solution, and resistance to the Nazis. Materials will include nonfictional texts, literature, art, and music. Three credits: English, open to all students. Four credits: required for German concentration credit, supplementary readings and compositions in German.

Ger 375. Grimms' Tales. (3-0) Cr. arr. *Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level.* Introduction to Germanic antiquities, mythology, and heroic legends; Herder's concept of Naturpoesie. Emphasis on the Grimm tales: theoretical approaches to the tales from the late 19th and early 20th centuries; perversions of these traditional tales by the National Socialists (Nazis). Readings in contemporary Grimm scholarship. Taught in English. Three credits: English, open to all students. Four credits: required for German concentration credit, supplementary readings and compositions in German.

Ger 378. German Film and Media Studies. (3-0) Cr. arr. S. *Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level.* Analysis and interpretation of film or media in German society. Study of media production and reception within multicultural and global contexts. Thematic emphases based on faculty and student interest including: 1) film directors, genres, movements (e.g. New German Cinema), aesthetics, and cinematography or 2) media studies (e.g. television, mass press, popular culture). Three credits: English, open to all students. Four credits: required for German concentration credit, supplementary readings and compositions in German.

Ger 395. Study Abroad. Cr. arr. *Prereq: 2 years university-level German.* Supervised instruction in language and culture of Germany; formal class instruction at level appropriate to student's training, augmented by practical living experience.

Ger 440. Colloquium in German Studies. Cr. arr. Repeatable. *Prereq: 302, and either 320 or 330.* Fourth credit required for the major. Emphasis on student research in a colloquium format. Nonmajor graduate credit.

Ger 475. Foundations of German Civilization. (3-0) Cr. arr. F. *Prereq: Sophomore classification. For fourth credit, six credits in 300-level courses instructed in German.* Study of various aspects of German history and culture from the Germanic tribes and Christianization to 1870. Three credits: English, open to all students. Four credits: required for German concentration credit, supplementary readings and compositions in German. Nonmajor graduate credit.

Ger 476. Topics in German Cultural Studies. (3-0) Cr. arr. S. *Prereq: Sophomore classification. For fourth credit, six credits in 300-level courses instructed in German.* Continuation of 475 and will cover German history and culture up to the modern era. Three credits: English, open to all students. Four credits: required or German concentration credit, supplementary readings and compositions in German. Nonmajor graduate credit.

Ger 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in German and permission of department chair.* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Ger 490 may be counted toward graduation.

Ger 499. Internship in German. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits of German at the 300 level; permission of advisor and the World Languages and Cultures Internship coordinator.* Work experience using German language skills in the public or private sector, combined with academic work under faculty supervision. Available only to majors and minors. Ger 499 may be repeated to a maximum of 6 credits. No more than 3 credits of Ger 499 may be applied to the major. Satisfactory-fail only.

Courses primarily for graduate students, open to qualified undergraduate students

Ger 590. Special Topics in German. Cr. arr. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level German.*
A. Literature or Literary Criticism
B. Linguistics
C. Language Pedagogy
D. Civilization

Greek (Greek)

For courses in Greek literature taught in English, see *Classical Studies.*

Courses primarily for undergraduate students

Greek 101. Elementary Ancient Greek I. (4-0) Cr. 4. F. Grammar and vocabulary of ancient Greek, within the context of Greek culture; reading knowledge through texts adapted from classical authors. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Greek 102. Elementary Ancient Greek II. (4-0) Cr. 4. S. *Prereq: 101.* Grammar and vocabulary of ancient Greek, within the context of Greek culture; reading knowledge through texts adapted from classical and later authors. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102 and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Greek 201. Intermediate Classical Greek. (4-0) Cr. 4. F. *Prereq: 102.* Emphasis on grammatical principles, composition and reading classical or Hellenistic texts. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102 and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Greek 332. Introduction to Classical Greek Literature. (3-0) Cr. 3. S. *Prereq: 201.* Readings in ancient Greek Literature with emphasis on critical analysis of style, structure or thought.

Greek 441. Advanced Readings in Greek Literature. (3-0) Cr. 3. Repeatable. F. *Prereq: 332.* Study of individual authors or genres; intensive reading in the original supplemented by modern criticism and analysis in English. Authors and genres will vary; courses may be repeated to a maximum of 6 credits each. Nonmajor graduate credit.

Greek 442. Advanced Topics in Greek Literature. (3-0) Cr. 3. Repeatable. S. *Prereq: 332.* Advanced study of authors or topics relating to Greek literature. Authors and topics will vary; courses may be repeated to a maximum of 6 credits each. Nonmajor graduate credit.

Greek 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Greek and permission of department chair.* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Greek 490 may be counted toward graduation.

Latin (Latin)

For courses in Latin literature taught in English, see *Classical Studies.*

Minor requirements
Minors are required to complete 9 credits at the 300 level or higher.

Courses primarily for undergraduate students

Latin 101. Elementary Latin I. (4-0) Cr. 4. F. Grammar and vocabulary of classical Latin, within the context of Roman culture; reading knowledge through texts adapted from classical authors. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102 and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Latin 102. Elementary Latin II. (4-0) Cr. 4. S. *Prereq: 101.* Grammar and vocabulary of classical Latin, within the context of Roman culture; reading knowledge

through texts adapted from classical authors. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102 and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Latin 201. Intermediate Latin. (4-0) Cr. 4. F. *Prereq: 102.* Emphasis on grammatical principles, composition and reading Latin texts. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102 and 201 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Latin 332. Introduction to Latin Literature. (3-0) Cr. 3. S. *Prereq: 201.* Readings in Latin Literature with emphasis on critical analysis of style, structure or thought.

Latin 441. Advanced Readings in Latin Literature. (3-0) Cr. 3. Repeatable. F. *Prereq: 332.* Study of individual authors or genres; intensive readings in the original supplemented by modern criticism and analysis in English. Authors and genres will vary; courses may be repeated to a maximum of 6 credits each. Nonmajor graduate credit.

Latin 442. Advanced Topics in Latin Literature. (3-0) Cr. 3. Repeatable. S. *Prereq: 332.* Advanced study of authors or topics relating to Latin literature. Authors and topics will vary; courses may be repeated to a maximum of 6 credits each. Nonmajor graduate credit.

Latin 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Latin and permission of department chair.* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits in Latin 490 may be counted toward graduation.

Polish (Polsh)

Courses primarily for undergraduate students

Polsh 101. Elementary Polish I. (3-2) Cr. 4. F. Introduction to the Polish language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Polish culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Polsh 102. Elementary Polish II. (3-2) Cr. 4. S. *Prereq: Polish 101.* Continued introduction to the Polish language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Polish culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Polsh 201. Intermediate Polish I. (3-2) Cr. 4. F. *Prereq: Polish 102 or permission of instructor.* Review of first year principles and expanded study of grammar. Development of reading, writing, listening comprehension, and speaking in Polish within the context of Polish culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Polsh 202. Intermediate Polish II. (3-2) Cr. 4. S. *Prereq: Polish 201 or permission of instructor.* Development of reading, writing, listening comprehension, and speaking in Polish within the context of Polish culture. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Portuguese (Port)

Courses primarily for undergraduate students

Port 101. Elementary Portuguese I. (4-0) Cr. 4. F. An introduction to the Portuguese language through the communicative approach within the context of Luso-Brazilian culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101-202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available. Enrollment not open to students who have completed Port 111.

Port 102. Elementary Portuguese II. (4-0) Cr. 4. S. *Prereq: 101.* An introduction to the Portuguese language through the communicative approach within the context of Luso-Brazilian culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101-202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available. Enrollment not open to students who have completed Port 112.

Port 111. Elementary Portuguese, Accelerated I. (3-0) Cr. 3. F. *Prereq: Four semesters of college Spanish or the equivalent. Students with four semesters at the college level or the equivalent of another Romance language may be admitted by permission of the instructor.* An introduction to the Portuguese language through the communicative approach within the context of Luso-Brazilian culture. Prepares for Port 112. Enrollment not open to students who have completed Port 101.

Port 112. Elementary Portuguese, Accelerated II. (3-0) Cr. 3. S. *Prereq: Portuguese 111.* An introduction to the Portuguese language through the communicative approach within the context of Luso-Brazilian culture. Prepares for Port 201. Enrollment not open to students who have completed Port 102.

Port 201. Intermediate Portuguese I. (4-0) Cr. 4. F. *Prereq: 102 or equivalent.* Intensive review of basic grammar and conversation. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature. Credit by examination in the Department of World Languages and Cultures for courses numbered 101-202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Port 202. Intermediate Portuguese II. (4-0) Cr. 4. S. *Prereq: 201 or equivalent.* Intensive review of basic grammar and conversation. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature. Credit by examination in the Department of World Languages and Cultures for courses numbered 101-202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Port 370. Luso-Brazilian Topics in English Translation. (3-0) Cr. 3. Repeatable. Study of a selected period, theme, genre, or author. Readings, discussion, and written work in English. Port 370 may be repeated for a maximum of 6 credits.

Port 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Portuguese and permission of department chair.* Designed to meet the needs of students who seek to work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Port 490 may be counted toward graduation.
D. Language Pedagogy
E. Civilization

Courses primarily for graduate students, open to qualified undergraduate students

Port 590. Special Topics in Portuguese. Cr. arr. Repeatable. *Prereq: Permission of instructor; 6 credits of 300-level Portuguese.*
A. Literature or Literary Criticism
B. Linguistics

Russian Studies (Rus)

World Languages and Cultures majors with a concentration in Russian Studies have two options:

WLC Option 1: Russian Studies
Required Core Courses: (12 credits)
Rus 301 (Composition and Conversation, 3 cr.)
Rus 314 (Reading Russian Literary and Cultural Texts, 3 cr.)
Rus 401 (Advanced Composition and Conversation, 3 cr.)
Rus 440 (Seminar in Russian Studies, 3 cr.)
Electives: (18 credits)
Hist 421 (History of Russia I, 3 cr.)
Hist 422 (History of Russia II, 3 cr.)
Hist 530 (Proseminar in Modern Russia/Soviet History, 3 cr.)
Pol S 349 (Politics of Russia and Soviet Successor States, 3 cr.)
Rus 304 (Russian for Business and Professions, 3 cr.)
Rus 320 (Russia Today, 3 cr.)
Rus 370 (Russian Studies in English Translation, 3 cr.)
Rus 378 (Russian Film Studies in English, 3 cr.)
Rus 395 (Study Abroad, 1-6 cr.)
Rus 401 (Advanced Composition and Conversation, 3 cr.)
Rus 490 (Independent Study, 1-6 cr.)
Rus 590 (Special Topics in Russian, 2-4 cr.)
Of these courses at least three credits must be taken outside the Russian curriculum.

Minor in Russian Studies

Minors in Russian Studies are required to complete 201 and 202. The remaining 9 credits must be at the 300 level and above, including at least 3 additional credits in Russian (courses taught in English or Russian) and at least 3 credits outside the Russian curriculum.

WLC Option II: Languages and Cultures for Professions
Business Option 1
International Business Secondary Major and Languages and Cultures for Professions Minor Emphasis (27 cr. total)

I. International Business Secondary Major (12 credits from approved list)
II. LCP Courses (15 credits)
Rus 301 (Advanced Composition and Conversation, 3 cr.)
Rus 304 (Russian for Business and Professions, 3 cr.)
Rus 320 (Russia Today, 3 cr.)
Rus 370 (Russian Studies in English Translation, 3 cr.)
Rus 395 (Study Abroad, 3 cr.)
or Rus 499 (Internship 3 cr.)
Curricular notes: Rus 395 or 499 fulfills the IB 3-month international experience requirement. Rus 304, 395 and 499 may be double counted under

OPTION 1. Students may only enroll in the LCP Option as a Second Major. They may not graduate with the Second Major in LCP alone.

Business Option 2
International Business Secondary Major and Language and Cultures for Professions Major
(42 credits)

I. International Business Secondary Major (12 credits from approved list)
II. LCP Core Courses: (15 credits)
Rus 301 (Advanced Composition and Conversation, 3 cr.)
Rus 304 (Russian for Business and Professions, 3 cr.)
Rus 320 (Russia Today, 3 cr.)
Rus 370 (Russian Studies in English Translation, 3 cr.)
Rus 395 (Study Abroad, 3 cr.)*
or Rus 499 (Internship 3, cr.)

*Additional credit from approved study abroad program may be applied to the major

III. Electives: (15 credits)
Rus 314 (Reading Russian Literary and Cultural Texts, 3 cr.)
Rus 378 (Russian Film Studies in English, 3 cr.)
Rus 395 (Study Abroad, 3 cr.)
Rus 401 (Advanced Composition and Conversation, 3 cr.)
Hist 421 (History of Russia I, 3 cr.)
Hist 422 (History of Russia II, 3 cr.)
Pol S 349 (Politics of Russia and Soviet Successor States, 3 cr.)

Curricular Notes: Rus 395 or 499 fulfills the IB 3 month international experience requirement. Students may only enroll in the LCP Option as a Second Major. They may not graduate with the Second Major in LCP alone.Business Option 3

Languages and Cultures for Professions (without International Business Major) (30 Credits)

I. LCP Core Courses (15 credits)
Rus 301 (Composition and Conversation, 3 cr.)
Rus 304 (Russian for Business and Professions, 3 cr.)
Rus 320 (Russia Today, 3 cr.)
Rus 370 (Russian Studies in English Translation, 3 cr.)
Rus 395 (Study Abroad, 1-6 cr.)* or
Rus 490 (Internship in Russian, 1-3 cr.)

*Additional credit from an approved study abroad program may be applied to the major

II. Electives: (15 credits)
Rus 314 (Reading Russian Literary and Cultural Texts, 3 cr.)
Rus 378 (Russian Film Studies in English, 3 cr.)
Rus 395 (Study Abroad, 1-6 cr.)
Rus 401 (Advanced Composition and Conversation, 3 cr.)
Hist 421 (History of Russia I, 3 cr.)
Hist 422 (History of Russia II, 3 cr.)
Pol S 349 (Politics of Russia and Soviet Successor States, 3 cr.)

Curricular Notes: Rus 395 or 499 fulfills the IB 3 month international experience requirement. Students may only enroll in the LCP Option as a Second Major. They may not graduate with the Second Major in LCP alone.

B. Languages and Cultures for Professions (Engineering) (30 credits)

I. LCP Core Courses (15 credits)
Rus 301 (Composition and Conversation, 3 cr.)
Rus 304 (Russian for Business and Professions, 3 cr.)
Rus 320 (Russia Today, 3 cr.)
Rus 370 (Russian Studies in English Translation, 3 cr.)
Rus 395 (Study Abroad, 1-6 cr.) or
Rus 490 (Internship in Russian, 1-3 cr.)

II. LCP Electives: (15 credits)
Rus 314 (Reading Russian Literary and Cultural Texts, 3 cr.)
Rus 378 (Russian Film Studies in English, 3 cr.)
Rus 395 (Study Abroad, 1-6 cr.)
Rus 401 (Advanced Composition and Conversation, 3 cr.)
Rus 440 (Seminar in Russian Studies, 3 cr.)
Rus 590 (Special Topics in Russian, 2-4 cr.)
Hist 421 (History of Russia I, 3 cr.)
Hist 422 (History of Russia II, 3 cr.)
Hist 530 (Proseminar in Modern Russia/Soviet History, 3 cr.)
Pol S 349 (Politics of Russia and Soviet Successor States, 3 cr.)

Curricular Notes: Students may only enroll in the LCP Option as a Second Major. They may not graduate with the Second Major in LCP alone.

Courses primarily for undergraduate students

Rus 101. Elementary Russian I. (4-0) Cr. 4. F. Introduction to the Russian language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Russian culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Rus 102. Elementary Russian II. (4-0) Cr. 4. S. *Prereq: 101.* Introduction to the Russian language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Russian culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Rus 201. Intermediate Russian I. (4-0) Cr. 4. F. *Prereq: 102.* Thorough review of grammar and growth of vocabulary. Selected readings. Continued use of the four basic skills. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Rus 202. Intermediate Russian II. (4-0) Cr. 4. S. *Prereq: 201.* Thorough review of grammar and growth of vocabulary. Selected readings. Continued use of the four basic skills. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Rus 301. Composition and Conversation. (3-0) Cr. 3. F. *Prereq: 202.* Thorough study of the Russian language, with emphasis on strengthening proficiency in writing, speaking, reading, and listening. Increased focus on syntax and word formation.

Rus 304. Russian for Business and Professions. (3-0) Cr. 3. F. *Prereq: 202.* Communication in business and professional contexts in Russian-speaking countries. Development of effective communication strategies and project management in the workplace. Cultural contexts of business and professional practice. Nonmajor graduate credit.

Rus 314. Reading Russian Literary and Cultural Texts. (3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: 301.* Selected readings in Russian literature and culture. Emphasis on techniques of reading and analysis of literary and cultural texts.

Rus 320. Russia Today. (3-0) Cr. 3. A survey of social, political, economic, and cultural topics relevant to contemporary Russia. Taught in Russian.

Rus 370. Russian Studies in English Translation. (3-0) Cr. 3. Repeatable. Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Readings, discussions, and papers in English.
R. Russian topics on women or feminism (cross listed to W S 370R)

Rus 375. Topics in Russian, East European, and Eurasian Studies. (3-0) Cr. 3. Repeatable. F. Selected topics dealing with a particular area, period, or cultural pattern. Readings, discussions, and papers in English. May be offered by the Russian, East European, and Eurasian Studies Distance Learning Consortium. Rus 375 does not fulfill the English proficiency requirement for WLC majors.

Rus 378. Russian Film Studies in English. (3-0) Cr. 3. Analysis and interpretation of cinema in Russia and the Soviet Union. Topics vary according to faculty interest. Film directors, genres, movements, historical survey, aesthetics, and cinematography. Readings, discussions and papers in English.

Rus 395. Study Abroad. Cr. arr. Supervised instruction in language and culture of Russia; formal class instruction at level appropriate to student's training, augmented by practical living experience.

Rus 401. Advanced Composition and Conversation. (3-0) Cr. 3. *Prereq: 314.* Intensive practice in composition and conversation with emphasis on mastery of speaking and writing skills; development of idiomatic usage and effective expression of ideas. Increased emphasis on vocabulary building, grammatical correctness, and compatibility of style and content. Nonmajor graduate credit.

Rus 440. Seminar in Russian Studies. (3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq*: 314.* Study of a selected topic in history, politics, Russian Orthodox religion, literature, art, theater, and/or cinema. Nonmajor graduate credit.

Rus 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Russian and permission of department chair.* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Rus 490 may be counted toward graduation.

Rus 499. Internship in Russian. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits of Russian at the 300 level; permission of advisor and WLC Internship Coordinator.* Work experience using Russian language skills in the public or private sector combined with academic work under faculty supervision. Available only to majors and minors. No more than 3 credits may be applied to the major.

Courses primarily for graduate students, open to qualified undergraduate students

Rus 590. Special Topics in Russian. Cr. arr. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Russian.*
A. Literature or Literary Criticism
B. Linguistics
C. Language Pedagogy
D. Civilization

Serbo-Croatian (SerbC)

Courses primarily for undergraduate students

Serbc 101. Elementary Serbo-Croatian I. (3-2) Cr. 4. Introduction to the Serbo-Croatian language, grammar, and syntax. Basic language communication skills in reading, writing, speaking and listening. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101,

102, 201, and 202 is available only to student who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Serbc 102. Elementary Serbo-Croatian II. (3-2) Cr. 4. Introduction to the Serbo-Croatian language, grammar, and syntax. Basic language communication skills in reading, writing, speaking and listening. Offered as part of Russian, Eurasian, and East European Distance Learning Consortium via electronic technology and extensive use of Internet and digital materials. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to student who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Spanish (Span)

World Languages and Cultures majors with a concentration in Spanish have two options:
WLC Option I: Hispanic Studies
Under WLC Option I, students with a concentration in Spanish must complete a minimum of 33 credits beyond the intermediate (201-202) level.

A. Hispanic Studies Required Core Courses: (12 cr.)
Span 301 (Spanish Grammar and Composition, 3 cr.)
Span 303 A or B (Spanish Grammar and Conversation, 3 cr.)
Span 314 (Introduction to Reading Hispanic Texts, 3 cr.)
Span 352 (Introduction to Spanish Phonology, 3 cr.)

B. Electives:
Students must take at least 15 credits chosen from a, b, and c below (minimum of 3 credits from each section).

a) At least 3 credits of literary studies chosen from the following:

Span 330 (Studies in Spanish Literature to 1700, 3 cr.)
Span 331 (Studies in Spanish Literature from 1700 to the Present, 3 cr.)
Span 332 (Studies in Latin American Literature from Pre-Columbian Times through the Nineteenth Century, 3 cr.)
Span 333 (Studies in Latin American Literature from the Twentieth Century to the Present, 3 cr.)

b) At least 3 credits of cultural studies chosen from the following:

Span 304 (Spanish for Business and Professions, 3 cr.)
Span 321 (Spanish Civilization, 3 cr.)
Span 322 (Latin American Civilization, 3 cr.)
Span 323 (Spain Today, 3 cr.)
Span 324 (Latin America Today, 3 cr.)
Span 326 (Studies in Hispanic Art or Film, 3 cr.)

c) At least 3 credits of applied language and linguistics chosen from the following:

Span 351 (Introduction to Spanish-English Translation, 3 cr.)
Span 401 (Advanced Composition and Grammar, 3 cr.)
Span 462 (Contrastive Analysis of Spanish/English for Translators, 3 cr.)
Span 463 (Hispanic Dialectology, 3 cr.)
Span 499 (Internship in Spanish, 3 cr.)

Students may apply up to 6 credits of Span 395 (Study Abroad) to section a, b, or c above (appropriate section based upon course content and assigned by the WLC adviser).

C. Students must take at least 6 credits of literature and/or culture at the 400 level, chosen from the following:

Span 440 (Seminar on the Literatures and Cultures of Spain, 3 cr., repeatable to 6 cr.)
Span 441 (Seminar on Cervantes and the Golden Age, 3 cr., repeatable to 6 cr.)
Span 445 (Seminar on the Literatures and Cultures of Latin America, 3 cr., repeatable to 6 cr.)

D. Study Abroad: The department strongly recommends that all students of Spanish participate in an approved study abroad program based in a Spanish-speaking country. Under Option I, any student who chooses not to participate in a department-approved program will be required to take 3 additional elective credits of Spanish at or above the Span 321 level (for a total of 36 credits beyond the intermediate 201-202 level).

E. **Communication Proficiency Requirements:** Degree-seeking students must earn a grade of C- or better in a sequence of English composition courses, usually Engl 150 and 250. The department will certify Communication Proficiency for students who receive a C or better in a WLC or Classical Studies course numbered 370-379. Because of the cultural affinities, historical traditions and geographic boundaries shared between the Spanish-speaking and Portuguese speaking-populations of the Iberian Peninsula and in the Americas Spanish majors are strongly encouraged to fulfill the requirement through Port 370. Such a course will also fill an LAS Group I (Arts and Humanities) requirement.

WLC Option II: Language and Cultures for Professions
Under WLC Option II students with a concentration in Spanish must complete a minimum of 30 credits beyond the intermediate (201-202) level.

A. Languages and Cultures for Professions (Business)
Students with a primary major in the College of Business may select from one of the following options:

Business Option 1
International Business Secondary Major And Languages And Cultures For Professions Minor Emphasis (27 credits total)

I. International Business Secondary Major: (12 credits from approved CoB list)

II. LCP Minor Emphasis Courses: (15 credits)

Span 303 B (Spanish Conversation for Professionals, 3 cr.)
Span 304 (Spanish for Business and Professions, 3 cr.)
Span 351 (Introduction to Spanish-English Translation, 3 cr.)
Span 323 (Spain Today, 3 cr.) or Span 324 (Latin America Today, 3 cr.)*
Span 499 Internship or Span 395 (Study Abroad, 3 cr.)**
* Span 321 Spanish Civilization and Culture and Span 322 Latin American Civilization and Culture may be substituted.
** Additional credit from an approved study abroad program may be applied to the major.
Curricular Notes: Span 395 or Span 499 fulfills the International Business 3-month international experience requirement. Span 304, Span 395 and Span 499 may be double counted under Option 1.

Business Option 2
International Business Secondary Major And Language And Cultures For Professions Major (42 credits total)

I. International Business Secondary Major: (12 credits from approved CoB list)

II. LCP Second Major (30 credits)

A. Required LCP Core Courses: (12 credits)
Span 303 B (Spanish Conversation for Professionals, 3 cr.)

Span 304 (Spanish for Business and Professions, 3 cr.)
Span 351 (Introduction to Spanish-English Translation, 3 cr.)
Span 499 (Internship, 3 cr.) or Span 395 (3 cr.)**

B. Literature and Culture Courses: (12 credits)
Span 301 (Spanish Grammar and Composition, 3 cr.)
Span 314 (Introduction to Reading Hispanic Texts, 3 cr.)
Span 323 (Spain Today, 3 cr.) or Span 322 (Spanish Civilization and Culture, 3 cr.)
Span 324 (Latin America Today, 3 cr.) or Span 322 (Latin American Civilization, 3 cr.)

C. Electives: (6 credits)
Select one course from each of the following two categories:

Category 1:
Span 330 (Studies in Spanish Literature to 1700, 3 cr.)
Span 331 (Studies in Spanish Literature 1700 to the Present, 3 cr.)
Span 332 (Studies in Latin American Literature from Pre-Columbian Times through the Nineteenth Century, 3 cr.)
Span 333 (Studies in Latin American Literature from the Twentieth Century to the Present , 3 cr.)

Category 2:
Span 440 (Seminar on Literatures and Cultures of Spain, 3 cr.)
Span 441 (Seminar on Cervantes and the Golden Age, 3 cr.)
Span 445 (Seminar on Literatures and Cultures of Latin American, 3 cr.)

*Students taking Span 330 or 331 in Category 1 should choose Span 440 or 441 from Category 2; students taking Span 332 or 333 in Category 1 should choose Span 445 from Category 2.

** Additional credit from an approved study abroad program may be applied to the major.

Business Option 3
Languages and Cultures for Professions (Business without International Business Secondary Major) (30 credits)

A. Required LCP Core Courses: (12 credits)
Span 303B (Spanish Conversations for Professionals, 3 cr.)
Span 304 (Spanish for Business and Professionals)
Span 351 (Introduction to Spanish-English Translation, 3 cr.)
Span 499 (Internship, 3 cr.)

B. Literature and Cultural Courses: (12 credits)
Span 301 (Spanish Grammar and Composition, 3 cr.)
Span 314 (Introduction to Reading Hispanic Texts, 3 cr.)
Span 323 (Spain Today, 3 cr.) or Span 322 (Latin American Civilization, 3 cr.)
Span 324 (Latin America Today, 3 cr.) or Span 322 (Latin American Civilization, 3 cr.)

C. Electives: (6 credits)
Select one course from each of the following two categories

Category 1:
Span 330 (Studies in Spanish Literature to 1700, 3 cr.)
Span 331 (Studies in Spanish Lit 1700 to the Present, 3 cr.)

Span 332 (Studies in Latin American Literature from Pre-Columbian Times through the Nineteenth Century, 3 cr.)
Span 333 (Studies in Latin American Literature from the Twentieth Century to the Present, 3 cr.)

Category 2:
Span 440 (Seminar on the Literatures and Cultures of Spain, 3 cr.)
Span 441 (Seminar on Cervantes and the Golden Age, 3 cr.)
Span 445 (Seminar on the Literatures and Cultures of Latin America. 3 cr.)

Curricular Notes: students may only enroll in the Languages and Cultures for Professions (LCP) Option as a second major. They may not graduate with the second major in LCP alone.

B. Languages and Cultures for Professions (Engineering) (30 credits total)
A. Required LCP Core Courses: (12 credits)
Span 303 B (Conversation for Professionals, 3 cr.)
Span 304 (Spanish for Business & Professions, 3 cr.)
Span 351 (Introduction Spanish-English Translation, 3 cr.)
Span 499 Internship (3 cr.) or Span 395 (3 cr.)**

B. Literature and Culture Courses: (12 credits)
Span 301 (Spanish Grammar and Composition, 3 cr.)
Span 314 (Introduction to Reading Hispanic Texts, 3 cr.)
Span 323 (Spain Today, 3 cr.) or Span 322 (Spanish Civilization, 3 cr.)
Span 324 (Latin America Today, 3 cr.) or Span 322 (Latin American Civilization, 3 cr.)

C. Electives: (6 credits)
Select one course from each of the following two literature categories:

Category 1:
Span 330 (Studies in Spanish Literature to 1700, 3 cr.)
Span 331 (Studies in Spanish Lit 1700 to the Present, 3 cr.)
Span 332 (Studies in Latin American Literature from Pre-Columbian Times through the Nineteenth Century, 3 cr.)
Span 333 (Studies in Latin American Literature from the Twentieth Century to the Present, 3 cr.)

Category 2:
Span 440 (Seminar on the Literatures and Cultures of Spain, 3 cr.)
Span 441 (Seminar on Cervantes and the Golden Age, 3 cr.)
\Span 445 (Seminar on the Literatures and Cultures of Latin America, 3 cr.)

Curricular Notes: students may only enroll in the Languages and Cultures for Professions (LCP) Option as a second major. They may not graduate with the second major in LCP alone.

The Spanish minor: Option 1: Hispanic Studies, Option 2: Languages and Cultures for Professions

Option 1: The Spanish minor in Hispanic Studies requires at least 15 credits, 12 of which must be at the 300 level or higher. The department strongly recommends that all students of Spanish participate in an approved study abroad program based in a Spanish-speaking country. Any student who chooses not to participate in a department-approved study abroad program will be required to take 3 additional elective credits of Spanish at the 300 level or higher.

Option 2: Language and Cultures for Professions. The Spanish minor in Languages and Cultures for Professions requires the following courses (12 credits): 303B, 304, 351 and one culture course chosen from the following: 321, 322, 323, or 324. The department strongly recommends that all students of Spanish participate in an approved study abroad program based in a Spanish-speaking country. Any student who chooses not to participate in a department-approved study abroad program will be required to take 3 additional credits in culture chosen from the following: 321, 322, 323, or 324. Note: students taking either 321 or 323 must take either 322 or 324; students taking either 322 or 324 must take either 321 or 323.

Courses primarily for undergraduate students

Span 097. Accelerated Spanish Review. (3-2) F.S. *Prereq: Two years but less than three years of high-school Spanish.* For students who require additional review at the first year (101-102) level. Course components include a compact review of 101 and the essential elements of 102. Course completed with a passing grade fulfills the LAS foreign language requirement. Not recommended for students who wish to continue language at the second year (201-202) level without completing 102.

Span 101. Elementary Spanish I. (4-0) Cr. 4. F.SS. A communicative approach to grammar and vocabulary within the context of Hispanic culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Span 102. Elementary Spanish II. (4-0) Cr. 4. S.SS. *Prereq: 101, 97 or placement by departmental exam.* Continuation of Spanish 101. A communicative approach to grammar and vocabulary within the context of Hispanic culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Span 195. Study Abroad. Cr. 3. SS. Supervised instruction in Spanish and Hispanic culture; formal class instruction at level appropriate to student's training, augmented by practical living experience. Taught in Spanish. Consult the department regarding equivalency with SPAN 101 or 102.

Span 201. Intermediate Spanish I. (4-0) Cr. 4. F. *Prereq: 102 or placement by departmental exam.* Intensive review of basic grammar and conversation. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Span 202. Intermediate Spanish II. (4-0) Cr. 4. S. *Prereq: 201 or placement by departmental exam.* Continuation of Spanish 201. Intensive review of basic grammar. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course.

Span 295. Study Abroad. Cr. 3. SS. *Prereq: 102 or equivalent.* Supervised instruction in Spanish and Hispanic culture; formal class instruction at level appropriate to student's training, augmented by practical living experience. Taught in Spanish. Consult the department regarding equivalency with Span 201 or 202.

Span 301. Spanish Grammar and Composition. (3-0) Cr. 3. F.S. *Prereq: 202 or placement by departmental exam.* Review and application of grammar concepts in the development of writing skills within the context of Hispanic culture. Taught in Spanish.

Span 303. Spanish Grammar and Conversation. (3-0) Cr. 3. F.S. *Prereq: 202 or placement by departmental exam.* Intensive oral practice and improvement of oral proficiency. Application of specific grammatical concepts for development of conversational skills within the context of Hispanic culture. Taught in Spanish.
A. Conversation through Culture
B. Conversation for Professionals

Span 304. Spanish for Business and Professions. (3-0) Cr. 3. F.S. *Prereq: 202 or placement by departmental exam (301 recommended).* Introduction to professional communication within a cultural context. Grammar review as needed. Individual projects will focus on special interests. Taught in Spanish. Nonmajor graduate credit.

Span 314. Introduction to Reading Hispanic Texts. (3-0) Cr. 3. F.S. *Prereq: 301.* Critical reading of Hispanic literary and cultural texts. Presentation of techniques and terminology of literary criticism. Study of basic genres such as: narrative, poetry, drama, essay. Taught in Spanish. Required as prerequisite for 330, 331, 332 and 333.

Span 321. Spanish Civilization. (3-0) Cr. 3. F. *Prereq: One course at the 300 level.* A survey of the social, political, religious, and cultural history of Spain. Taught in Spanish.

Span 322. Latin American Civilization. (3-0) Cr. 3. S. *Prereq: One course at the 300 level.* A survey of the social, political, religious, and cultural history of Spanish America. Taught in Spanish.

Span 323. Spain Today. (3-0) Cr. 3. *Prereq: One course at the 300 level.* A survey of social, political, economic, and cultural topics relevant to contemporary Spain. Taught in Spanish.

Span 324. Latin America Today. (3-0) Cr. 3. *Prereq: One course at the 300 level.* A survey of social, political, economic, and cultural topics relevant to contemporary Latin America. Taught in Spanish.

Span 326. Studies in Hispanic Art or Film. (Dual-listed with 526). (3-0) Cr. 3. *Prereq: One course at the 300 level.* Survey of major currents and figures in Spanish and Latin American art and/or film. Taught in Spanish.

Span 330. Studies in Spanish Literature to 1700. (3-0) Cr. 3. F. *Prereq: 314.* Introduction to Spanish literature from the earliest times through the Golden Age; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish. Nonmajor graduate credit.

Span 331. Studies in Spanish Literature from 1700 to the Present. (3-0) Cr. 3. S. *Prereq: 314.* Introduction to Spanish literature from the eighteenth century to the present; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish. Nonmajor graduate credit.

Span 332. Studies in Latin American Literature from Pre-Columbian Times through the Nineteenth Century. (3-0) Cr. 3. F. *Prereq: 314.* Introduction to Latin American literature from the earliest times to circa 1900; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish. Nonmajor graduate credit.

Span 333. Studies in Latin American Literature from the Twentieth Century to the Present. (3-0) Cr. 3. S. *Prereq: 314.* Introduction to Latin American literature from the twentieth century to the present; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish. Nonmajor graduate credit.

Span 351. Introduction to Spanish-English Translation. (3-0) Cr. 3. F. *Prereq: 301, 303 or 304.* Introduction to the theory, methods, techniques, and problems of translation. Consideration of material from business, literature, and the social sciences. Taught in Spanish. Nonmajor graduate credit.

Span 352. Introduction to Spanish Phonology. (Cross-listed with LING). (3-0) Cr. 3. F.S. *Prereq: 301, 303 or 304.* An introductory study of the articulation, classification, distribution, and regional variations of the sounds of the Spanish language. Taught in Spanish. Nonmajor graduate credit.

Span 370. Hispanic Topics in English Translation. (3-0) Cr. 3. Repeatable. Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Readings, discussions, and papers in English. May not be counted as a prerequisite.
S. Hispanic topics on women or feminism (cross listed to W S 370S)

Span 395. Study Abroad. Cr. arr. *Prereq: 2 years university-level Spanish or equivalent.* Supervised instruction in Spanish and Hispanic culture; formal class instruction at level appropriate to students' training, enhanced by practical living experience.

Span 401. Advanced Composition and Grammar. (Dual-listed with 501). (3-0) Cr. 3. F. *Prereq: 314 and one course at the 320-level or above.* Advanced study of Spanish grammar and syntax. Students' writing of compositions incorporates an advanced understanding of grammar, syntax, and principles of organization of thought and ideas. Taught in Spanish. Nonmajor graduate credit.

Span 440. Seminar on the Literatures and Cultures of Spain. (Dual-listed with 540). (3-0) Cr. 3. Repeatable. *Prereq: 330, 331, 332, or 333. (Recommended 330 and 331).* Discussion and analysis of selected topics in Spanish literature and culture from the Middle Ages to the Present. Taught in Spanish. Nonmajor graduate credit.

Span 441. Seminar on Cervantes and the Golden Age. (Dual-listed with 541). (3-0) Cr. 3. Repeatable. *Prereq: 330, 331, 332, or 333. (330 recommended).* Discussion and analysis of selected works of Cervantes within the social and cultural context of the Golden Age. Taught in Spanish. Nonmajor graduate credit.

Span 445. Seminar on the Literatures and Cultures of Latin America. (Dual-listed with 545). (3-0) Cr. 3. Repeatable. *Prereq: 330, 331, 332, or 333. (332 and 333 recommended).* Discussion and analysis of selected topics in Latin American literature and culture from Pre-Colonial times to the Present. Taught in Spanish. Nonmajor graduate credit.

Span 462. Contrastive Analysis of Spanish/ English for Translators. (Cross-listed with LING). (3-0) Cr. 3. *Prereq: 351.* Linguistic study of the major differences between the Spanish and English grammatical systems and their applications in the translation of Spanish to English. Taught in Spanish. Nonmajor graduate credit.

Span 463. Hispanic Dialectology. (Cross-listed with LING). (3-0) Cr. 3. *Prereq: 352.* Intensive study of the phonology, morphosyntax and lexicon of the Hispanic dialects of Spain and Latin America in their historical context. Taught in Spanish. Nonmajor graduate credit.

Span 490. Independent Study. Cr. arr. Repeatable. *Prereq: 6 credits in Spanish and permission of department chair.* Designed to meet the needs of students in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 6 credits in Span 490 may be counted toward graduation.

Span 499. Internship in Spanish. Cr. arr. Repeatable. F.S.SS. *Prereq: 9 credits of Spanish at the 300 level; permission of advisor and WLC Internship Coordinator.* Work experience using Spanish language skills in the public or private sector, combined with academic work under faculty supervision. Up to 3 credits may apply toward the major. Available only to majors and minors.

Courses primarily for graduate students, open to qualified undergraduate students

Span 501. Advanced Composition and Grammar. (Dual-listed with 401). (3-0) Cr. 3. F. *Prereq: 314 and one course at the 320-level or above.* Advanced study of Spanish grammar and syntax. Students' writing of compositions incorporates an advanced understanding of grammar, syntax, and principles of organization of thought and ideas. Taught in Spanish.

Span 526. Studies in Hispanic Art or Film. (Dual-listed with 326). (3-0) Cr. 3. *Prereq: 6 credits in Spanish literature or culture at 400 level.* Survey of major currents and figures in Spanish and Latin American art and/or film.

Span 540. Seminar on the Literatures and Cultures of Spain. (Dual-listed with 440). (3-0) Cr. 3. *Prereq: Six credits in Spanish literature or culture at 400 level..* Discussion and analysis of selected topics in Spanish literature and culture from the Middle Ages to the Present. Taught in Spanish.

Span 541. Seminar on Cervantes and the Golden Age.. (Dual-listed with 441). (3-0) Cr. 3. *Prereq: Six credits in Spanish literature of culture at 400 level.* Discussion and analysis of selected works of Cervantes within the social and cultural context of the Golden Age. Taught in Spanish.

Span 545. Seminar on the Literatures and Cultures of Latin America.. (Dual-listed with 445). (3-0) Cr. 3. *Prereq: Six credits in Spanish literature or culture at 400 level..* Discussion and analysis of selected topics in Latin American literature and culture from Pre-Colonial Times to the Present. Taught in Spanish.

Span 580. Graduate Seminar in Hispanic Literature or Culture. Cr. arr. Repeatable. *Prereq: 6 credits of 400 level Spanish.* Topics may include a particular period, a genre, an author, a theme, or a particular type of cultural production. Taught in Spanish.

Span 590. Special Topics in Spanish. Cr. arr. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Spanish.*
A. Literature or Literary Criticism
B. Linguistics
C. Language Pedagogy
D. Civilization

Special Courses in World Languages and Cultures (WLC)

Courses primarily for undergraduate students

WLC 119. Introduction to World Languages. (Cross-listed with Ling). (3-0) Cr. 3. Study of language diversity and the personal, social and political effects of diversity. Language families, attitudes toward language and dialects, language and culture, multilingualism, foreign language learning, written codes, official languages, and language policy.

WLC 417. Student Teaching. (Cross-listed with C I). Cr. arr. F.S. *Prereq: Admission to teacher education, approval of coordinator during semester before student teaching.* Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

G. Foreign Language (Same as C I 417G.)

WLC 484. Technology, Globalization and Culture. (Dual-listed with 584). (Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: senior classification for 484; graduate classification for 584.* Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

WLC 486. Methods in Elementary School World Language Instruction. (Cross-listed with C I, Ling). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language.* Current educational methods and their application in the elementary school classroom. Special emphasis on planning, evaluation, and teaching strategies. Nonmajor graduate credit.

WLC 487. Methods in Secondary School World Language Instruction. (Cross-listed with Ling, C I). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language, admission to the teacher education program.* Theories and principles of contemporary world language learning and teaching. Special emphasis on designing instruction and assessments for active learning.

WLC 491. Language in Motion. (1-0) Cr. 1. Repeatable. *Prereq: Minimum of six ISU credits for study abroad and/or internship abroad and completion of at least a fourth-semester (202 level) foreign language course or equivalent.* First 8 weeks of semester only. Enrollment by instructor permission only. Students returning from study abroad prepare presentations about an aspect of the culture they experienced and spend one day in a high school where they give their presentations to multiple classes. Satisfactory/fail only.

Courses primarily for graduate students, open to qualified undergraduate students

WLC 584. Technology, Globalization and Culture. (Dual-listed with 484). (Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: senior classification for 484; graduate classification for 584.* Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

Zoology

Interdepartmental Graduate Major

John E. Mayfield, Director of Graduate Education

Undergraduate Study

The undergraduate major in zoology is no longer available to new students. Those wishing to pursue an undergraduate degree in basic animal study are encouraged to investigate the numerous possibilities available to them at Iowa State University. The undergraduate Biology Program, jointly administered by faculties of the departments of Ecology, Evolution, and Organismal Biology (EEOB) and Genetics, Development and Cell Biology (GDCB), includes a wide spectrum of opportunities for students to develop their academic interests through the study of animal biology. Contact the Biology Program office for more information, or see www.biology.iastate.edu for more information. For those students interested in applied animal study, undergraduate majors in Animal Science and Entomology are available.

Graduate Study

The Zoology Graduate Program is closed to new students. Prospective students should contact the Genetics, Development and Cell Biology (GDCB) Graduate Program Director of Graduate Education for specific details about the program's status.

Related interdepartmental graduate majors in Ecology and Evolutionary Biology, Genetics, Immunobiology, Molecular, Cellular, and Developmental Biology, Neuroscience, and Toxicology should be investigated as possible alternative graduate programs.

Designators-Course Abbreviations

A E	Agricultural Engineering
A Ecl	Animal Ecology
Acct	Accounting
Advrt	Advertising
Aer E	Aerospace Engineering
AESHM	Apparel, Education Studies, and Hospitality Management
Af Am	African and African American Studies
AFAS	Air Force Aerospace Studies
AgEds	Agricultural Education and Studies
Agron	Agronomy
Am In	American Indian Studies
An S	Animal Science
Anthr	Anthropology
Arabc	Arabic
Arch	Architecture
Art	Art and Design
Art H	Art History
ArtEd	Art Education
ArtGr	Art: Graphic Design
ArtID	Art: Interior Design
ArtIS	Integrated Studio Arts
Astro	Astronomy and Astrophysics
Ath	Athletics
B M S	Biomedical Sciences
BBMB	Biochemistry, Biophysics, and Molecular Biology
BCB	Bioinformatics and Computational Biology (graduate)
BCBio	Bioinformatics and Computational Biology (undergraduate)
BioE	Bioengineering
Biol	Biology
BPM I	Biological/Pre-Medical Illustration
BRT	Biorenewable Resources and Technology
BSE	Biological Systems Engineering
BusAd	Business Administration
C E	Civil Engineering
C Dev	Community Development
C I	Curriculum Instruction
C R P	Community and Regional Planning
CAS	Complex Adaptive Systems
Ch E	Chemical Engineering
Chem	Chemistry
Chin	Chinese
CJ St	Criminal Justice Studies
Cl St	Classical Studies
CmDis	Communication Disorders
Com S	Computer Science
ComSt	Communication Studies
Con E	Construction Engineering
Cpr E	Computer Engineering
Czech	Czech
Dance	Dance
Diet	Dietetics
Dsn S	Design Studies
E E	Electrical Engineering
E M	Engineering Mechanics
E St	Engineering Studies
Econ	Economics
EdAdm	Educational Administration
EEB	Ecology and Evolutionary Biology
EEOB	Ecology, Evolution, and Organismal Biology
EL PS	Educational Leadership and Policy Studies
Engl	English
Engr	Engineering
EnSci	Environmental Science
Ent	Entomology
Env S	Environmental Studies
FCEdS	Family and Consumer Sciences Education and Studies
FFP	Family Financial Planning
Fin	Finance
For	Forestry
Frnch	French
FS HN	Food Science and Human Nutrition
GDCB	Genetics, Development and Cell Biology
Gen	Genetics
Genet	Genetics—Interdisciplinary
Geol	Geology
Ger	German
Geron	Gerontology
Globe	Global Resource Systems
Gr St	Graduate Studies
Greek	Greek
H P C	Historical, Philosophical, and Comparative Studies in Education
H S	Health Studies
H Sci	Human Sciences
HCI	Human Computer Interaction
HD FS	Human Development and Family Studies
Hg Ed	Higher Education
Hist	History
Hon	Honors
Hort	Horticulture
HRI	Hotel, Restaurant, and Institution Management
I E	Industrial Engineering
Ia LL	Iowa Lakeside Laboratory
IGS	Interdisciplinary Graduate Studies
Imbio	Immunobiology
InfAs	Information Assurance
IntSt	International Studies
JI MC	Journalism and Mass Communication
Kin	Kinesiology
L A	Landscape Architecture
LAS	Liberal Arts and Sciences Cross-Disciplinary Studies
Latin	Latin
Lib	Library
Ling	Linguistics
LSCM	Logistics and Supply Chain Management
M E	Mechanical Engineering
M S	Military Science
M S E	Materials Science and Engineering
Mat E	Materials Engineering
Math	Mathematics
MCDB	Molecular, Cellular and Developmental Biology
Mgmt	Management
Micro	Microbiology
MIS	Management Information Systems
Mkt	Marketing
Mteor	Meteorology
Music	Music
N S	Naval Science
Neuro	Neuroscience
NREM	Natural Resource Ecology and Management
Nuc E	Nuclear Engineering
NutrS	Nutritional Sciences
OLHRD	Organizational Learning and Human Resource Development
OSCM	Operations and Supply Chain Management
OTS	Organization for Tropical Studies
Perf	Performing Arts
Phil	Philosophy
Phys	Physics
Pl P	Plant Pathology
PlBio	Plant Biology
Pol S	Political Science
Polsh	Polish
Port	Portuguese
Psych	Psychology
Relig	Religious Studies
ResEv	Research and Evaluation
Rus	Russian
S E	Software Engineering
SCM	Supply Chain Management
Serbc	Serbo-Croation
Soc	Sociology
Sp Cm	Speech Communication
Sp Ed	Special Education
Span	Spanish
Stat	Statistics
STB	Seed Technology and Business
SusAg	Sustainable Agriculture
T C	Textiles and Clothing
T SC	Technology and Social Change
Thtre	Theatre
Tox	Toxicology
Trans	Transportation
TSM	Technology Systems Management
U St	University Studies
V C S	Veterinary Clinical Sciences
V MPM	Veterinary Microbiology and Preventive Medicine
V Pth	Veterinary Pathology
VDPAM	Veterinary Diagnostic and Production Animal Medicine
W S	Women's Studies
WLC	World Languages and Cultures

The Faculty

Distinguished Professor denotes those faculty members who have been recognized for having attained outstanding national and international reputations within their professional disciplines.

University Professor denotes those faculty members who have been recognized for having made outstanding contributions to the quality of education at Iowa State University.

Inquiries concerning the faculty list should bedirected to the Office of the Provost, 1550 Beardshear Hall.

ABBOTT, ERIC ALAN, Professor of Greenlee School of Journalism and Communication. B.S., 1967, Iowa State; M.S., 1970, Ph.D., 1974, Wisconsin.

ABELSON, ABRAHAM G., Professor of Curriculum and Instruction. B.A., 1964, M.Ed., 1970, Pennsylvania State; Ph.D., 1976, Michigan.

ABENDROTH, ROBERT E., Associate Professor of Civil, Construction and Environmental Engineering. B.S., 1966, M.S., 1968, Ph.D., 1983, Wisconsin.

ABRAHAM, ROBERTA G., Emeritus Professor of English. B.A., 1953, Cornell; M.A., 1976, Iowa State; Ph.D., 1981, Illinois.

ABRAHAM, WILLIAM H., Emeritus Professor of Chemical and Biological Engineering. B.Ch.E., 1952, Cornell; Ph.D., 1957, Purdue.

ACHTER, CHARLES T., Lecturer in Curriculum and Instruction. B.A., 1969, St. John's; M.S., 1975, St. Cloud State.

ACKER, DAVID G., Professor of Agricultural Education and Studies; Associate Dean of the College of Agriculture and Life Sciences. B.A., 1975, Wilmington; M.Ed., 1980, M.S., 1980, California (Davis); Ph.D., 1989, Oregon State.

ACKERMAN, BRENDA P., Lecturer in Apparel, Educational Studies and Hospitality Management. B.S., 2005, M.S., 2008, Iowa State.

ACKERMAN, RALPH A., Professor of Ecology, Evolution and Organismal Biology. B.A., 1967, Rutgers; Ph.D., 1975, Florida.

ACKERMANN, MARK R., Professor of Veterinary Pathology. D.V.M., 1986, Ph.D., 1990, Iowa State.

ADAMS, DEAN, Associate Professor of Ecology, Evolution and Organismal Biology; Associate Professor of Statistics. B.A., 1992, Franklin and Marshall College; M.Sc., 1994, Louisiana; Ph.D., 1999, New York (Stony Brook).

ADAMS, DONALD R., Emeritus Professor of Biomedical Sciences; University Professor. A.B., 1960, California (Davis); M.A., 1967, Chico State; Ph.D., 1970, California (Davis).

ADAMS, JEAN W., Emeritus Professor of Economics. B.A., 1969, M.A., 1971, Ph.D., 1973, Illinois.

ADAMS, ROY DEAN, Emeritus Professor of Economics. B.A., 1968, M.A., 1971, Ph.D., 1972, Illinois.

ADELEKE, RAIMI OLATUNJI, Professor of History. B.A., 1978, Ife (Nigeria); M.A., 1981, Ph.D., 1985, Western Ontario.

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AGARWAL, SANJEEV, Professor of Marketing. B.E., 1979, Roorkee (India); M.S., 1980, California (Davis); Ph.D., 1986, M.A., 1986, Ohio State.

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AKERS, ARTHUR, Emeritus Professor of Aerospace Engineering. B.Sc., 1953, London; M.Sc., 1955, Cranfield; Ph.D., 1969, London.

AKINC, MUFIT, Professor of Materials Science and Engineering. B.S., 1970, M.S., 1973, Middle East Technical (Turkey); Ph.D., 1977, Iowa State.

AKKURT, CIGDEM T., Associate Professor of Art and Design. B.A., 1961, Cornell College; M.A., 1970, Iowa; M.S., 1982, Massachusetts.

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ALCOTT, CODY J., Adjunct Instructor in Veterinary Clinical Sciences. B.S., 2000, California State Polytechnic; D.V.M., 2004, Iowa State.

ALEKEL, D. LEE, Professor of Food Science and Human Nutrition. B.S., 1979, Cornell; M.S., 1985, Pennsylvania State; Ph.D., 1993, Illinois.

ALEXANDER, DAVID, Assistant Professor of Philosophy and Religious Studies. B.A., 1999, M.A., 2001, Toronto; Ph.D., 2008, Washington.

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ALEXANDER, TERRY J., Senior Lecturer in Economics. B.A., 1980, M.A., 1984, Ph.D., 1989, Maryland.

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ALLEN, ALISON JO, Lecturer in Mathematics. B.S., 2004, North Carolina; M.S., 2006, Iowa State.

ALLEN, BEVERLYN LUNDY, Associate Professor of Sociology. BSW, 1975, M.S.W., 1977, Temple; Ph.D., 1995, Iowa State.

ALLEN, LINDA QUINN, Associate Professor of World Languages and Cultures; Associate Professor of Curriculum and Instruction. B.A., 1978, Purdue; M.A., 1982, Ball State; Ph.D., 1994, Purdue.

ALLEN, PHILIP MANNING, Emeritus Professor of Art and Design. B.F.A., 1960, M.F.A., 1961, Drake.

ALREAD, JASON, Associate Professor of Architecture. B.A., 1988, Florida; M.Arch., 1991, Yale.

ALURU, SRINIVAS, Professor of Electrical and Computer Engineering; Professor of Computer Science. B.Tech., 1989, Indian Institute of Technology; M.S., 1991, Ph.D., 1994, Iowa State.

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ANDERSON, DEAN, Professor of Kinesiology. B.S., 1968, M.A., 1972, Ph.D., 1978, Minnesota.

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ATWOOD, DAVID M., Senior Lecturer in Physics and Astronomy. B.S., 1984, Toronto (Canada); M.S., 1987, Ph.D., 1989, McGill.

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BACHMANN, ROGER W., Emeritus Professor of Natural Resource Ecology and Management. B.S., 1956, Michigan; M.S., 1958, Idaho; Ph.D., 1962, Michigan.

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BAENZIGER, MARDITH A., Associate Professor of Civil, Construction and Environmental Engineering. B.Arc.E., 1968, M.S., 1969, Iowa State; M.S., 1979, Ph.D., 1981, Wisconsin.

BAER, ROGER EDWARD, Professor of Art and Design and Chair of the Department. B.A., 1968, California State (Long Beach); M.F.A., 1978, Illinois.

BAHADUR, SHYAM, Emeritus Professor of Mechanical Engineering; University Professor. B.E., 1957, M.E., 1962, Roorkee (India); Ph.D., 1970, Michigan.

BAILEY, MICHAEL DAVID, Assistant Professor of History. B.A., 1993, Duke; Ph.D., 1998, Northwestern.

BAILEY, THEODORE B. JR., Professor of Statistics. B.S., 1964, Iowa State; M.S., 1969, Ph.D., 1972, Minnesota.

BAIN, CARMEN M., Assistant Professor of Sociology. M.A., 2001, Canterbury (New England); Ph.D., 2007, Michigan State.

BAKAC, ANDREJA, Adjunct Professor of Chemistry. B.S., 1968, M.S., 1972, Ph.D., 1976, Zagreb.

BAKER, JAMES L., Emeritus Professor of Agricultural and Biosystems Engineering; University Professor. B.S., 1966, South Dakota School of Mines; Ph.D., 1971, Iowa State.

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